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strong
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collaboration
communication
wisely
physics
interested
energetic
focused

Professional Identity and Role of the Engineer in a Challenged Society

Empirical Investigation of Engineering Student Conceptions

Sanne Haase

PhD Dissertation

Professional Identity and Role of the Engineer in a Challenged Society

Empirical Investigation of Engineering Student Conceptions

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Preface

As the genre prescribes, an opening disclaimer must be made: no one but I can be held responsible for this dissertation. Nonetheless, I owe a great deal of thanks to a whole lot of people.

I gratefully acknowledge the PROCEED Alliance, which I have been affiliated with throughout this period. In particular I would like to thank its coordinator, Professor Andrew Jamison; my collaborators in the B subgroup; Professor Anette Kolmos (who is also my co-advisor); and Associate Professor Jette Egelund Holgaard, all from Aalborg University. The PhD process would not have been the same without their input to the survey development process and insight into the field of engineering, let alone the discussions they contributed to.

I am also indebted to the faculty and staff members of the engineering institutions around Denmark who helped provide the register and contact data necessary for my investigation, as well as to the more than two thousand engineering students who took part.

Furthermore, I am grateful for the collaboration I had with Professor Sheri D. Sheppard and her research group at Stanford University during and after my visiting scholarship there, including Research Scientist Helen L. Chen. It was a pleasure to be a part of the vibrant research environment there. I hope to be able to expand our collaboration at a later point in time. While at Stanford I was also included in the online research collaboration with Professor Cynthia Atman's group at the University of Washington and elsewhere. I wish to express my gratitude to Research Scientist Ken Yasuhara, Ryan Campbell and Micah Lande for their immediate openness and interested feedback and to Cyndi Atman for her welcoming attitude and for introducing me to word clouds.

During my project I have had the pleasure of being part of the research environment at the Centre for Studies in Research and Research Policy. I am grateful to all my colleagues here for their contribution to a pleasant and inspiring work environment. First and foremost, my gratitude goes to Centre Director Niels Mejlgaard, who has managed to juggle his roles as my supervisor, employer and collaborator with elegance throughout this process. I have appreciated his sincerity, his sense of diplomacy, his acceptance of my outspoken way of communicating and not least his humour.

I am also indebted to Head of Research Ebbe Krogh Graversen, who initially hired me as a research assistant at the Centre. He sets an example with his insistence on following the ways of his heart.

Along with the rest of the Centre, I am indebted to our Centre Secretary Jane Frølund Irming, who supports us in every possible way and contributes remarkably to our coherence and the Centre's ambience.

Thanks go to Data Manager Per Stig Lauridsen for his meticulous assistance with handling the register data and the survey deployments.

I also gratefully acknowledge the assistance of several research assistants and our former Head of Research Peter S. Mortensen, who is now retired. He helped me make my first steps into the world of statistics.

Postdoc Kaare Aagaard was the only PhD student at the Centre when I started. But Kaare never really counted as one, being an experienced researcher before he began. I have tried to remind myself not to expect to be able to compare my work with his. That said, Kaare's high-quality criteria are exemplary for any researcher and I have enjoyed working with him in science-based consultancy work.

I have also drawn on the considerable insight of Senior Researcher Mads P. Sørensen who has contributed with quite a few further references worth looking into. I look forward to work more with him in the coming period.

A PhD group was unexpectedly built up before my eyes. I am grateful for the contribution each and every one has made to the group and for our mutual agreement to insist on support and collaboration rather than competition. Thanks to Lise Degn for tolerating my disorder during the most intense, final period of my project, during which we were officemates, and for sharing my vision of joint research projects in the future. Thanks to Mathias Wullum Nielsen for bright comments on quite a few first drafts of my chapters. Thanks to Tine Ravn for her pleasant disposition and willingness to share her insights from the field of sociology. Also thanks to Heidi Skovgaard Pedersen who, on more than one occasion, brought me homemade cake, just because she knows I have a sweet tooth. I owe them all for their large contribution to making each coffee break and work day a little more enjoyable. I hope to be able to support them during the last long haul of their projects.

I am also indebted to Associate Professor Niels Brügger at the Faculty of Arts, Aarhus University, who contributed more to my academic upbringing than I realised at the time.

Thanks for English linguistic assistance also go to my uncle Johan Schioldann, who lives abroad and happens to be an Emeritus Professor, albeit in a somewhat unrelated field.

On a personal level, I am grateful for all the help provided to me and my family by my parents, who were always prepared to give a hand with snotty noses and dirty nappies so I could go to work. They also gave me the very precious gift of growing up with three loving sisters. I am indebted to my mother, whose stubborn insistence on fair and equal treatment has been inspirational. My father's unconditional love of her has set a high standard, although he found it a matter of course. I was brought up not to settle for less.

The most profound gratitude goes to my husband, who has taken on a whole lot more than his share of the daily duties in our household to support my academic endeavours. Without him and our children, nothing would really matter.

1. Introduction

This introductory chapter first outlines the context and relevance of the research presented in this dissertation from a macro-societal perspective; the challenges to societal sustainability and the role of engineering in response to these challenges. Subsequently, the research project is presented followed by a brief overview of the content and structure of the dissertation.

1.1 Engineering in an Era of Crisis

Technology imbues our world in palpable ways along with invisible and barely noticeable technological inventions that support the functions of our society. Technology heavily influences all levels of society and has contributed profoundly to the shaping and reshaping of the way we live. (See Baillie (2006) for more in depth-descriptions of technology's contribution to working conditions, urbanisation, international division of labour, family structures and women's political awakening and Landström (1998) for gender-specific implications of household technology).

However, technological development is no longer considered an entirely positive means to a better life for humans. Auschwitz, Chernobyl and International Financial Crisis are three very different examples of man-made, technologically advanced disasters. Epochal changes and challenges seem to confront contemporary societies.

1.1.1 Sustainable Development

Sustainability is a recurring concern of the dissertation. As an increasingly pressing imperative of technological development, it should also be of concern to engineering professionals.

The so-called Brundtland report (World Commission on Environment and Development, UN 1987) has become renowned for its whole-hearted political embrace of the urgent need for change at the face of serious challenges to *Our Common Future*, as the report was titled. The report ambitiously addressed sustainable development from a holistic perspective encompassing not only environmental matters and critically questioning the notion "environment" as something that environs us:

> The environment does not exist as a sphere separate from human actions, ambitions, and needs, and attempts to defend it in isolation from human concerns have given the very word "environment" a connotation of naivety in

> some political circles … the "environment" is where we all live (UN 1987: foreword).

Environment and economic development are considered intertwined and mutually depending on each other. The report specifically addresses a range of problems such as poverty, safety, inequality, illiteracy, resource depletion, starvation and diseases caused by human activity along with desertification, deforestation, acid precipitation, global warming and ozone shield demolition (UN 1987).

However, sustainability remains a contested concept (Gallie 1956, Connolly 1993) encompassing internal dilemmas and discrepancies (Costanza & Pattern 1995, Jamison 2013). It is used in this dissertation as an umbrella term offering an opportunity to encompass in one term a complex engineering contextual aspect construed in a wide sense covering political (Lourdel et al. 2005), environmental, social and economic aspects (Carew & Mitchell 2008, Lozano 2008) and stretching locally, nationally and globally as well as over time (Lozano 2008). Sustainability has been appropriated into specific discourses within the field of engineering education resulting in specific curriculum reforms and educational initiatives (see also Jamison 2001, p. 94-95). Section 1.2.4 gives more explicit reference to the societal challenges I conceptualise as features of the sustainability concept with respect to an engineering perspective. Chapter 7 reviews the literature on education for sustainable development in order to identify the skills required from engineers to address sustainability challenges.

1.1.2 A Sick Society? Diagnosing Contemporary Times

This section briefly presents theories about contemporary society emphasising how sustainability challenges are intertwined with other tendencies of contemporary societies in order to underline the contingency of the theoretical foundation I have chosen to cumulatively build upon and its normative ideals flowing through the thesis.

The scientific consolidation of sociology at the beginning of last century marks a break with the teleological way of considering contemporary society in previous philosophy of history. Diagnosing the state of society and contemporary time has been an increasingly comprehensive academic activity ever since (Kristensen 2008). Such diagnostic undertaking involves comparison to the past. Regardless of the verdict made about the state of society, the characterisation takes as a frame of reference how society is considered to have been in some previous period. Historical epochs are defined, contemporary trends outlined and criticism stated (Hammershøj 2008, Harste 2013).

> It is the best of times. It is the worst of times. It is a time for the celebration of diversity. It is a time of fear for the Other who is different. It is a time of technological marvel and a time of fear and distrust of science. It is a time of unprecedented affluence and a time of the direst poverty. It is a time of nostalgia for the old and enthusiasm for the new. It is a time of optimism and hope for humanity's possibilities of freedom and happiness and yet grim pessimism and fear about our future (Potter & Lopez 2001: 3).

As Potter and Lopez (2001) point out in the above quote, the statements intended to characterise our contemporary society and assess its state are highly ambiguous and confusing.

Whether we live in late, second or radicalised modernity (Giddens 1996, 1994, Beck 1997), liquid modernity (Bauman 2001), postmodernity (Lyotard[1] 1996), a knowledge society (Nowotny et al. 2001), a network society (Castells 2000, Stalder 2006) or a risk society (Beck 1997) to mention but a few of the renowned "labels", is under debate. A common trait is the mentioning of fundamental changes in contemporary society often linked to globalisation (Bertilsson 1999, Giddens 1994, Nielsen 2001) and technological development. The organisation of work, including that of professionals, has also undergone a range of changes. (See Chapter 3 for more on processes of professionalisation and de-professionalisation). As personalised links to society's knowledge-foundation, professionals are first in line to feel the implications of a changed position and status of knowledge, for instance in the form of accountancy demands (Evetts 2010, Bertilsson 1999, Hjort 2008).

Some of the main bones of contention in the debate over the diagnosis of society relate to the inevitability of these changes, the positive or negative assessment of their implications, and whether or not they imply a break with the previous period (the definition of which is equally disputed) or just some modifications to it (Harste 2013, Poder 2013, Kristensen 2008).

In the light of the project of this dissertation, the role and status of science and technology and the implications of the changes in the production, distribution and status of knowledge are particularly relevant contextual factors.

Lyotard (1996) finds that the legitimacy of scientific truth claims has been invalidated and academia's monopoly of knowledge production questioned. The changing characteristics and conditions of knowledge production are main foci for Gibbons et al. (1994) and Nowotny et al. (2001). They distinguish between a traditional academic type of knowledge at Mode 1 and "a socially distributed knowledge production system" (Gibbons et al.

[1] See Brügger (1999) for a clarification of the somewhat unsubstantiated but oft-found paralleling of Lyotard with postmodernism in general.

1994: 10). The latter (Modus 2) encompasses actors outside of universities and practical, applied notions of knowledge. Hård & Jamison (2005) provide a cultural history of technology of science in which the implications for society of these new conditions for knowledge production and technology are scrutinised and the transgression of the dual relation between mode 1 and mode 2 knowledge presented as "hybrid imagination".

On an individual level, the consequence of the delegitimisation of scientific knowledge as a firm foundation is uncertainty (Nowotny et al. 2001, Beck 1997, Bourg 2003), risk (Beck 1997) and "an increased awareness of contingency" (Wagner 1998: 241). As Bauman (2001) points out, the newness of contemporary uncertainty is not just that stable systems of intergenerational processes of social stratification have melted and given way to alternate routes of individual life; fluidity characterises life trajectory and means that no alternative positions in society present themselves to be claimed, everything is mobile and in flux.

> … in our times of 'liquid' modernity … the places to which the individuals may gain access and in which they may wish to settle are melting fast and can hardly serve as targets for 'life projects'. This new restlessness and fragility of goals affects us all, unskilled and skilled, uneducated and educated, work-shy and hardworking alike. There is little or nothing we can do to 'bind the future' through following diligently the current standards … Not just the individuals are on the move but also the finishing lines of the tracks they run on and the running tracks themselves. 'Disembeddment' is now an experience which is likely to be repeated an unknown number of times in the course of individual life … forcing men and women to be constantly on the run and promising no rest and no satisfaction of 'arriving', no comfort of reaching the destination where one can disarm, relax and stop worrying (Bauman 2001: 125).

In the above quote, Bauman captures the contemporary conditions of life, the feeling that nothing gives reassurance, no knowledge provides certainty. Human identity is heavily affected by this condition (Bauman 2001, Harste 2013, Jacobsen 2005, Sørensen & Christiansen 2012). Identity is deprived of its "core" and set free to be continually enacted and created, involving emancipatory potentials and a sense of loss alike (Bauman 2001, Nielsen 2001). As Giddens terms it: "self becomes a reflexive project" (Giddens 1996: 46, translated from Danish). Along with reflexivity, uncertainty and risk become conditions of contemporary life (Beck 1997, Giddens 1996, Luhmann 1997). A new type of risks is characterised by human inability to detect them without scientific measuring or estimation. However, science does not provide absolute knowledge. Rather, it contributes to produce additional uncertainty (Beck 1997, Luhmann 1997), since we become increasingly aware of our lack of knowledge; our non-knowledge (Sørensen 2013). Moreover, contemporary society is marked by a double-bound uncertainty of having to deal even with non-knowledge, the lack of which we are unaware of[2]. The challenges of sustainability encompass exactly the type of complex societal problems that are objects of scientific production of knowledge and non-knowledge. With every new insight in these problems we become increasingly aware that exhaustive knowledge is impossible (Sørensen 2013).

1.1.3 The Engineer: Hero or Villain?

> The problems of the relations of technology to society, like the dilemmas of the engineering profession, do not have simple, complete solutions. Our situation is both tragic and ironic … The flaws in technology, like those in man, are ultimately ineradicable … Galileo and Newton would have been surprised to discover that the enterprise they so nobly began would lead to the nightmare of nuclear weapons. So would their successors down to the 1930's. We are like sorcerer's apprentices playing with forces whose full implications we cannot know. This does not mean that we should be passive or attempt to halt technological development; such a development would certainly lead to catastrophe. No possible reform program will eliminate all harmful effects of technology (Layton 1986: ix).

The blame for societal "ills" is often put on engineers. Engineers are crucial for the development of contemporary society and they have often been assigned to the role as villains in the aftermath of man-made disasters.

The development and spread of (e.g. information and communication) technology contribute considerably to – and form part of – the epochal changes of society and identity, particularly in relation to spatial and temporal organisation of our lives (Castells 2000, Luhmann 2002, Slevin 2000).

Bugliarello (1991: 81) describes the American engineering profession as having "… limited or simplistic views of the social role of engineering." He finds that engineers are largely unaware or unreflective about their potential power and leave the assessment and ideal formulations about impact on society to other disciplines. Likewise, Baillie notices a general lack of reflexivity about the drivers of development:

[2] See Sørensen 2013 for a discussion of such "unknown unknowns" and their societal implications.

> Whatever our chosen definition of development is … we can see that engineering will facilitate the process. Who wants development, what it is for and whether it is a good thing for a particular community is rarely questioned (Baillie 2006: 24).

Engineering reflexivity, socio-cultural awareness and consciously acknowledged professional responsibility are among the ingredients that Jamison mixes into the notion of a hybrid imagination (Hård & Jamison 2005, Jamison et al. 2011, and Jamison 2013) as a response to sustainability and societal challenges in a contemporary society marked by the above mentioned epochal shifts in the interrelation of science, technology and human life.

> Since climate change and sustainability in general are such all-encompassing and multifaceted issues, it will be necessary in this emerging third mode of greening science and technology to foster what we have termed … a "hybrid imagination," mixing natural and social, local and global, academic and activist forms of knowledge in new combinations (Jamison, Christensen & Botin 2011: 147)

This third mode of knowledge production and the call for more change-oriented research implies a hope for society to approach the positive "diagnosis" of sustainability. With this normative ideal of hybrid imagination as the dissertation's launching pad, I make the contingent choice to insist on a cautious positive aspiration that society is not terminally ill (not yet, at least), to make use of the medical metaphor of the diagnosis. Instead, I will contend that problematising technological determinism, problematising the hegemony of development and raising awareness and self-critical positioning towards these conditions of contemporary society and their implications for technology professionals may still present a road to betterment. The dissertation investigates how engineering students consider this particular nexus of engineers' professional obligation towards society, how they anticipate their professional engineering identity and role in this challenged society.

1.2 Outline of the Project

When I was preparing one of the first presentations of my PhD project I got the idea that I wanted to illustrate "engineering". I searched the internet for pictures relating to this word. The standard picture coming up showed a white, nicely dressed, middle-aged male wearing a yellow safety helmet standing on a construction site sometimes preoccupied with a working drawing. Visual presentations that challenged this simplistic, stereotypical engineering conception were sparse. I decided not to try to illustrate what engineering is. However, efforts to understand what engineering could and should be have preoccupied a considerable proportion of my working hours since. On the front page of this dissertation I have let more than 1200 first year engineering students do their part of the definitional work. Their key words characterising an engineer provided in a survey have formed a word cloud where word sizes reflect the number of references to each word. (For an analysis of these answers confer to Chapter 5). The next sub-sections present the research objectives of the dissertation and a clarification of its central concepts and underlying assumptions.

1.2.1 Research Objectives

I wish to emphasise the distinction I make between what engineering "is" – or is considered to be – and what it "should" be. Whereas the first aspect is descriptive, the latter implies a normative dimension. The dissertation takes as its starting point the normative stance that not all engineering is equally desirable. This relates to the societal impact of engineering. To a large extent the appropriation of science and technology (Hård & Jamison 2005, Kleinman 2005) – how humans take responsibility for ensuring the appropriate use of new technological development – lies in the hands of engineers. Hence, their practice cannot be considered their own business entirely. Engineers are technological experts with a huge potential power to influence society (Ambler 2009). Therefore, it matters how they practice their profession, how they approach, define and solve problems. This dissertation does not investigate actual engineering practice, nor does it assess what engineering "is". Rather, engineering student conceptions of what engineering is and what societal role engineers should play will be identified and discussed against the theoretically based ideals of the role of professional engineers in a society facing a range of grand challenges.

By means of engineering student surveys reaching the total population of a year group of engineering students shortly after their enrolment in any given engineering education in Denmark in the fall term 2010 and again at the end of their freshman year it will be investigated *how engineering students conceive of an engineer, how they conceive of sustainability and societal challenges, and what professional role they take on in response to these challenges*.

The engineering student conceptions of *professional engineering identity* will be further explored by means of the following sub-questions:

- How and to what extent do engineering students include a range of broad skills in their conception of professional engineering? And do engineering students with different notions of engineering skills distinguish from each other in groups sharing other characteristics in comparable ways in Denmark and in the US? (Chapter 4)
- How do engineering students conceive of an engineer? And do they share common conceptions of professional engineering identity? (Chapter 5)

The *role of sustainability and societal challenges in the professional engineering identity* as the engineering students conceive of it will be analysed by means of the following sub-questions:

- How do engineering students conceive of sustainability? And how do they picture their future professional roles in society in relation to sustainability, technology and nature? (Chapter 6)
- What clusters of different ways of approaching sustainability can be found among engineering students? And how can each cluster grouping be characterised? (Chapter 7)
- What tendencies begin to appear across the first year of engineering studies in the students' prioritisation of different engineering roles, in their prioritisation of different sustainability-related issues and in their assessed progress within these issues? (Chapter 8)

Each sub-question is the main focus of one of the articles that form part of the dissertation as presented in section 1.3. Methodological and methodical choices and their implications will be presented in Chapter 2. First, two research initiatives that I cumulatively build upon and add to deserve attention.

1.2.2 Seeds of PROCEED

The PhD project is embedded in the Program for Research on Opportunities and Challenges of Engineering Education in Denmark, PROCEED, financed by the Strategic Research Council. This research alliance connected Danish and international expertise from different disciplinary fields. The point of departure of the alliance was the internationally recognised need to reform engineering education systems to better encompass and address a range of technological and societal challenges. The challenge conception described in works of research alliance members, most notably by its coordinator Professor Andrew Jamison (2013 & Jamison et al. 2011, Buch 2012, Buch 2011) is largely adhered to as a point of departure of this dissertation. An introduction to the societal challenges pertaining to engineering and the terminology used to refer to them will be given in section 1.2.4. Furthermore Jamison's (Hård & Jamison 2005, Jamison et al. 2011, Jamison 2013, Boersen & Botin 2013) referral to hybrid imagination as engineering response strategy in the face of the challenges will be the recurring engineering ideal type adequately able to take on his/her potential power as a change agent working for sustainable, societal development. The overall research objective of the dissertation can thus be recapitulated to focus on diverse aspects of how and to what extent the engineering students seem to show signs of a hybrid orientation of their nascent professional identity.

A hybrid engineering orientation or a hybrid engineering identity not only connotes to the combination of diverse – previously estranged – approaches. As the term is used here, hybridity also involves a conscious professional responsibility acknowledging engineering's social function and potential societal impact. Jamison (Jamison et al. 2011: chapter 1 & 6, Hård & Jamison 2005) uses the term in opposition to hubris, originating from the Greek mythology, with reference to the human desire to overcome natural boundaries and limitations in an unreflected technologically determined quest for progress. Instead, hybridity involves self-reflection, cultural perspectives and value judgement.

1.2.3 APPLES Seeds

The Academic Pathways Study (APS) was funded by the National Science Foundation and undertaken by five partnering institutions at the Center for the Advancement of Engineering Education in the United States. A range of research instruments were developed within this collaborative study including longitudinal and cross-sectional surveys and qualitative interviews (Atman et al. 2010, Sheppard et al. 2010, Sheppard et al 2009b). In particular the Academic Pathways of People Learning Engineering Survey (APPLES) was pioneering in terms of a student-focused perspective to the engineering profession. Although the APS focuses more at pathways into and out of engineering, vast fields of interest overlap with mine, and APPLES has influenced the dissertation's questionnaire design, and a range of items have been replicated in this study (see section 2.4.2) in order to facilitate cross-country comparison (as analysed in Chapter 4).

1.2.4 Conceptualising Sustainability

The concept of sustainability is being investigated exploratively which means that no fixed definition is made to search for a priori among the engineering students. This said, the major challenge conceptions underlying the PROCEED research alliance function as guide lines of potential sustainability conceptualisations in the survey construction. These are:

- The challenge of resource depletion is often referred to as environmental sustainability and poses the question of how to deal with environmental problems and climate change
- The societal challenge covers the sustaining of social systems and interhuman relations and ethics. A techno-societal core question here is how to foster a sense of social responsibility among engineers
- The techno-scientific challenge has to do with a blurring of boundaries between science and technology, nature and humanity, and between theoretical and practical knowledge, skills, and competencies. The techno-scientific challenge makes demands on engineers' ability to combine scientific understanding and technical skills
- The challenges of globalisation apply to either of the other challenges, since the increasing interdependence of people and their political, economic, and cultural actions all over the planet is affecting all the other aspects mentioned. The question here is how to qualify engineers to act and practice competently, locally as well as globally

These challenges give an insight in what elements could constitute sustainability. A frequently mentioned aspect of sustainability is economic sustainability, often forming a conceptual triad together with environmental and social sustainability. The economic aspect is not excluded here, though it is not explicitly mentioned. It is construed as an underlying rationale that could play a role in relation to all other challenges mentioned.

1.2.5 Engineering Education in Denmark

The Danish engineering education system offers two different types of educations. One is an academic master level education corresponding to 5 years of full-time studies at a university; the other is a vocational education offered both in universities and at university colleges lasting 3½ years including an internship of approximately 6 months and leading to a professional bachelor's degree. Most engineering education institutions take pride in a highly practice- and/or project related teaching (Edström & Kolmos 2012, Lehmann et al. 2008, Crawley et al. 2007).

Historically, there has been an overweight of vocational engineers in the engineering work force.[3] But a large part of the vocationally educated engineers are approaching retirement age. A higher share of newly educated engineers consists of academically rounded engineers, which implies a shift in the total engineering work force (IDA 2010b). In the fall term 2010 (the population of this dissertation), the shares of students enrolling in academic and vocational engineering programmes were close to equal (45 and 55% respectively).

Danish engineering educations have traditionally been organised in a two-tier system providing the two types of engineers. However, both types of systems have come under pressure. Universities increasingly need to focus on employability and the needs of the market, whereas an academisation has taken place within the university colleges and engineering colleges in some cases resulting in mergers with universities.[4] With the last education policy reform the two systems, previously under the jurisdiction of two different ministries both came to belong in the Ministry of Science, Innovation and Higher Education (Christensen & Ernø-Kjølhede 2011, FIVU 2013, Hansen 2012, Poulsen 2006).

Most socio-economic extrapolations foresee a lack of engineers in Denmark (DI 2010). The unemployment rate of engineers is remarkably low[5] even taken into consideration the economic crisis. Especially engineers with a PhD degree and a master level degree are expected to become highly demanded over the next years (IDA 2009). Therefore, much interest is in how to attract higher numbers of (female) students to engineering and how to minimise the drop-out rates.

Engineering graduates form about 9% of the total amount of graduates from higher education institutions in Denmark. Engineering educations are unique in comparison to most other higher educations in Denmark in their ability to attract immigrants at an extent that corresponds to the total share of immigrants in Denmark. The engineering educations have been less successful in attracting female students, though. In an educational environment where women form the majority of the matriculating students, engineering, still, attracts fewer than 25% female students. And the engineering education institutions seem to have a hard time holding on to the few women that en-

[3] For a historical description of the vocational line of engineering in Denmark see Boje et al. 2011.

[4] During the PhD project period such a merging of an engineering college (IHA) with a university (AU) took place.

[5] According to the Danish society of Engineers the unemployment rate for engineers in spring 2009 1.9%, in spring 2013 it was 3.2% (IDA 2009, Rosendal 2013b).

rol, according to research on the vocational engineering programmes. The retention rates for engineering students have been close to 65% over the last years but a little lower for female engineering students in vocational engineering programmes. It seems the first year of the engineering education serves as a hurdle for the students. If that first year is overcome, the risk of dropping out diminishes remarkably (Jensen et al. 2010).

The engineering title:

> … has been used for persons with a certain occupational standing, that is as a designation of their work. In this connection the question of where such persons acquired the appropriate knowledge was of secondary importance. In fact, the employer had the right to decide whether a person was competent or not. On the other hand, the title was used for people who had a training, diploma or charter to define them as engineers. These people would continue to be engineers regardless of how they earned their living. They were defined not through employment but through institutional arrangements sanctioned by the state (Torstendahl 1994: 33).

Unless otherwise stated, in this dissertation, the term "engineer" follows Torstendahl's (1994:33) second description, referring to educational background, since this use of the title is most frequent in everyday Danish terminology.

1.3 Structure and Content of the Dissertation

In Chapter 2 I will present critical discursive realism as the methodological foundation of the thesis, the research design and the methods employed to collect, validate and analyse the empirical data within an overall mixed-methods approach.

Further details about the literature reviews informing the survey construction are documented in the article presented as Chapter 7, most notably in its appendices. Therefore, they are not duplicated in the framework chapters of the dissertation.

Throughout the dissertation, theory is used in a somewhat instrumental manner to support the empirical investigation of the research questions and in accordance with the critical intention to include the discursive and social practices producing the actual data. Thus, theory is included along the way to qualify the findings. However, to give an overview of the contingent theoretical notions of professional engineering and the role of engineers in society, I have conjoined engineering education research and socio-cultural technology studies with sociology of professions as presented in Chapter 3 providing a comprehensive theoretical background serving as a basis for reflecting and discussing the findings.

Chapter 4 through 8 contain the empirically based content of the dissertation in the form of articles. The first two articles investigate engineering student conceptions of engineering, the following articles focus on the role of sustainability and societal challenges in these emerging professional identities of first year engineering students.

Chapter 4 is an article published in *International Journal of Engineering Education,* written in collaboration with Research Scientist Helen Chen, Professor Sheri Sheppard, both Stanford University, Professor Anette Kolmos, Aalborg University, and Centre Director Niels Mejlgaard, Aarhus University. Anette and Niels are both members of the PROCEED sub-group that the PhD project is affiliated to. The article provides a comparative analysis of the skills considered important to practice engineering by Danish and American engineering students, respectively. A four-dimensional model distinguishing the engineering students by their emphases on either math/science skills or interpersonal and professional skills, on both types of skills or on none of these types is developed and tested for its applicability across the two national contexts. The four groups of students that are identified differ from each other in terms of their motivation to study engineering and in their confidence. This pattern is rather similar in the two settings. The findings indicate that students who assign low levels of importance to both types of skills may require educational attention in other ways than the students with a double focus, knowledgeable about the importance of both types of skills for practising engineering due to marked differences in their preconceptions and prerequisites. The empirical data analysed in the first chapter encompass survey responses collected within the framework of this project as well as previously collected survey data from American engineering students that I was allowed access to during my research stay at Stanford University.

The second article is largely based on a paper presented at a research conference in *NordPro* (Nordic Network for Profession Research) in October 2012. Here, the conception of the engineering identity of the student cohort at the end of their first year is explored on the basis of their keywords characterising an engineer. The extent to which a meaningful common understanding of the professional engineer can be identified is investigated by means of qualitative and quantitative methods. Five professional engineering identity foci are identified with problem solving as a thematic core of the engineering student discourse.

Chapter 6 consists of an article published in *Science and Engineering Ethics* applying interpretive forms of analysis to student descriptions of sustainability. The findings indicate that the engineering students have oversimplified construals of sustainability. They mainly consider it an environmental issue, which may be important in the long run, but a barrier nonetheless, to productivity and development. They attribute technological development with autonomy independently of human agency. Their acknowledgment of the blame of technology for a range of present ills goes hand in hand with their technology fascination, which poses them in a classic, symbolic dilemma between nature and technology. To a large extent, they try to disregard this dilemma finding no possible synthesis. However, a few students present a synthesising vision of a green technology in the service of the sustainable development of people and planet.

The fourth article forming Chapter 7 is published in *European Journal of Engineering Education*. The article presents the results of an explorative cluster analysis identifying three different approaches to sustainability in engineering among the newly enrolled engineering students. One group of students are very open towards and confident in social, environmental and business aspects of engineering as well as in math/science. Another group focuses on math/science aspects and shows some neglect of the sustainability context. Finally, one group is less motivated by math/science aspects and more tuned in to "softer" sustainability aspects than average. The findings show that the student prerequisites for sustainable engineering education are very different from one group to another. Teaching and motivating them to develop into broad thinking, hybrid engineering professionals may demand a corresponding diversity in educational strategies.

The last article presented in Chapter 8 starts to explore the potentials of a longitudinal analysis of the engineering students' perspectives by focusing on their development over the first year of their engineering studies. The article is presented at the Annual Research Conference of *Society for Research into Higher Education*, December 2013. The article focuses on questionnaire rankings, ratings and priorities of items emphasising different conceptions of the role of professional engineers in society. Societal and global context seems to decline in importance among the engineering students during their first year, and the students generally assess their progress within sustainability-related fields as very limited.

The final chapter concludes on how engineering students conceive of an engineer, how they conceive of sustainability and societal challenges, and what professional role they take on in response to these challenges and discusses the implications of these findings.

A comprehensive documentation is enclosed as appendices.

2. Methods and Methodology

This chapter presents the methodological basis of the entire dissertation followed by a thorough exposition of the methodical steps undertaken before, during and after the data collection.

2.1 Critical Discursive Realism

The meta-theoretical aim of the thesis is to transcend dualistic methodological disputes in social sciences by the use of both quantitative and qualitative methodologies. This implies a combination of a nomothetic and an idiographic approach and a focus on recurring regularities as well as on individual phenomena. The intent is both “erklären” and “verstehen”, to refer to Diltheys dichotomy (Bruhn Jensen 2002, Danermark et al. 2002, Dilthey 1964). In order to achieve this, the philosophical tenet of the study’s scientific foundation is a combination of critical realism (Bhaskar 2008, Archer 1995, Danermark et al. 2002) and discursive realism (Schrøder et al. 2003).

The critical discursive realism provides a corrective to both interpretationalism and empiricism. In opposition to relativism, the ontological assumption is that a social reality exists independently of our knowledge of it. (Schwandt 2000, Halkier 2002, Schrøder et al. 2003, Danermark et al. 2002, Bhaskar 2008). However, reality and its social phenomena are not unequivocal, tangible entities that can be measured by the researcher directly. According to a critical realist position, the nature of social science studies involves an epistemological constructivism.[6] According to Bhaskar (2008: 21 ff.),[7] scientific endeavour is socially produced in a cumulative process building on previous knowledge and has two sides. The intransitive objects of human knowledge exist independently of our knowledge about them, whereas transitive objects of knowledge are the results of humans subjecting intransitive objects to scientific discovery.

[6] See Andersen (2005) for the distinction between ontological and epistemological constructivism and a discussion of the methodical implications of this distinction.

[7] Bhaskar (2008) introduces an ontological trichotomy distinguishing the real, the actual and the empirical domains of reality in his critique of empirical realism. This aspect of his theory is highly relevant as a contribution to a philosophy of science. However, the trichotomy implicates a hierarchical levelling of reality that is not easily operationalised in social sciences and, hence, not applied. For a meta-theoretical assumption of this dissertation, Bhaskar’s underlying emphasis of transitivity will suffice.

Bhaskar (2008: 197) uses language as a metaphor to illustrate the scientist's relation to society:

> Men never create... language. For it always preexists them. But it exists as an actual i.e. 'living' language only in virtue of, and changes with, their uses of it. Thus, if society is represented by the model of a language it may be regarded as a structure which is always there; which men must reproduce or partially transform; but which would not exist without its 'functionaries'...a reading depends upon antecedent social activity; the acquisition of a language by the reader.

In this way, Bhaskar touches upon the interrelatedness of agents and structures, this being another dualism that critical realism seeks to reconcile (Danermark et al. 2002, Buch-Hansen & Nielsen 2005). Instead of conflating the dualism into an integrated theory as Giddens (1984) is considered to do with his theory of structuration, where one analytical focus involves a bracketing of the other, critical realism is in favour of maintaining the two perspectives. The perspectives intertwine, but in fact they can only be detected by means of social scientific analysis. In order to reconcile the dualism and analytically conceive the interrelatedness of structure and agency, a time dimension is introduced. (Danermark et al. 2002). As in the case of language, structure pre-exists human agency. Subsequently, an interaction takes place where structures both enable and constrain social agency. Social action is not determined by structures but reproduces and transforms them in a cyclical manner, which may result in a structural elaboration (Danermark et al. 2002).

The discursive emphasis of the meta-theoretical foundation lies in the epistemological assumption that *"...our only access to knowledge about ... reality goes through language and other sign systems"* (Schrøder et al. 2003, p. 45). When critical realism refers to social relations as the field of social scientific research (Danermark et al. 2002), the discursive perspective of realism offers a more straightforward view, takes the consequence of the epistemological relativism and realises that the object of science is discursively constructed. Therefore, the field of social research consists of discourses – here widely understood as social practise involving use of language or symbolic signs. Discourse is described in more detail when analysed in Chapter 6.

The critical focus of Bhaskar (2008) is not only directed at empiricist realism and positivism on the basis of ontological indifferences. His critique also impacts the scientific method in itself as he advocates judgemental rationality, which implies theoretical thoroughness and acceptance of the fallible status of scientific, transitive knowledge; the production of knowledge must add to or replace preceding knowledge. And knowledge production does not take place in a relativist manner. Not all scientific knowledge is equally valid (Danermark et al. 2002, Buch-Hansen & Nielsen 2005), this being a scientific quality criterion that will be adhered to in quantitative as well as qualitative approaches of the dissertation. In cases where interpretive textual data analysis takes place, a transparency of the steps of data gathering, data analysis and data interpretation is aimed at as well as a search for contradictory results. Ricoeur (1971: 549-50) states as follows:

> To show that an interpretation is more probable in the light of what is known is something other than showing that a conclusion is true … The role of falsification is played here by the conflict between competing interpretations. An interpretation must not only be probable, but more probable than another.

In addition, the critical term is construed as a normative obligation of the researcher in line with that of action research or critical theory (e.g. Schrøder et al. 2003, Fairclough 2003, Fairclough 1995, Fairclough 1989). In this dissertation, being critical is not considered to involve any particular political stance or message, but a clear normative element is an underlying presupposition; societal sustaining and the inexorable necessity to address societal challenges contribute to occasioning the dissertation. Thus, in accepting a normative scientific responsibility, the discursive critical and realistic meta-theoretical framework resembles Creswell and Plano Clark's description of transformative-emancipatory mixed methods approaches (Creswell & Plano Clark 2011: 44).[8]

Unlike pragmaticist claims that multiple worldviews may coexist in the same study and give rise to contradictions and tensions, one overall meta-theoretical perspective is applied throughout the entire dissertational research (Creswell and Plano Clark 2011). An intra-paradigmatic unambiguity is intended in order to focus on the effort to reconcile the methodological differences at hand.

Methodologically, the study is marked by its interdisciplinary field with few established theoretical or methodical paradigms, reflecting the so-called hybrid nature of the challenges at stake (Mejlgaard 2006, Williams 2003, Jamison 1997, Jamison 2001, Jamison & Mejlgaard 2010). The nature of the research question and the field of research as well as the aim of describing, exploring and explaining call for diversity in the methodical ap-

[8] Creswell and Plano Clark (2011: 45) categorise critical realist perspectives differently and criticise this approach for confounding theory with meta-theory. This critique cannot be sustained for this – entirely meta-theoretical – purpose.

proach. Methodical pluralism or a mixed methods research approach involves a clear, coherent way of collecting, analysing and interpreting data. Theoretical thoroughness in the efforts to understand and explain the empirical findings and their wider implications is also pivotal. (Bhaskar 2008, Bloch et al. 2013, Creswell and Plano Clark 2011, Flick 2002, Halkier 2002, Henkel 2000, Schrøder et al. 2003, Schwandt 2000).

Regardless of our methods of approaching the world, we understand and theorise about it through the use of language and other symbolic sign systems only. This is the epistemological basis of the project. Surveys with closed-ended as well as a couple of open-ended questions serve as means with which to gather empirical data about the professional identity and the sustainability attitudes of Danish engineering students. The combination of quantitative and qualitative approaches to data collection occurs in concordance with a critical discursive realist worldview emphasising both the role of agency and structures and combining idiographic with nomothetic approaches.

The methods applied in the dissertation follow two tracks. Quantitative and qualitative approaches will be applied concurrently, as more meticulously accounted for in each of the articles. These two main approaches fuse and synthesise in an overall mixed methods approach. In the following section, the research design will be described in more detail.

2.2 Research Design

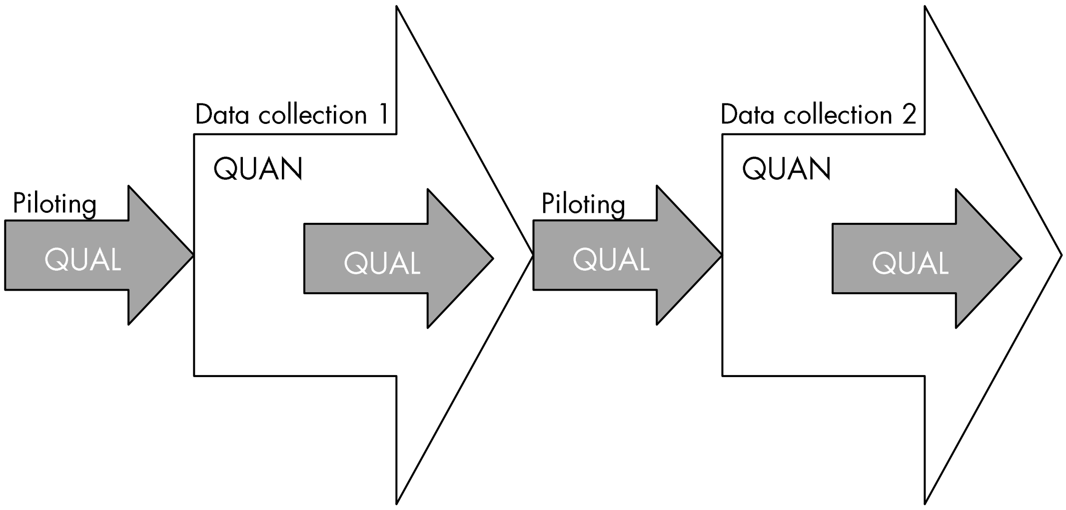
The research design mixes a repeated, exhaustive questionnaire with comprehensive qualitative elements in a panel study with nation-wide coverage of an entire cohort of engineering students. This mixed methods study not only blends qualitative elements with quantitative ones. The design involves different ways of conducting mixed methods research. The following approaches (Creswell & Plano Clark 2011) are mixed:

1. Sequential explorative mixed methods design; the surveys serving as the main instruments were tested in qualitative pilot studies in advance of the deployment as described in section 2.4.5
2. Embedded concurrent mixed methods design; qualitative elements were embedded in each of the two data collections, and both quantitative and qualitative analyses are conducted, mainly in separate articles. The chapters 4, 7 and 8 apply quantitative techniques for data analysis, whereas the article in Chapter 6 applies interpretive methods. Chapter 5 applies mixed methods of analysis

3. Sequential quantitative data collection and analysis; a panel study design. In Chapter 8 I will commence the unfolding of the potential of the longitudinal perspective

The methods used to collect data are illustrated in Figure 2.1. The arrows indicate the succession of the elements of the data collection.

Figure 2.1. Data collection methods



The process of exploring data patterns is systematic, and the analysis stands in a continual, reciprocal relationship with relevant theory. Literature from sociology of professions, engineering education research, learning theory and higher education is used as input to understand the process of acquiring an engineering identity along with theories that inform the understanding of sustainability and societal challenges and their engineering-specific implications. In many ways, the research process resembles what Rosenberg (1968) describes as the "pursuit of an idea":

> Indeed, it seems evident that the empirical findings outrun the theory. The "pursuit of an idea" often involves a complex interplay between theory and data for testing or elaborating the theory. This research strategy is possible only if one demonstrates a willingness to be led by the data but, at the same time, to direct it in accord with some interpretive or theoretical position (Rosenberg 1968, p. 216).

The engineering student survey is designed as a longitudinal two-point web-administered survey reaching the full population of the 2010 engineering student year group. Answers will be collected from students who have only just commenced their engineering education and again after they have received engineering education corresponding to approximately one academic year. This means that the first round of the survey establishes a starting point that can be used as a reference for later responses from the engineering students. The design provides knowledge of an entire year group of future engineers and provides the opportunity to follow them individually as well as on the aggregate level in the course of their freshman year.

A survey intervention was chosen because of its ability to reach a large population and to enable statistically valid comparisons of different groupings within the population as well as a comparison of the population with other groups. See section 2.3 on the comparative framework.

The web-based survey offers a range of possibilities. It is relatively easy and time-saving to conduct in comparison to postal and phone surveys as well as personal interventions. The greatest disadvantage in terms of scientific usage comes with intercept-based surveys to online visitors at particular sites where non-response bias may be aggravating (Alvarez & Van-Beselàere 2005). In this case, register information is available on the entire population including email lists, which not only makes sampling obsolete but also allows for a testing of possible non-response biases according to the known background variables. In other words, statistically systematic differences in response rates on the basis of gender, type of engineering degree programme and institution could be estimated, which, in turn, allows for statistical correction of possible non-response biases. (See Appendix 8).

A qualitative item is embedded in each of the survey instruments to facilitate the collection of student interpretations of sustainability and engineering identity, respectively, that the questionnaire may otherwise fail to capture in its closed-ended format. (See Fabrigar & Krosnick 1995 for a discussion of advantages of open-ended questions in surveys).

Qualitative pilot testing of each of the survey questionnaires was intended to maximise respondents' understanding of the questions, the survey system and its navigation facilities.

2.3 Comparative Framework

Comparative analysis is used as a tool to assist the systematic production of knowledge by its focus on "description and explanation of similarities and differences (mainly differences) of conditions or outcomes" (Smelser 2003: 645). Comparisons provide a frame of reference for both quantitative and qualitative analysis (de Vaus 2001, Smelser 2003, Creswell & Plano Clark 2011), and the focus of the comparison ranges from an individual level to a population level context. This section outlines the different ways in which the research design facilitates comparative analysis.

The entire Danish engineering student cohort initiating their education in the fall term of 2010 forms the population of the study. Identification and comparison of different groupings within this population take place in different ways as demonstrated in Chapters 4, 7 and 8. Although statistical control is performed and institutional variation examined in Chapter 5, the comparisons here and in Chapter 6 are mainly of a conceptual nature. This means that occurrences of qualitative types of data (words, sentences, utterances, keywords) are coded and analysed with other occurrences as a frame of reference.

A comparison of the Danish population and similar populations in different national contexts is made possible by means of replication of questionnaire constructions developed in the US and in a European context, respectively. The comparison of US and Danish national contexts is the focus of Chapter 4.

Over-time development is cautiously commenced in Chapter 8, which implies a comparison of responses to the same survey question when deployed in the first and second surveys.

Ideally, the compared units should be the same in all relevant respects other than in regard to the specific trait that is being compared (de Vaus 2001). Even in a simple scientific experiment, this is not easily accomplished. In a complex research design involving various comparisons, holding all other things equal is impossible. One of the advantages of multivariate analysis is that statistical controls can be performed to ensure meaningful comparisons in spite of this unattainable ideal. In all quantitative analyses, multivariate analysis is performed to control for critical differences other than the context compared. This implies tests for non-response biases and interaction effects on the basis of gender, education institutions (eight different schools/universities), type of engineering education (Master or Bachelor level degree programme), and where N sizes allow for adequate statistical power, type of engineering programmes (e.g. grouped under thematic headings such as Mechanical or Chemical engineering). Intra- and inter-institutional comparisons are performed in Chapters 5, 7 and 8.

2.4 The Engineering Student Surveys

This section presents the methodical choices and initiatives undertaken to develop the questionnaires and facilitate and qualify their deployment.

2.4.1 Register Acquisition and Security

An important prerequisite of initiating a survey is access to contact information of the population. The acquisition of this information relies heavily on the engineering education institutions. All eight institutions have been contacted with a request to participate in the investigation by providing personal information on their students from their registers.

They all accepted to contribute with Excel files containing the following information regarding each human subject: name, address, civil registration number, engineering degree programme and institutional mail address.

Because of the entirely non-commercial purpose of the investigation and the lack of so-called sensitive questions about issues such as religion, political and sexual orientation and health, the Danish Act on Processing Personal Data that restricts handling of this kind of data to strictly scientific purposes allows for the use of the civil registration number. The civil registration number provides instant information about the respondents' gender and age. It also serves as a unique identifier of each respondent and can be utilised to find, for instance, the address of any registered citizen and often also a range of other publicly registered personal data.

In compliance with the legal, moral and ethical requirements to secure the identity of the participating respondents, both the register information provided by the engineering education institutions and the answers provided by the respondents in this study have been treated accordingly.

The civil registration numbers are not included in any other data files and only used to rectify incorrect register information, for instance, when one individual is registered more than once.

All individual responses are kept confidential – also from the engineering education institutions. This means that personal identifiers such as names are removed from files that are made available for other uses.

2.4.2 Questionnaire Construction

The operationalisation of the research questions to actual questionnaire items took place as a multifaceted process. This involved an identification of an inclusive landscape of possible dimensions of what being equipped to meet the societal challenges of engineering may actually mean. To qualify the operationalisation a clarification of the desired skills and competencies of future engineers took place in the form of comprehensive literature reviews in the field of education for sustainable development, in engineering education research and of previous studies assessing sustainability. The hereby acquired information was used as input to qualify the survey development as more thoroughly described in Chapter 7.

Concurrently, discussion and idea creation took place in a collaborative setting in the PROCEED working group including Niels Mejlgaard, Centre for Studies in Research and Research Policy and experts in engineering education and sustainability, Professor Anette Kolmos and Associate Professor Jette Egelund Holgaard, both Aalborg University.

In order to allow for cross-country comparisons, the surveys include questionnaire constructs that were initially developed by the collaborating partners and schools involved in the Center for the Advancement of Engineering Education, including researchers from Stanford University and the University of Washington (Atman & Nair 1996, Atman et al. 2007, Atman et al. 2008, Atman et al. 2010, Kilgore et al. 2007, Kilgore et al. 2010, Sheppard et al. 2008, Sheppard et al. 2009b, Sheppard et al. 2010). The research instruments they developed and used in the National Science Foundation-funded Academic Pathways Studies, most notably the APPLES surveys described in sub-section 1.2.3, but also the previously undertaken PIE (Persistence in Engineering) have informed the survey construction markedly.

Furthermore, questions on technology in society were adapted to Eurobarometer surveys in order to allow for comparisons between the engineering student population and the Danish general population as well as populations of other European nations.

Questions that are replicated are altered only to a minimum to ensure comparability of the collected data to the original research. Eliciting the option "I prefer not to answer" and introducing the possibility of skipping questions in the web survey system instead (an active survey-design, Alvarez & VanBeselàere 2005) is an example of the changes made.

A variety of questions are developed to assess perceptions of and attitudes to various aspects of sustainability and societal challenges as well as to professional engineering and its societal role.

The research questions are complex, which calls for a multiple items approach. This implies that the concept of sustainability, for instance, is sought estimated with a variety of items tapping into different aspects of the multifaceted concept. (Fabrigar & Krosnick 1995). See Table 2.1 for an overview of questionnaire concepts, Appendix 3 for an overview of all items in both surveys and appendices 1a through 2d for the full Danish and English versions of the questionnaires. The questions include:

1. Engineering student motivations for commencing an engineering education, including the extent to which a perception of engineers as

contributing to solving society's problems plays a role in their choice of education
2. Self-assessed competencies and knowledge levels concerning technical, interpersonal and sustainability-related issues
3. Attitudes to technology, ranking of importance of societal challenges and roles of engineers in society, importance assessment of items and qualifications for professional engineering
4. Practices regarding technology, learning and engagement in sustainability-related activities
5. Meanings and understandings – how engineering students describe the sustainability concept and characterise an engineer and their engineering education
6. Socio-demographic data.

Gender and age are background variables along with name, line of study, engineering institution information and student email address acquired directly from the institutions.

Controversy surrounds the use of "Do not know" (DK) response categories (e.g. Martin 2005, Alwin & Krosnick 1991, Krosnick 1999). A pragmatic operationalisation is decided on utilising DK options in case of replicated questions and in cases with an assessed possibility for the respondent not to know the answer to the question. In the data analyses, "Do not know" responses are removed and treated as missing data since the reasons for such answers can be many and it cannot be argued that they correspond to a neutral or "average" response.

The self-constructed questions take various forms. Likert scale battery questions were designed to appear similar to the previously validated questions. Likert scale questions have the advantage that, in spite of their ordinal scale, they can be treated as interval variables if the response options can be meaningfully construed as evenly distanced from each other (Fabrigar & Krosnick 1995). A few questions ask the students to prioritise (rank), and in each questionnaire, a question or two take a qualitative form, asking the respondent to fill in text or keywords, respectively.

The closed questions are easily administered and coded (Fabrigar & Krosnick 1995), but open questions allow for much richer responses and facilitate what Geertz (1993) refers to as "thick description" of the studied concept. Open questions do not confine responses to a list and involve a potentially high data quality. Krosnick (1999) mentions but one disadvantage of open-ended questions, namely the challenging task of coding and analysing the data.

Table 2.1. Survey content

Theme	Oct. 2010	May 2011	Source
Motivation	X		APPLES
Skills and competencies			
Ability ranking compared to others	X	X	APPLES
Preparedness to incorporate in engineering practice	X	X	PIE
Level of knowledge in a variety of different engineering and sustainability issues	X		new*
Rating of own abilities – process competencies	X	X	new
Progress estimate – process competencies + others		X	new
Interests			
Degree of interest in a variety of different engineering and sustainability issues	X		new
Attitudes			
Importance of abilities for engineering	X	X	APPLES
Most important items practicing engineering (5 of 20)	X	X	ABET, PIE
Playground – scenario of most needed information	X		ETD
Prioritising of importance of challenges relative to each other	X	X	new
Prioritising of statements on the role of engineers in society relative to each other	X	X	new
Sustainability conception – issue selection	X	X	new
Assessment of sustainability focus of own institution	X	X	new
Level of agreement in statements on the role of science and technology in society	X	X	Euro-barometer
Attitudes towards fields of science	X		new
Student satisfaction		X	new
Practices			
Level of engagement with science and society	X	X	Euro-barometer
Level of engagement with environmental questions	X		new
Ethical/environmental consumption habits	X		new
Previous educational experiences	X		new
Qualitative aspects			
Description of the concept of sustainability	X		new
3 keywords characterising an engineer		X	new
3 keywords characterising their engineering education		X	new
Socio-demographics (educational background, parental education, STEM/engineering relatives, nationality)	X	(X)**	
Background variables: gender, age, institution, programme	X	X	

*) Response options replicated from Azapagic et al. 2005.

**) Question only given to those who had not previously responded because of the assumption that possible changes in these variables would be too small to be worth the additional inconvenience.

Response order effects are important to consider when constructing surveys (Martin 2005:726, Olsen 2006: Ch. 5). Response order effects refer to the overall ordering of questions and concepts investigated in the survey as well as to the ordering of items in a single question. In a multi-item question that is visually presented, people are inclined to select the options offered early in a list, perhaps because of cognitive fatigue (Krosnick 1999, Krosnick & Alwin 1987). This can be avoided by means of a randomisation of the order of the items. Because of a wish to maintain the possibility to compare the results of the replicated questions with the original findings, randomisation has not been realised, however.

Response order effects in the overall progression of the survey are given thorough consideration. The term sustainability does not occur until question 16 in 2010 and question O in 2011. There is a risk, however, that respondents are influenced in their responses to, for instance, the qualitative question 16 by the items earlier in the survey tapping into this concept. In this particular matter, the advice of Olsen (2006: 59) to begin with particular items and ask the general, summarising question last, is adhered to.

The survey construction does not prevent response sets in the form of acquiescence (de Vaus 2002: 107, Martin 2005, Hellevik 2002). This means that respondents are more apt to answer positively to a question regardless of its content. The risk of acquiescence is particularly high in Likert scale questions and can be minimised by reversing some item formulations from a positive to a negative direction or vice versa so that an equal share of items of both types is approximated. This can be illustrated with the items of question 12 in the 2010 survey (equalling question J in the 2011 survey). "Science and technology can sort out any problem" and "The applications of science and technology can threaten human rights" are examples of a positive and a negative statement, respectively, on the role of technology in society that the respondents are asked to rate their level of agreement or disagreement with. Equal numbers of positive and negative response options are not found in the surveys out of consideration for facilitating comparison with the results found in the original contexts of the questions.

Social desirability is another type of response set that refers to a tendency of respondents to overestimate what they construe as socially desirable responses (Hellevik 2002, de Vaus 2002, Krosnick 1999). Some of the survey contents may seem to involve "political correctness". As mentioned previously, sustainability is no norm-free field, but an unanimously positive, value-laden concept. Disagreeing to sustain is hardly possible. Although the use of the concept of sustainability is limited and measurements involving it mainly occur indirectly through multi-item measures, respondents may construe some of these sub-items in terms of social desirability, which entails that this type of bias cannot be ruled out. On the other hand, the confidential and impersonal nature of the response situation is expected to decrease biasing because of this response mechanism (Krosnick 1999, Olsen 2006).

2.4.3 Questionnaire Context, Language and Translation

The questionnaires (Appendices 1 through 2) are constructed using the software SurveyXact, which offers a wide range of functionalities including conditional jumps in the questionnaire, allowing adapting of question flow on the basis of respondent group or previous response to a certain question. The socio-demographic variables from the first questionnaire conditioning the second time deployment of the same questions is an example of such a jump. Furthermore, the respondents were not required to answer in one continuous process. Answers are saved along the way, and the respondents can interrupt and continue the process as they wish without risk of losing answers already typed in. Possible internet instability also results in system saving of temporary responses and allowance of later completion.

The survey interface is designed with as much consideration to simplicity and non-commercial style as possible within the boundaries of the web survey system in order to maximise response rates. For example, logos connoting spam are avoided.

In the email inviting the respondents to participate (Appendices 6 through 7) as well as in the first introductory page of the questionnaire, language is equally intended to convey a serious image in opposition to commercial requests. At the same time, the message is kept as short and clear as possible.

Confidentiality is clearly communicated to the respondents in both email and questionnaire introductions.

Each questionnaire is constructed in Danish and English alike to allow foreign students to participate in the survey. Switching between languages is possible in the web survey system at any time during the answering process. To secure a maximum quality of the translation, a professional translator was consulted along with experts from the engineering education system.

2.4.4 Survey Distribution

The actual distribution of the questionnaire to the entire population took place through student emails acquired from the eight different Danish engineering education institutions.

The mail they received (Appendices 6 through 7) contained a direct, personal link to the web-administered survey.

To increase student incentives to participate, a prize was offered to responding students randomly picked. Two different models were used; the first survey offered one large sum of DK10,000, whereas the second awarded 10 smaller prizes of DKK1,000 each in an attempt to emphasise the fairly good chances of winning.

An emphasis of seriousness and affiliation to the education institution instead of highlighting the award in a way that resembles commercial competitions is intended. In order to enhance survey legitimacy and response rates, a good institutional framing of the survey at the engineering education institutions was facilitated by means of information letters (Appendix 4) distributed to the institutions through the contacts already appreciating the investigation so that information about the survey and the PROCEED research alliance could be offered to teachers and other faculty members. Furthermore, short messages that could be uploaded on the institutions' intranet and other internal communication systems were distributed to all institutions at the same time in both rounds of survey distribution (Appendix 5).

Four reminder mails (Appendices 6 through 7) were distributed to non-responding students after the initial contact to maximise the response rates. During the first survey deployment, engineering student feedback pointed out some technical problems relating to the capacity of the web-survey system causing disconnections. This lead to the decision to tailor one of the reminders particularly at respondents with an incomplete survey response.

2.4.5 Testing of Questionnaires

The testing of survey number one took place in two different institutional settings, namely the Institute of Business and Technology in Herning, Aarhus University, and Aalborg University. The reason for selecting these institutions was mainly practical and related to matters of access and distance. The testing took place on two consecutive days; the first day in Aalborg, the next in Herning.

In Aalborg, the tests took between 35 and 45 minutes each. In Herning, the time frame was not as wide, and we experienced some technical problems, which meant that the testing became somewhat rushed at times, lasting between 20 and 45 minutes.

Among the criteria for selecting test pilots was a wish to represent students from different programmes within the target group of the questionnaire, which meant that they had to be among the cohort of all newly enrolled engineering students in Denmark that would receive the actual questionnaire the following week. Both male and female and Danish and non-Danish-speaking students were recruited in order to perform a testing of both the Danish and the English versions of the questionnaire. Six tests were performed in each institution.

The testing of the second questionnaire took place in only one institution due to a combination of practical reasons and the fact that only a few questions were new compared to survey number one. This time testing was undertaken at the Institute of Business and Technology in Herning, Aarhus University. The second round of survey testings lasted from 25 to 40 minutes each.

The test pilots were picked out in very different ways at the two different institutions. In Herning, the students had been picked out by their teacher at a previous occasion, and they were asked to show up at a certain time and place. The students here had no idea what they were going to participate in. One student initially mentioned his *"nervousness"* (tester no. 9) of what this was all about. Therefore, the initial framing of the situation and their role in it had to be of some length.

In Aalborg, a contact person guided a tour to a range of group study rooms to recruit test pilots. After a brief introduction to the test, its purpose and themes, the students could volunteer if they did not have any teaching scheduled. This meant that much of the information and framing of the testing took place in advance of the actual test situation.

The first pilot testing was performed with 12 engineering students from the actual population representing seven different lines of engineering education. The second piloting recruited seven students from three different programmes (see Tables 2.2 and 2.3).

The questionnaire testing took place as a "think aloud" test (Martin 2005, Olsen 2006), which means that the students were instructed to express their thoughts during the test. Student understanding, experience and perceived progression were in focus along with the more technical aspects of navigation in and usability of the web-administered survey.

To avoid social desirability and inhibiting of critique, the moderator role was performed with a downplaying of own involvement in the questionnaire construction, without violating the truth, of course. Testers' questions to the meaning of survey content in no cases led to an authoritative explanation, since uncertainty about how to interpret the questions were among the test results. Although observation was the main moderator role, there was no refusal of participating in conversation, and questions were asked along the way to clarify the reactions or thoughts of the student test pilots.

Table 2.2. Overview of the selected test pilots, questionnaire no. 1

Test number	Institution	Engineering programme (The first six are Danish programmes, the latter are international programmes)	Sex	Language of test pilot and survey
1	Large, both types of engineering degrees offered	Software	Male	Danish
2	Large, both types of engineering degrees offered	Software	Male	Danish
3	Large, both types of engineering degrees offered	Electronic	Female	Danish
4	Large, both types of engineering degrees offered	Electronic	Female	Danish
5	Large, both types of engineering degrees offered	Health technology	Male	Danish
6	Large, both types of engineering degrees offered	Chemistry	Female	Danish
7	Small, offering only professional bachelor's degrees	Business Development Engineering	Male	Partly Danish, partly English
8	Small, offering only professional bachelor's degrees	Business Development Engineering	Female	Danish
9	Small, offering only professional bachelor's degrees	Electronic Design Engineer	Male	Danish
10	Small, offering only professional bachelor's degrees	Electronic Design Engineer	Male	English
11	Small, offering only professional bachelor's degrees	Global Management and Manufacturing	Male	English
12	Small, offering only professional bachelor's degrees	Global Management and Manufacturing	Male	English

The testing of the first round of the engineering student survey led to changes in the visual presentation of the questionnaire in order to improve the overview of the questions and to avoid the impression of the survey as *"a wall of text"*, as one tester expressed it.

A more serious misconception was detected in the testing of the question regarding student motivation, where items (e.g. "Technology plays an important role in solving society's problems") were not linked to the overarching question "We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you". Some students simply read the sub-question (the item) and indicated their degree of (dis)agreement with it instead of assessing the role of each item in their choice to study engineering. This misconception led to a change in the options that could be ticked. Instead of the categories "Not a reason", "Minimal reason", "Moderate reason" and "Major reason", each option was renamed "...reason for my choice of education".

Table 2.3. Overview of the selected test pilots, questionnaire no. 2

Test number	Institution	Engineering programme (The first six are Danish programmes, the latter are international programmes)	Sex	Language of test pilot and survey
1	Small, offering only professional bachelor's degrees	Electronic Design Engineer	Male	Danish
2	Small, offering only professional bachelor's degrees	Electronic Design Engineer	Male	Danish
3	Small, offering only professional bachelor's degrees	Business Development Engineering	Female	Danish
4	Small, offering only professional bachelor's degrees	Business Development Engineering	Male	English
5	Small, offering only professional bachelor's degrees	Business Development Engineering	Male	English
6	Small, offering only professional bachelor's degrees	Global Management and Manufacturing	Male	English
7	Small, offering only professional bachelor's degrees	Global Management and Manufacturing	Female	English

The first questionnaire contained one open question where the respondents were asked to answer the question "How would you characterise sustainability? Please describe in your own words how you understand the concept". This led to frustration among some of the test pilots. One male tester even commented that these kinds of questions were "no good for engineers" (my translation). He seemed to believe that engineering students are not fond of working with language. Hence, a qualitative question was not appropriate when dealing with this target group. After much scrutiny, the question was kept in the final questionnaire since it was possible to skip it and go directly to the next question and since some of the test pilots welcomed the opportunity to express their own ideas without the constraints of pre-formulated terms. However, the most important argument in favour of the inclusion of an open-ended question in the survey is the enhanced data quality of such questions, where respondents' attitudes are not confined to pre-existing categories (Fabrigar & Krosnick 1995, Krosnick 1999).

Another important change had to do with the format of two different questions that asked for the students' prioritising of two statements that were set up as statement A or B. One of the questions is shown below.

Excerpt 1. Question 8 from the first questionnaire before testing

Below we have listed some issues that different people find important. In each line, please indicate if you find statement A or B most important, or if you find statement A and B equally important.

	A is definitely most important	A is more important than B	A and B are equally important	B is more important than A	B is definitely most important	
A: To prevent pollution						B: To generate economic growth in Denmark
A: To prevent pollution						B: To improve living conditions of people in developing countries
A: To ensure resources for future generations						B: To improve living conditions of people in developing countries
A: To ensure resources for future generations						B: To prevent pollution
A: To generate economic growth in Denmark						B: To ensure resources for future generations
A: To generate economic growth in Denmark						B: To combat global climate changes
A: To combat global climate changes						B: To prevent pollution
A: To combat global climate changes						B: To ensure resources for future generations
A: To improve living conditions of people in developing countries						B: To generate economic growth in Denmark
A: To improve living conditions of people in developing countries						B: To combat global climate changes

The fact that almost all the test pilots interpreted the question as a test of their abilities to rank each item in a logically adequate relation to the other items led to an altering of the question to a straightforward matter of numbering the five different items according to priorities. In this way, the students' attention to the content of the questions was maintained; what they felt in regard to the statements instead of the question format. The changed question can be seen below:

Excerpt 2. Question 8 from final questionnaire 2010

8. Prioritise how important the issues below are to you using the numbers from 1-5. Please write 1 at the issue that you find most important, 2 at the second-most important issue, etc.

To prevent pollution	(Filling in of one of the numbers 1-5)
To ensure resources for future generations	(1-5, but not a previously used number)
To generate economic growth in Denmark	(1-5, but not a previously used number)
To combat global climate changes	(1-5, but not a previously used number)
To improve living conditions of people in developing countries	(1-5, but not a previously used number)

Furthermore, a few wordings were simplified after some test pilots had indicated unfamiliarity with abstract or academic style concepts that could be articulated closer to everyday speech, such as the Danish terms for "integrate" and "contribute".

The length of the second questionnaire was given much thought since it was expected that high response rates were even more difficult to obtain in the second round than in the first and a lengthy questionnaire could lower the student motivation for completing it (Olsen 2006).

After testing the second engineering student survey, two questions were withheld from the second round because of test pilots' experience of the questionnaire as somewhat tiresome.

Furthermore, the decision was made to shorten the survey for the second round by eliciting the socio-demographic questions for all respondents that had already answered in the first round of the survey. This implies an assumption of these data to be relatively stable across the time difference of approximately eight months. Of course one could argue that, for example, the level of education completed by a respondent's parent could have altered during the time span between the two rounds of surveys, but this is considered a factor too small to be worth the additional inconvenience.

2.4.6 Data Cleansing

The use of registers from eight different institutional settings involves a certain level of adjustment, standardisation and correcting of the information withheld in the different data files.

The data cleansing process took place in different stages. Thorough information about the engineering education institutions was sought before their handing over of personal information regarding the human subjects in order to ensure a certain degree of homogeneity in the data files. Nonetheless, there were differences in the ways of registering the engineering students. Therefore, a manual adjustment process was necessary.

In both rounds of surveys, a few email addresses (16 and 17, respectively, with some overlap) turned out to be malfunctioning, presumably because of incorrect address information, so the mail system could not deliver the mails. These were removed from the working population.

The availability of civil registration numbers made it possible to detect respondents appearing twice in the data, since they were erroneously registered at more than one education institution. Cleaning of the data to correct this double representation led to an additional deletion of 13 "copies" and two persons, of which the valid identity could not be estimated from the working population.

Finally, an error in the English version of the survey was detected; the arrangement of two items in one of the questions had been reversed. A manual recoding of the answers to these two items was undertaken based on insight in the response language of each respondent from the qualitative responses and indices on student nationality (e.g. temporary civil registration number and enrolment at an international education).

2.5 Responses and Representation

The study uses respondent replacement in the total population in the second data collection to a minor extent, namely in the cases where students were accepted to the engineering programmes after the first round of surveys. But in this case, where representation is paramount not in the comparison of population to sample but in the comparison of responding to non-responding members of the population, a mechanism similar to replacement does occur. This happens when first-time responding respondents are "replaced" after the first round of surveys by first-time non-responding members of the population who now decide to respond. See Figure 2.2 for a graphic illustration of population and responding group.

Figure 2.2. Overview of panel design with minor replacement in total population and response versus non-response movements in population

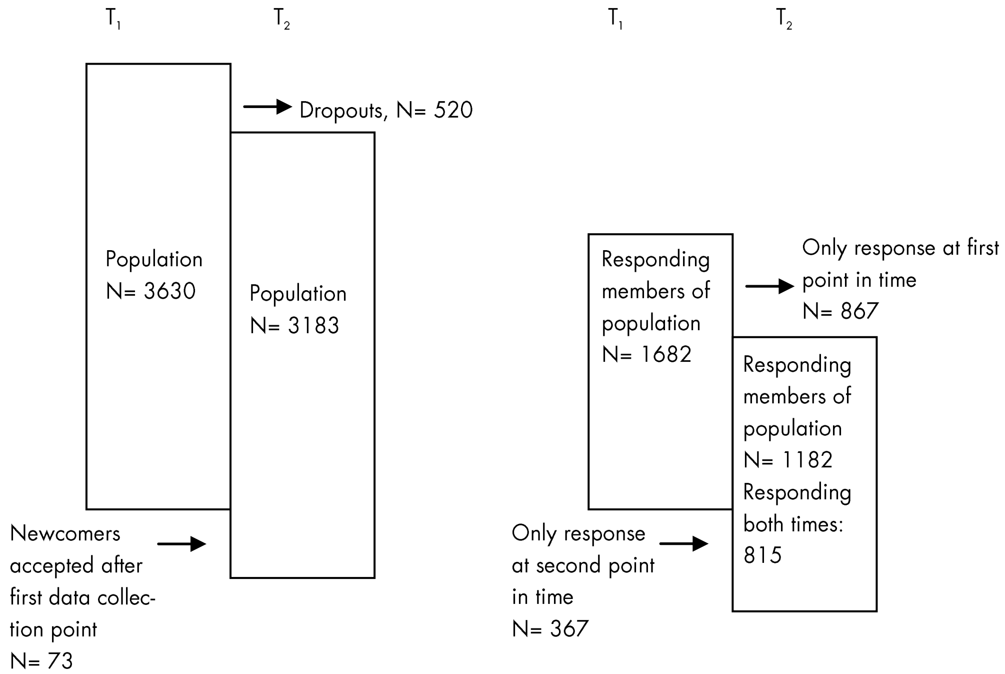


Figure adapted from De Vaus 2001, p. 121.

Altogether, the responses included in the investigation cover people in eight different categories, as shown in Table 2.4 below.

Table 2.4. Overview of response combinations within population

Response combinations in population	Second-time response	Second-time non-response	Not member of second-time working population	Total
First-time response	815	726	141	1682
First-time non-response	341	1228	379	1948
Not member of first-time working population	26	47	-	73
Total	1182	2001	520	3703

Non-response analysis is undertaken to assess possible non-response bias. (See Appendix 8). The analyses assess the responding groups' representation of the total population on the basis of gender, age, institution, education type (bachelor level or master level education) and type of engineering discipline.

2.5.1 Weighting

In order to correct for the risk of non-response bias based on institutional differences in response rates, weighting of the data according to institutional affiliation is carried out. Gender differences, age differences and engineering programme differences in response rates are considered minor and unsystematic. However, there are clear differences in response rates between different institutions. To ensure that the responses from each institution are represented equivalently to the share of the total population from the institution, each respondent from an institution with a low response rate is given a higher weight than respondents from an institution with a high response rate. This weighting technique to adjust for non-response requires a priori knowledge on the population-level distribution on the relevant variables (Rea & Parker 2005, Thomsen 2010, Buckingham & Saunders 2004) – here only distribution of population on institutions.

Weighting increases the statistical power of the data material and reduces the risk of bias due to possible differences between – in this case – respondents from different institutions. Weighting according to one variable comes with a risk of overlooking other possible biases in the material that may be increased by this weighting (Pike 2008). If having blue eyes were considered to influence survey responses and blue-eyed respondents were significantly more likely to enrol at one of the institutions, weighting for institutional non-response biases would skew the "blue eyes" response bias. The risk of imposing this kind of bias on the data as a consequence of the weighting is considered very little since other variables that were suspected sources of bias (e.g. differences in gender representation) were also investigated.[9]

Following a conservative precautionary principle, the statistical analyses are always also examined with un-weighted data to ensure detection of any potentially undesirable consequences of the weighting procedure.

2.6 Methods for Data Analysis

This section is a summary outline of the applied methods for data analysis. Ordinary least squares (OLS) serve as the general, underlying statistical framework of the quantitative analyses assuming linear associations of variables. A recoding of the initial quantitative data includes standardising of

[9] Some critique of more advanced types of weighting exists (cf. discussion of Pike 2008), whereas simple weighting of non-response bias is predominantly considered a correction to otherwise biased data (Buckingham & Saunders 2004).

variables, removal of "Do not know" answers and simple data manipulation. A standard procedure in social science involves the assumption that Likert scale measurements providing ordinal scale data (with categories such as "Totally agree", "Tend to agree", "Neither agree nor disagree", Tend to disagree" and "Totally disagree"[10]) can be meaningfully construed as interval scales, which presumes that attitude differences can be translated into distances and that the distance between, for example, "Totally agree" and "Tend to agree" equals the distance between "Tend to agree" and "Neither agree nor disagree". This procedure is adhered to since ordinal scale level is a minimum requirement for some of the statistical data analyses. The limitations of this standard procedure for survey analysis are acknowledged and affect the way in which the findings are interpreted throughout.

The statistical analyses include uni-, bi- and multivariate analyses such as frequency analysis, correlations, index constructions, factor analysis, analysis of variance (ANOVA), cluster analysis and various statistical tests (e.g. test of normal distribution, post hoc testing, Chi^2 goodness of fit testing, inter-item correlation test) and controls for third variable effects on bivariate association. Furthermore, qualitative answers are coded by means of computer-assisted qualitative data analysis as well as with more interpretive approaches, including textual analysis, metaphor analysis, semiotic analysis and critical discourse analysis.

2.7 Ensuring Research Quality

Conclusions and claims of inference in the field of social scientific empirical analysis rely on various steps undertaken to ensure the quality of the data collected and the methods used to analyse and interpret the data. In concordance with the critical discursive realism, a "reality" may exist, and at the same time, an epistemological constructivism is adopted. No "truth" claim will be made, and the status of any findings will be a temporary, indicative one acknowledging the transitivity and cumulative nature of scientific knowledge. This does not lead to a scientific relativism, however. A critical, judgmental rationality implies scientific discussion and theoretical foundation. Systematic and transparent analysis and argumentation are general, scientific requirements strived towards throughout the dissertation. The concepts of validity and reliability are prevalent parameters of quality assess-

[10] This scale is, for instance, used in question 12 in the 2010 questionnaire, replicated as question J in 2011. A "Do not know" category was included in this particular question formulation. See sub-section 2.4.2 on questionnaire construction for a discussion of the inclusion of DK response options.

ment in quantitative methodology, whereas relevance and transferability are emphasised in a qualitative context. This section highlights how some of the previously mentioned steps in the research process contribute to the overall quality of the research.

The concepts of reliability and validity are both scientific ideals best described as endpoints of continua. This means that quality enhancement is a continual attention to ensuring *more* reliable and *more* valid results, rather than a final verdict passed on any distinct process of the research or result (McDonald 2005, de Vaus 2001).

Reliability is, in a quantitative terminology, the degree to which methods of measurement provide consistent measures (Hellevik 2002). Reliability is closely linked to the desire to ensure replicability (Bryman 2004, McDonald 2005). Working with human subjects and social processes calls for a translation of replication and accurate measurement: *"Another way of putting this is that we must strive to eliminate arbitrariness of measurement and interpretation"* (Schrøder 1999: 51). The replication of survey questions previously used in other contexts is one way of establishing a frame of reference for assessing the reliability of the collected responses. The absence of conventional methods of measuring students' conceptions of sustainability, professional engineering identity and their interrelation requires development of new constructs, however. In this regard, considering reliability implies openness and transparency, which makes repeated measures possible. The use of multiple-item indicators, scales, contributes to the reliability of the estimates and facilitates the assessment of reliability[11] (inter-item correlation). Furthermore, meticulous consideration of formulation, translation and student understanding, for example, by means of the processes of pilot testing also contribute to decreasing the risk of random and systematic misinterpretation.

Whereas insufficient levels of reliability cause random errors in the data collection process, insufficient levels of validity result in systematic biases in the measurement (Hellevik 2002). The term validity[12] is understood as the degree to which the methods applied for data collection and analysis appear to succeed in estimating the concepts and contribute to answering the research questions posed.

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[11] This type of reliability is difficult to distinguish from what McDonald (2005) refers to as convergent validity.

[12] Adcock and Collier (2001) identify 37 different ways of defining (aspects of) validity. Many of these definitions are not mutually exclusive, which contributes to confusion. Only a few of these subtypes of validity will be described here. With direct reference to Adcock and Collier (2001), focus is instead on the processes and considerations contributing to valid results; they term it validation.

Large-scale surveys are potentially strong in external validity, which enables generalisation to a larger context than the actual survey respondents (Munck & Verkuilen 2005, Neuman 2000). Surveys bear the potential to estimate the prevalence of different issues in that they make aggregate measures on the basis of the intervention (Hellevik 2002). A large N study potentially establishes patterns of association with a high degree of precision and confidence by means of statistical procedures for data analysis (Munck & Verkuilen 2005). Surveys are especially good at procuring estimates of the prevalence and incidence of different circumstances (Hellevik 2002) as utilised for comparative matters.

The selection of a random sample or, in the case of the engineering student survey, the acquisition of a response pattern representative of the population is an important prerequisite of strong statistical power and external validity (Hellevik 2002). The correcting of the data for non-response bias based on affiliation to education institution is one way of eliminating systematic bias and ensuring data quality.

Another important way of ensuring research quality concerns the multiple incentives performed to maximise survey response rates (Pike 2008).

The criterion of transferability is often raised in relation to qualitative data elements instead of generalisability. The fact that the qualitative data are collected through the engineering student survey results in an extraordinary numeric magnitude of the qualitative data. The analytically derived qualitative results are not generalisable in quantitative terms, however; the magnitude and prevalence of the identified patterns are not statistically tested. This brings the notions of transferability and relevance into bearing (Bruhn Jensen 2002, Peshkin 1993, Flick 2002). At a first glance, the qualitative findings can be transferred to the nearest context, namely the total population of engineering students in the year group. But the results of not only qualitative analyses, but of the entire research undertaken are considered very relevant contributions to a much larger context of engineering education, higher education research and professional engineering practice in Denmark and elsewhere. The internal dilemma of the engineering students opposing technology with nature and triggered by the sustainability concept as found in Chapter 6, for instance, refers back to a pre-existing theoretical discussion about this opposition and, at the same time, points forwards to an actual debate on professional responsibility and the role of technology in society.

An ongoing process in the qualitative data analysis of looking for results that point in other directions than what temporary findings seem to do (refutability, Olsen 2002). This contributes to increasing the quality of the data analysis and the consistency and level of detail of the patterns and results.

A disadvantage of the research is the absence of strong theoretical frameworks in the field. Neither engineering education research, nor education for sustainable development offers applicable theoretically founded expectations of the engineering student expectations and conceptions of their future profession and its societal role. If identification and assessment of causal relations in the data were the main intention, the weak and incoherent theoretical landscape had been a problem in terms of internal validity, since causal claims need to be substantiated by theory suggesting the existence and direction of – as well as the explanation to – this relation between given variables[13] (Nørgaard 2007). The wish to decrease the complexity and the number of variables in the design therefore shrinks from the wish to include a satisfactory number of variables to test different relations in the material (Munck & Verkuilen 2005: 392) in a more explorative manner. The immature theory development in the field of research is also a disadvantage for the measurement validity of the investigation. According to empiricist ideals, definitions and concept development on the basis of firm, theoretically informed background concepts and an established knowledge base supporting hypotheses on relations between variables would be the starting point of the survey development. In the case of the engineering student survey, a wider range of possibly important variables is included among the concepts investigated; the findings potentially contribute to theory development.

Another decisive contribution to data quality is the existence of meaningful links from definitions and concepts to operationalised constructs. Social science measurement provides approximations to the "real world" by means of a projection of abstract concepts onto it. The process requires a translation

[13] The dismissal of the term causality does not imply that cause-and-effect-relations are not sought for. Causality understood in a strict sense as something that can be assessed via the isolation of the relationship between an independent and a dependent variable all other things being equal, is considered an epistemological utopia. All other things are not equal. In social sciences where human beings are research subjects this is particularly so, but not even a controlled laboratory experiment provides certainty about causal relations, because it is not "real". Nonetheless, the investigation undertaken does hold as an objective to clarify relations between variables that affect each other. This happens in a more explorative manner by means of quantitative and interpretive analyses in interaction.

Another note relates to the issue of causality. To the extent that a mildly interpreted causality is investigated, cross-sectional surveys may come across the problem of endogeneity, which implies that the direction of a causal relation cannot be estimated from a cross-sectional analysis in itself. The time-lagged repetition of at least some of the questions presents a solution to this problem, as Chapter 8 starts to explore.

of concepts to operational questions and vice versa. Respondents' understanding of the question formulation, the operationalisation of the theoretically based concepts one wishes to investigate, must be as closely concurrent to that of the researcher as possible. (Klemmensen, Andersen & Hansen 2010, Adcock & Collier 2001, Hellevik 2002, McDonald 2005). This so-called measurement validity – sometimes referred to as content validity (Hansen & Andersen 2009, de Vaus 2001) – is strived at in various ways. First, several possible multiple-item constructs are explored to estimate theoretical concepts. Second, intense collaboration took place in the PROCEED workgroup including engineering educators with a close connection to engineering students to reach formulations that would make sense for this target group. Third, pilot testing and subsequent adjustment of the surveys are supposed to assure measurement validity.

A related concern has to do with the fact that different measures or words represent different meanings in different survey contexts. *"Survey research is particularly sensitive to contextual specificity"* (McDonald 2005: 942). This is particularly pertinent in comparative settings since no valid inferences on group differences in survey responding can be made if one cannot assume that the survey understanding is similar across the different groups compared. The fairly high level of homogeneity of the respondents in the group suggests that contextually determined differences in the survey understanding are not considered a high risk. The use of an English language survey addressing, for instance, foreign students enrolled at international engineering educations in Denmark holds a risk of transferring unintended meaning across language-specific contexts. The risk is diminished in the following ways, however. To the extent that the surveys replicate previously validated survey questions, the transfer of meaning goes the other way around, from other contexts (US higher education and European cross-national comparison, respectively) to a Danish engineering student context, and the comparison across national contexts is tested in Chapter 4. The process of translation involved both engineering expertise and professional English-Danish translation expertise. Finally, absence or lack of Danish skills was among the selection criteria when choosing some of the students to perform the pilot testing of the questionnaire, which means that an interpretive check of the English questionnaire could reduce the risk of severe, systematic misconceptions because of contextual differences.

The respondents' possibility to contribute with their own formulations and keywords contribute to the overall validity in that this qualitative element can be considered a representation of reality that comes closer to reality than check marks in boxes can ever achieve. This results in a higher overall validity of the type that Bryman (2004) refers to as ecological validity. Ecological validity is often a weakness of survey methods since the unnaturalness of the contextual setting involves a risk of removing the findings from what would be naturally found. Unsatisfactory levels of ecological validity would challenge the linking of the transitory research result to a "real world" in the same way as, for example, the previously mentioned quantification of distance measures between degrees of agreement or disagreement. However, this critique applies to some extent also to the qualitative, open-ended questions. Measured with interpretationalist standards, the nature of the open-ended questions embedded as they are in a survey format does not make possible interactive use of the respondents as contributors to the analytic and interpretive phase of the research process. Such a feedback mechanism is often pursued by means of in-depth interviews where analyses and interpretations of the respondent's life world can be contributed to and validated interactively in the data collection process itself. Nonetheless, the critical focus of the analyses will be pursued by including the discursive and social practices in which the pieces of text have been produced. For this purpose theory will be included along the way to qualify the findings.

3. Professions in Theory

This chapter serves to provide an overview of ways to understand the characteristics, conditions and societal role of occupations claiming professional status. In order to understand the engineering student conceptions of engineering and the role of societal challenges to the engineering identity, contingent – in part, competing – ways of conceiving professionals will be identified and discussed in relation to the field of engineering.

Engineering education research and the sociology of professions are two largely disconnected fields of research. From time to time, engineering appears as an example of a profession in profession studies, but discussion rarely addresses what makes this label apply – or not – to engineers. Conversely, the immature field of engineering education research largely focuses on concrete experiences with didactic and pedagogical strategies and curriculum development and provides rather fragmented perspectives on what an engineer is and should be. A systematic literature review of sociological notions of professions and professional identity will be presented in this chapter forming the theoretical basis for the understanding of professional engineering identity. The chapter intends to combine this field of research with the findings of a systematic literature review of engineering education research with respect to the definitions of desired engineering competencies and requirements (further findings of this review can be found in Chapter 7, where it is juxtaposed with a review of literature on the desired skills and requirements when educating for sustainable development).

To render possible a critical synthesis of the empirical findings with larger aspects of the discursive and social practices they are situated in, theory is used instrumentally for complementing and contrasting. Engineering could be approached as a field, occupation or (educationally conditioned) career trajectory. The theoretical emphasis of the dissertation does not rule out any of these approaches. The sociology of professions is used as an entry point to understanding individual and societal issues relating to the engineering occupation. An inclusive overview of this theoretical field serves the dual purpose of informing the empirical investigation of possible ways of understanding engineering and its societal role and implications as well as the purpose of providing the theoretical foundations for mirroring the findings and enabling a discussion of these findings.

The theoretical chapter seeks to bridge lay notions or everyday use of the concept of being “professional” and scientific construal of the profession, as suggested by both Freidson (1983) and Bourdieu & Wacquant (1996: 222 ff).

They find that professions can be considered a "folk concept" that must not unquestioningly be translated into social sciences[14]. Freidson (1983) emphasises the importance of history and a dynamic use of the notion and points out that the concept is highly influenced by a handful of specific Anglo-American occupations and their archetypical traits. Bourdieu (Bourdieu & Wacquant 1996) focuses on the mechanisms of negotiation and demarcation going on to determine the boundaries of the professional field. They both suggest empirical investigation of these processes as a means to meaningfully analyse professions (Freidson 1983: 32, Bourdieu & Wacquant 1996: 225, Harrits 2011).

A mapping of the ways in which the sociology of professions and engineering education theory conceptualises the engineering identity will be provided in this chapter in order to illuminate the professional distinction; the contingencies making the label of "engineer" seem adequate or not.

The theoretical section combines a descriptive and a normative perspective. Notions of what engineering is are supplemented with norms about what it should be.

3.1 The Role of Professionals in Society

This section examines the notion of a professional as someone with a normative obligation towards society. It will be asserted that the socio-cultural ideals referred to as hybridity (Hård & Jamison 2005, Jamison et al. 2011, Jamison 2013) can be considered an engineering-specific parallel to Freidson's (2001) third logic; an ideology of professionalism.

The conception of professions as a societal good contributing to continuous development, social order and cohesion is underlined by Parsons (1939).

> The importance of the professions to social structure may be summed up as follows: The professional type is the institutional framework in which many of our most important social functions are carried on, notably the pursuit of

[14] Bourdieu is no proponent of the use of the term "profession" and argues in favour of replacing academic use of the term with the "field" concept, since he considers it an example of an ideologically biased universalisation unquestioningly applied and delimiting the critical, sociological perspective. The notion implies a normative accentuation of some occupations in the guise of a neutral, scientifically validated terminology, he comments (Bourdieu and Wacquant 1999, Brante 2011, Schinkel & Nordegraaf 2011). Another objection to the term profession may be rooted in the French language in which profession and occupation are slightly differently used (Sciulli 2009 and 2010, Schinkel & Nordegraaf 2011).

> science and liberal learning and its practical application in medicine, technology, law and teaching (Parsons 1939: 467).

Parsons' approach has been labelled as naive (Fauske 2008, Brante 1988) due to its focus on the positive contribution of professions to societal cohesion. More critical approaches emphasise that professions actively influence the shaping of culture, structure, institutions and discourses as well as the execution of power in ways that are not always transparent or accessible for laymen (Abbott 1988, Larson 2013, Laursen 2004).

> The professions dominate our world. They heal our bodies, measure our profits, save our souls. Yet we are deeply ambivalent about them. For some, the rise of professions is a story of knowledge in triumphant practice … For others it is a sadder chronicle of monopoly and malfeasance, of unequal justice administered by servants of power (Abbott 1988: 1).

Abbott's quote points to the ambivalent role of professions in society. Without disregard and criticism regarding the potentially negative role of professionals I will next turn to the implications of the positive, since the focus here is on how engineering professionals "should" be. Moreover, these normative ideals are largely formulated in commemoration of the risks of a negatively enacted professional practice.

3.1.1 The "Third Logic" of Professionalism

In this sub-section Freidson's (2001) ideal type professionalism involving a "Third Logic" alongside the logics of the market and the firm will be explained.

Professionals are expected to take on fiduciary responsibilities. They are expected to follow a seemingly self-sacrificing logic in the service of others; an altruistic motive is often attributed to professions, also outside of the healthcare sector.

> … most sociologists have been inclined to see professions as honoured servants of public need, conceiving of them as especially distinguished from others by their orientation to serving the needs of the public through the use of their unusually esoteric knowledge and complex skill (Freidson 1983: 19).

Professionals are considered to be driven by a rationale very different from that of other types of occupations. According to this ideal-typical conception, professionals find an intrinsic value in their work (Larson 2013: 61). This implies that the work they do is considered rewarding in itself. This intrinsic motivation is considered more influential than external mechanisms of reward, such as “profit or salvation, God or mammon” (Larson 2013: 61). In this respect, being a professional is similar to a calling[15]. This has profound influence on professional identity, because person and profession become difficult to separate. Professional work implies commitment, a degree of personal investment.

A professional is expected to disregard their own personae and refer to disinterestedness and universal standards in their work practice (Parsons 1939). Professional procedures, rationality and affective neutrality secure a collective solidarity and contribute to societal coherence. These elements of public service orientation set professions apart from other occupations (Brunkhorst 2008).

Analytically, a distinction is often drawn between the altruistic self-sacrifice of the professions and egoistic self-interest of other occupations (Freidson 2001, Brante 1988). Parsons (1939) already pointed to the fallacious polarisation of this distinction. Businessmen aiming at economic gain cannot necessarily be deemed to be egoists (Parsons 1939).

Freidson (2001) focuses on the professions’ role as mediators between market and bureaucracies, much like civil society. He uses the term “free market” as a non-existent ideal type, opposed to the somewhat more blurred ideal type of a bureaucracy controlled by managers aiming at policy implementation as opposed to economic gain. The division of labour assigns certain roles to different occupations. When occupations gain control over the labour market, they have become professions, which leads to the rise of the third ideal type with its *“third logic”*, as he coins the term in his renowned book title, *Professionalism: The Third Logic* (Freidson 2001). Other than an organisational form that challenges ideal typical notions both of a customer-directed free market and a management-determined bureaucracy, his third logic also implies an ideology of professionalism underlying professional decision-making and practice[16]. This logic ideally should supersede the role of economic profit as a motivator of professions. (Freidson 2001, Parsons 1939, Larson 2013). In practice, however, a range of motives might be expected to

[15] See Sciulli & Halley (2009) and Sciulli (2005a) for a discussion of etymological connotations to different conceptions of professions in different languages, including the German notion “Beruf” specifically emphasising the occupational aspect of calling.

[16] Evetts (2010) argues that Freidson’s third logic is increasingly inadequate in that the organisational dimension of the notion is not really distinguished from the market, due to commodification tendencies and a borrowing of market rationales. However, as I use Freidson’s third logic, the emphasis is on the other dimension of the term, namely the normative dimension, or – as Evetts (2010) terms it – professionalism as “occupational value”.

coexist among professionals, causing increased complexity and ambiguity (Bertilsson 1999).

3.1.2 The Role of Engineers in Society

After theoretical input about the ideal role and logic of professionals, I will turn to the societal role of the engineering profession more explicitly. I find that engineering education literature defines engineering with referral to its purpose, the characteristics of the conduct of engineering or in terms of an engineering culture. Ideal notions about the role of engineers in society are found with referral to the purpose of engineering and involve discussions about whom to be in service of.

Historically, the engineering profession is rooted in the military field. The first engineers were occupied with concrete problem solving of military strategic importance. At a later point in time, engineers found employment in non-military fields, hence the use of the term "civil engineer"[17] (Mitcham 2009). These engineers were publicly employed to develop sanitation or infrastructure, for instance, in the service of the state as a kind of civil servants (Mitcham 2009, Wagner 2006). Engineers and the state still are mutually dependent on one another in the same way as other professions. The engineers perform the function of contributing to the solution of a range of state problems. At the same time the state exercises a symbolic power over the engineering education system that secures the legitimacy and exclusivity of the engineering profession. (Harrits & Olesen 2012).

Concurrently to the industrialisation of the Western world, a genuine professionalisation took place linking engineering identity closely to a technical paradigm coined by an optimistic confidence in the internal forces of progression and industrial development (Wisnioski 2009). Wishes of mastering and exploiting nature and its resources for civilisation's purposes were traditionally part of engineering identity *per se*, and technical development was considered a means to this purpose (Wagner 2006, Jamison 1997, Bowden 2004, Jamison & Heymann 2012).

After the time of the great ideologies with the late or post-modern critique of negative consequences and risks posed to society by industry and

[17] The direct Danish translation of this title does not correspond to international notions of a civil engineer. Internationally, a civil engineer still refers to the type of engineering that deals with construction of concrete structures, probably most similar to the Danish "building" or "construction" engineer. The Danish term "civilingeniør" refers to a person with an academic engineering degree at the Master's level which includes a variety of different types of engineering programmes. (See fx Tilmeldingssekretariatet 2010.)

technical innovations, the formation of ethical codices pertaining to engineering became increasingly common. These codices emphasise the ethical obligations of an engineer going beyond the serving of state interests; an engineer should serve the general society and mankind. Today, serving a greater societal good is to a large extent considered part of the engineer's professional identity (Ambler 2009, Downey et al. 2007, Mitcham 2009, Wisnioski 2009).

The ideal notion of engineers' professional role is intricately linked to the role attributed to technology in society. In addition to technology's two-edged nature of supporting, but sometimes also potentially harming, human activity, technology also influences human thinking and communication (Baillie 2006). Furthermore, technology can be construed as a social and political phenomenon, which means that technology-professionals are playing social and political roles in their everyday work (Kleinman 2005).

3.1.3 Hybrid Imagination: Engineering's Normative Ideal of Professionalism?

This sub-section will couple two previously separated theoretical perspectives in the assertion that the call for a hybrid imagination among engineers stated from the position of socio-cultural technology studies can be considered an ideal notion of professionalism – an engineering-specific "Third Logic".

In the same way as Freidson's (2001) professional logic, the normative ideal of engineering hybridity (Hård & Jamison 2005, Jamison 2013, 2012, Jamison & Heymann 2012, Jamison et al. 2011, Jamison & Mejlgaard 2010) transgresses and balances different demands and mediates between a multitude of logics serving a higher goal of sustaining society and the development of people, planet and prosperity.

> A hybrid imagination can be defined as the combination of a scientific-technical problemsolving competence with an understanding of the problems that need to be solved. It is a mixing of scientific knowledge and technical skills with what might be termed cultural empathy, that is, an interest in reflecting on the cultural implications of science and technology in general and one's own contribution as a scientist or engineer, in particular. A hybrid imagination involves recognizing the limits to what we as a species and as individuals can do, both the physical limits and constraints imposed by "reality" as well as those stemming from our own individual limits of capabilities and knowledge. As such, a hybrid imagination is often manifested collectively, involving

> collaboration between two or more people, either in a project group or in relation to a broader social or cultural movement (Jamison 2013: 17).

Mejlgaard (2006) points to scientific citizenship as a form of responsibility particularly relevant to the engineering profession. Harmful effects of technology are omnipresent risks in society, and engineers have an ethical responsibility as technology specialists towards the rest of their society that they continually must weigh against other responsibilities, such as economic profit.

Ethics and social responsibility are considered increasingly important in engineering practice. Risk management and efforts to prevent eventual harmful implications of technical development and problem solving have become important aspects of ethical codices for engineers (Ambler 2009, Buch 2012, Buch 2011, Carew & Mitchell 2008, Downey et al. 2007, Jamison 1997, Jamison 2012, Jamison & Heyman 2012, Jamison & Mejlgaard 2010, Mitcham 2009, Petroski 2008, Sheppard et al. 2009a, Williams 2003, Wisnioski 2009). Ambler (2009) finds that engineering is a dynamic force which can potentially change society, thereby threatening societal stability. He discusses the moral consequences of the human control of this kind of power over nature and suggests a more reflected philosophical scrutiny of the ethical, moral and social responsibilities in engineering practice (Ambler 2009).

3.1.3.1 Approaching Hybrid Imagination

One thing is advancing normative ideals about the engineering profession. How to actually take on a hybrid imagination in everyday practice as an engineer is much more difficult to outline.

Layton (1986) represents a pragmatic branch of theorists emphasising the feasibility of enacting the role of professional engineer in a society marked by fast change, risks and uncertainty as well as profitability concerns competing with professional ideals:

> The best we can hope for is a system of rational trade-offs of the sort engineering designers call "optimization." That is, we can strive for the best actually possible, rather than the best conceivable. We can attempt to reduce costs and increase benefits. But the costs will not go away. When engineers have acted on the assumption that cost-free technological fix was possible, the results have been ironic. The history of engineers as social thinkers is full of such irony.

> Neither are there simple, complete solutions to the dilemmas of engineers. Engineers cannot be completely free because they have other responsibilities that cannot be ignored (Layton 1986: ix).

Engineering involves acts of balancing various demands and claims, and not one solution or decision may appear to be the right one. There is no direct way to approach sustainable engineering practice; sustainability is an essentially contested concept (Carew & Mitchell 2008, Connolly 1993, Gallie 1956).

Bell (2011) who reformulates the societal role of engineers as change agents in a world seriously endangered dares to put forward almost utopian ideals to aim at:

> Sustainability requires changes in how humans interact with natural systems and with each other. This cannot be achieved simply by continuing existing patterns of development in the hope that new technologies will solve environmental pollution and overcome resource shortages. Since the industrial revolution, most cultures and regions have witnessed dramatic social, technical and economic change. The historical trajectory of industrial and technological development cannot continue. Engineers have a central role in determining the direction of change in response to growing ecological and social crises (Bell 2011: 85-86).

Baillie (2006 and 2009) underlines the need to focus on international equity and social justice in a new, responsible engineering identity.

Beder (1998:64 ff.) places engineers in a field of tension between technological determinism and economic or market determinism. "… technological development often has a trajectory or direction which is influenced by a number of factors" (Beder 1998: 79). Instead of external factors governing technological development and hereby limiting the role of engineers, she calls for interactive, social models of technological development (Beder 1998) and trusts that "engineering in the 21st century will shift … to a profession that seeks to serve the community in a socially and environmentally responsible manner" (Beder 1998: 35).

Investigating the adequacy of a range of American engineering educations to tackle societal challenges is the objective of Sheppard et al. (2009a). They are discouraged by their findings and demand a reorientation of engineering educations where one of the key insights is that engineers need to take on them the ethical and professional responsibility of affecting the world (Sheppard et al. 2009a: 175ff). By means of a break with existing paradigms of teaching in engineering education and reforms of the educational system Baillie (2006 and 2009), Sheppard et al. (2009a), Beder (1998 and 1999) and Bell (2011) intend to contribute to qualify the engineering education systems to their task (see also Jamison et al. 2011). This places the ball in their court. Gough & Scott (2007), Scott & Gough (2010) and Sterling (2001) also claim that to fully embrace the challenges of society, educations must radically change. Engineering education institutions must provide change agents tuned in to their responsibility for societal cohesion and development (Jamison 2013, Holgaard et al. 2006, Jamison et al. 2011). Jamison (2013) acknowledges the need for a new habitus (Jamison 2013, Jamison et al. 2011), which encompasses the complex interplay of the educational institution both with the communities of practice in which learning is situated and with contextual, social practice. Habitus (Bourdieu 1995a, 1995b) refers to the pattern of values, assumptions and preferences taken for granted by members of a field; dispositions legitimating and "naturalising" field membership.

The empirical data collection intends to provide an insight in engineering student habitus by means of the surveying of various aspects of their anticipated professional identity and the role of sustainability and societal challenges herein. This may provide a useful input informing and qualifying engineering education institutions with intentions to affect the habitus of their engineering graduates.

3.2 Professionalisation and De-Professionalisation

After an overview of the overlying purpose and rationale that purportedly motivates professionals including engineers and gives them a particularly important role in sustaining and developing society I will turn to an identification of the mechanisms of professionalisation and de-professionalisation. De-professionalisation is considered a general denomination for a range of tendencies challenging (engineering) professionals and their role in society. I consider these tendencies specific instances of the societal challenges opposing the engineering professions at large.

The professionalisation process can be described as a development of functionally differentiated, specialised fields of labour contributing to societal sustainment. The process can also be investigated from the point of view of a specific occupation pursuing professional status; in practice, this involves an approaching to the professional attributes listed in section 3.4. Such professionalisation projects have been the focus of studies among welfare- and "semi"-professionals (Etzioni 1969, Evetts 2011 & 2008, Brante 1988, Hjort 2004, 2008). "De-professionalisation" refers to a countermovement and the redeployment of the professionalisation process. Currently, external as well as internal pressure is put on the professions, causing de-professionalisation. De-professionalisation involves a loss of professional prerogatives and is often accompanied by proletarianisation; loss of power, prestige and work control to others (Leicht & Fennell 2001, Schinkel & Noordegraaf 2011: 89-90, Scanlon 2011).

> … professionals … constitute no united, collegial group but are fragmented within different social sectors. Professionals within the university, the state, and industry work in different institutional contexts, involving different norms, career systems, values, standards, and interests. The diversification of the institutional base implies that a traditional common value orientation is lost (if it has ever existed). Thus the loyalties of professionals will also be fragmented into particular interests (Brante 1988: 134).

One aspect of de-professionalisation concerns an increased routinisation of tasks that – sometimes by means of technological devices – become less demanding and cease to involve professional competencies.

> … the most important divisions of labor divide fully professional work into routine and nonroutine elements, with the two falling to different segments of a profession or even to paraprofessionals … the eventual result has been the degradation of what had been professional work to nonprofessional status, sometimes accompanied by the degradation of those who do the work (Abbott 1988: 125-126).

Along with this increased functional differentiation and devolution an opposing tendency prevails. More and more boundaries between scholarly disciplines, technical fields and professions are blurring, as the need for cross-disciplinarity and a wider complexity of knowledge is recognised in actual problem solving (Beder 1999, 1998, Grimen 2008, Jamison et al. 2011, Hjort 2008, Williams 2003, Sheppard et al. 2009a).

Furthermore, economic and managerial changes during the last decades increase the pressure on the autonomy of the professions (Leicht & Fennell 2001). In a Scandinavian context, the public welfare professions are particularly subjected to this type of contextual changes. A wave of New Public Management-inspired reforms, commodification of the professional services, public access requirements, incentives to control and limit the costs of these services, increased demands to professional documentation and a questioning of professional authority headline these changes (Laursen et al. 2005, Hjort 2008, Hjort 2004, Bertilsson 1999, Evetts 2011, 2006, Mastekaasa 2008). The engineering profession is not exempted from such contextual change. Evetts (2011), for instance, finds that engineers have difficulties sustaining occupational control of their work and their discretionary decision-making. Additionally, the large-scale societal challenges including sustainability challenges and increased internationalisation and globalisation (Baillie 2006, Bertilsson 1999, Buch 2012, Buch 2011, Evetts 2011 & 2008, Jamison 1997, Jamison 2012, Jamison & Heyman 2012, Jamison & Mejlgaard 2010, Petroski 2008, Sheppard et al. 2009a, Williams 2003, Wisnioski 2009) complicate professional engineering work and contribute to de-professionalisation.

> Debates about professionalization and deprofessionalization … could give you the false impression that professions revert to organizational forms found at earlier times in history. But social change rarely runs in reverse like a cassette tape. Instead, professional work is moving in new directions that are distinctive departures from traditional professional life or the pre-professional history of most occupations (Leicht & Fennell 2001: 16-17).

Working conditions, work practices and work place context are all changing. Routinisation and transcendence of boundaries both challenge professions and contribute to a destabilisation of the professional identities. Elite status and exclusivity are no longer a matter of course for professionals (Scanlon 2011). Professional jurisdiction must be resettled, which involves a threat to professional legitimacy. The process of de-professionalisation implies uncertainty about the future direction(s) of the engineering profession and the conception of an engineering identity.

3.3 Defining or Not Defining the Concept of Profession?

The first sections of this chapter conjoined engineering education theory and sociology of profession in the outline of a normative ideal of the role of professional engineers in society. Next, processes of professionalisation and de-professionalisation contributing to condition this professional project were presented. In this section positions in the definitional debate will be discussed.

As a theoretical field, the sociology of professions is marked by a discussion of how to define its field of research, namely professions (Torstendahl 2005, Sciulli 2005a, 2005b, 2009, 2010, Sciully & Halley 2009, Saks 2012, Brante 2011, 1988, Evetts 2011, 2006).

The notion of a professional can refer to a person's scholarly obtained degree, their membership of an occupational group or their function via their job, as Bomke (2003) refers to. In lay terminology a professional can also be the opposite of an amateur (paid vs. unpaid activity) or simply someone who is good at what they do (Christensen and Delahousse 2003, Bennion 1969, Flexner 2001). Some scholars have produced exhaustive lists of the attributes necessary for an occupation to be reckoned as a profession (Bennion 1969, Greenwood 1957, Flexner 2001[18], Sciulli 2005a, 2009, 2010), functionalists emphasise the importance of the relation between professions and society, hence their function in promoting social order (Saks 2012) and the sustaining of societal institutions and operations (Parsons 1939).

Some lean towards a continuum-understanding of the field, implying that occupations can be more or less professional (Greenwood 1957). - Others focus on the processes of professionalisation (Larson 2013, Freidson 2001, Hjort & Weber 2004). And some profession researchers argue that a full definition of a profession is neither imperative nor interesting in order to investigate actual professionalisation or professions (Evetts 2003, Abbott 1988, see also Saks 2012). At the same time, an increasing number of occupational claims to a "professional" status threaten to undermine the content of this label (Evetts 2003, Flexner 2001, Staugård 2011: 162ff., Brante 2011), as pointed out by Brante (1988):

> If the concept of profession is to be of analytical value it is imperative that it actually can discriminate between professional and non-professional groups. Several scholars, however, have found that the boundaries are fluid, which has resulted in concepts such as 'semi-profession', and resulted in assertions to the effect that today all reasonably qualified occupations are professionalized. As a result the concept becomes rather meaningless and unusable (Brante 1988: 125).

Sciulli (2005a, 2005b, 2009, 2010, Sciully & Halley 2009) represents one extreme, advocating for the necessity of reaching a generally agreed upon definition of the concept of a profession independent of time and place; a definition that he generously provides. Sciulli's opponents generally find his project unrealistic (Torstendahl 2005, Evetts 2006, Svensson & Evetts 2010, Larson 2013). In particular the delimiting of a profession seems to be difficult:

[18] Flexner (2001) originally published his influential paper "Is Social Work a Profession?" in 1915, arguing that social work was not a profession, although it aspired to be and could eventually gain such professional status. Flexner's pursuit of a final list of attributes illustrates how the current debate is rooted in history. Cf. section 3.5 on professional identity for more on the chronological development of perspectives on profession and identity.

> Professions are historic and dynamic entities and hereby also complex entities which must continually be analysed and assessed as parts of the societal context of which they are part. Hereby also said that professions must be seen in the light of the conflicts and opposing interests that they find themselves in at any given time (Staugård 2011: 162 [translated from Danish])

Freidson (1983) is in favour of the argument that providing an exact, static definition to end the debate is not possible. At the same time he argues that the definitions must continually be sought for and made explicit in order to assure the foundation for scientific debate:

> … writers will differ, but they are unlikely to be able to debate the relative virtues of those differences if they are not self-conscious of what they are (Freidson 1983: 36).

In many ways, the difficulties involved in an exact capturing of the nature of being professional are embodied by the engineers and their identity problems amidst different societal challenges and tendencies of disintegration and expansion at the same time (see also Chapter 5 and Chapter 9).

For the sake of this dissertation it is not considered important whether a profession is clearly defined or not, nor is it important how the debate is settled. It is the clarification and identification of the contingent positions of this landscape in itself – with its static elements and dynamic positions – that contribute to enlighten the issue of the troubled professional identity of engineers. The following pages will clarify some of the elements proposed as defining traits or attributes of professionalism. Hereby a theoretical landscape is provided in which actual empirically derived engineering student conceptions of the engineering profession can be positioned.

3.4 Attributes of Professionalism

A range of scholars within the field of profession studies attempt to provide an attributive definition of professions[19]. Although the theorists providing such "list approaches" pursue universal validity of their profession approach, the definitional debate questions such static attributes. In this section I will focus on attributes of professional*ism*, indicating that an end position of acquired professional status may not be acquirable. However, at least, everyday use

[19] In a chronological order, the most prominent profession attribute listings may be those of Flexner (2001 [1915]), Greenwood (1957), Bennion (1969) and Sciulli (2010 and 2009). See also Fauske (2008) for more listings and an in-depth discussion of their historical contexts and interrelated role in profession studies.

of the concept of profession and the occupations' pursuit of professional status imply a conceived direction or ideal type professionalism to aim for. Whether or not they succeed in settling the definitional profession debate, the attributes imply such ideal type descriptions. I have included both attributes used to characterise "a profession" and attributes used to characterise the movement towards professionalism in a more dynamic perspective.

I have categorised the attributes found in the literature review into three main groups: The first group encompasses what Larson (2013) refers to as cognitive dimensions, e.g. different forms of knowledge. The second group of attributes are the mechanisms required to institutionalise professions *as* professions in society. Third, I list the attributes that are mainly profession-internal characteristics.

The sub-sections include discussion of the adequacy of each attribute in the case of engineering and cross-referencing to the dissertation's articles to guide the reader to empirical findings of engineering student positions relating to the different theoretical dimensions of professionalism.

3.4.1 Cognitive Attributes

Cognitive attributes of professionalism entail that certain cognitive capacities are considered a prerequisite for professional status. Actual cognitive "content" can take many forms, however the acclaimed knowledge-base of professions plays a large role in the construal of professionalism.

3.4.1.1 Scientifically Founded Knowledge

Among the oft-mentioned, required attributes of professions is a theory-based, intellectual and practical expertise (Greenwood 1957, Harrits & Olesen 2012, Saks 2012, Flexner 2001, Bennion 1969, Larson 2013, Freidson 2001, Sciulli 2010 and Sciulli 2009, Brante 2011). The acquisition of an education and passing of its tests and exams form the institutionalised means by which society assures a professions' uniform, codified knowledge base – "book knowledge", to use the term coined by Wackerhausen (2011: 13).

At the same time, the availability of information and a new, more risk-conscious status of knowledge produced under new conditions in the so-called knowledge society imply a massive reservoir of resources for professionals and laymen alike and a threat to the exclusive status of the professionals. Scientific knowledge no longer has universal status; uncertainty is inherent in professional work (Weber 2004, Jamison et al. 2011, Brante 1988, Abbott 1988: 52ff). In the pre-Internet age, Flexner (2001: 154-155) forebode a degeneration of the professionals' character, were they to rely – even in part – on generally accessible knowledge. The general availability of knowledge plays a major role in the everyday work practice of most contemporary professionals, and much public debate has taken place regarding the exclusivity of the competencies of e.g. teachers or social educators/pedagogues. For engineers, the ubiquitous nature of new types of technology, incorporated into otherwise non-technical areas of our lives and combined with other types of disciplinary knowledge, might not be an entirely identical issue, but it certainly adds new dimensions to the nature of these technology-directed occupations questioning the character and demarcation lines of their professionalism as opposed to both non-professionals and other professionals (see for instance Hjort 2011, Jamison 2009, Jamison & Heymann 2012, Jamison & Holgaard 2008 on the new modes of knowledge production and their professional implications). It is in the light of these socio-technical and techno-scientific changes in the role of knowledge and technology in society that some engineering education research calls for a change in the societal role of the engineer towards a more holistic role involving ethical questions and philosophy of sciences in an increased emphasis on the role of technology in society (Beder 1999, Beder 1998, Grasso 2002, Jamison 2009, Jamison et al. 2011, Jamison & Heymann 2012, Jamison & Holgaard 2008, Kolmos 2006, Christensen et al. 2006). Chapters 6 through 8 focus on different aspects of the relationship between the engineering profession and society, including the role of sustainability challenges in this relation from the point of view of the engineering students.

> What is at risk today, and likely to be at greater risk tomorrow, is the independence of professions to choose the direction of the development of their knowledge and the uses to which it is put (Freidson 2001: 14).

The mere use of technology e.g. by a technician is not considered sufficient to be professional.

> The execution or application of a thoughtout technique – be it crude or exquisite, physical or mental – is after all routine. Someone back of the routineer has done the thinking and therefore bears the responsibility, and he alone deserves to be considered professional (Flexner 2001: 154).

Abbott (1988) points to abstract knowledge as particularly distinctive of professions.

> only a knowledge system governed by abstractions can redefine its problems, and tasks, defend them from interlopers, and seize new problems ... Abstraction enables survival in the competitive system of professions. If auto mechanics

> had that kind of abstraction, if they “contained” the relevant sections of what is presently the engineering profession, and had considered taking over all repair of internal combustion engines on abstract grounds, they would, for my purposes, be a profession (Abbott 1988: 9).

For engineers to be considered a profession, a solid scientific knowledge-base is necessary, including abstraction and insight in research and theoretical progress as well as a meta-level understanding of the role of technology in society (Bomke 2003, Perrucci 1971, Abbott 1988).

Professionals distinguish from scientists, however, in that professional practice requires practical and tacit forms of knowledge in line with ideals of a profession’s application orientation.

The use of a distinction of the field of engineering in active opposition to that of scientists is an example of a potential issue of investigation that turned out not to be particularly pertinent among the engineering students’ ways of defining professional engineering, as mentioned in Chapter 5.

3.4.1.2 Practical and Tacit Knowledge

Practical and tacit knowledge are among the profession attributes contributing to the distinction between professionals and “pure” scientists or academics.[20] The practical, application-oriented approach is an important requirement for the professional status of an occupation (Flexner 2001, Freidson 2001).

> The instrument is an incident or an accident; the real character of the activity is the thinking process. A free resourceful and unhampered intelligence applied to problems and seeking to understand and master them – that is in the first instance characteristic of a profession (Flexner 2001: 154).

The practical application orientation of professionals is related to their role as intervening agents. Brante (2011:14) emphasises intervention as the professional’s *sine qua non* and an important demarcation between professionals and scientists (see also Abbott 1988: 40ff).

A clear demarcation line between the natural sciences and engineering activities can be impossible to make in practice, as Pawley (2009) notes, since natural science does not abandon the possibility of applicability and certain engineering activities can resemble what may be called pure science (see also Lehmann et al. 2008). The distinction is often a question of

[20] See Bourdieu (1987: 821) for an analysis of the ”structural hostility” between theorists and practitioners within the juridical field.

whether or not application is the declared aim of the activities in question (Pawley 2009, Williams 2003, Christensen & Kjølhede 2008).

The application focus of engineering requires other types of knowledge than natural science.

> Whereas the scientific aim is to generalise and explain across time and space, the professions typically have a practical objective … in concrete social and historical contexts … And whereas science studies the object systematically, the observations of the professions are often based on experience and tacit knowledge which is grounded in concrete situations, acts and in 'knowing how'… (Harrits & Olesen 2012: 11, translated from Danish).

The combination of codified academic knowledge with practical application-oriented knowledge is a continual challenge for the institutions responsible for educating the new professions.[21] In Denmark an academisation process has marked the landscape of professional educations (Hjort 2008, Smeby & Terum 2011). In the case of engineering education the previously separated lines of engineering oriented to academic and practical knowledge, respectively, have grown much closer and have in many instances been tied together because of the institutional merger of engineering colleges and universities (Christensen & Ernø-Kjølhede 2011).

While professionals apply science in practice, this is not all they do. A professional must "know that" (codified science-based knowledge), "know how"' (practical knowledge) (Grimen 2008), and be able to intuitively enact their professional role and knowledge when encountering new phenomena. This requires tacit knowledge, as Polanyi coined the term, which is not codified, verbalised and systematically taught, rather embedded in practical previous perceptions and experiences (Polanyi 2012, Grimen 2008, Harrits & Olesen 2012, Freidson 2001). Professional practice also involves discretionary judgement on the basis of available knowledge about the situation or problem at hand (Freidson 2001, Grimen & Molander 2008, Pahuus & Eriksen 2011).

New approaches to and developments within knowledge production (Gibbons et al. 1994, Nowotny et al. 2001, Jamison et al. 2011, Brown & Duguid 2001) imply that professionals may need to re-examine and re-legitimise their relation to knowledge in its various forms (Weber 2004, Hjort 2011). Becoming a professional involves learning *to be* as much as learning

[21] However, academic knowledge plays a somewhat smaller role in English professional traditions in comparison to the Continental development (Torstendahl 1994).

about (Brown & Duguid 2001, Wenger 1998, cf. section 3.5 on professional identity).

A mediating role between science and society is an intrinsic part of all professions. The societal pertinence of technology – the field of expertise of engineers – does not make engineers' relation to science and knowledge less complex.

3.4.1.3 Identifying the Cognitive Dimensions of Engineering Practice

How to define the specific cognitive dimensions (e.g. scientific, practical and tacit knowledge base) of engineering is probably the most disputed question in the engineering identity literature as well as the delimitation of activities that do not count as engineering. This sub-section juxtaposes the construal of a profession as based on certain cognitive "content" with the findings of my review of engineering education literature where engineering is identified as the conduct of engineering or "what engineers do". Mitcham (2009) stresses that such attempts to define engineering are in fact circular arguments defining engineering as the activities of an engineer or vice versa. Without fully escaping such a philosophical circularity, the conduct of engineering in this sub-section is considered to include practices, knowledge forms and competencies considered specific to engineers and institutionalised in the engineering profession (Pawley 2009).

The conception that engineering encompasses a core of disciplines and a range of contextual competencies is a central element in much engineering education literature (see e.g. Downey et al. 2007, TA 2009, Bowden 2004). An engineer is often depicted as someone with a theoretical foundation in mathematics and the natural sciences. These disciplines are described as instruments and prerequisites for the actual engineering focus, namely technology, more explicitly narrowed down to specific technologies depending on the engineering discipline (Downey et al. 2007). Some balancing of practical knowledge forms with a scientific knowledge base consisting of codified, formal knowledge marks the engineering identity (Heymann 2009, Jamison & Heymann 2012).

An increasingly wide conception of which knowledge and which subjects are satisfactory to gain an engineering degree challenges the engineering education system. Already in 1971, Layton mentions *"… a quantum jump in engineering knowledge"* in his first edition of *The Revolt of the Engineers,* analysing the history and trends of the American engineering profession (Layton 1986: 251).

In the engineering student survey a range of knowledge-based skills and competencies were presented to the engineering students. In Chapter 4 the engineering students' estimates of which types of skills and knowledge they find important for successful engineering is investigated in a cross-national comparison.

Engineers are criticised for their inability to care for the social context of their work (Bugiarello 1991, Bell 2011). Bell (2011: 3) points to the intangible nature of social life as an impediment for the inclusion of this field into engineering knowledge where a natural scientific rationale traditionally reigns.

The engineering students' perception of the social role of engineering is pursued in Chapter 7 and 8 and in part in Chapters 5 and 6.

Technology is the core and the object of engineering activities, but the importance of social and other non-technical activities are increasingly acknowledged (ABET 2006, Abraham 2006, Armstrong et al. 2007, Atman & Nair 1996, Christensen et al. 2009, Crawley et al. 2007, Hansen 2006, Henriksen 2006, Holgaard et al. 2006, Jamison 2009, Jamison & Holgaard 2008, Jamison & Mejlgaard 2010, Kolmos 2006, Sheppard et al. 2009a, TA 2009), although some dispute and hesitation can still be found (RAE 2007, Christensen et al. 2009). The non-technical or contextual elements of engineering play an important role not very well captured by their peripheral status, but more exact definitions and delimitations of them and the practices and competencies to which they relate are not uniform. The remainder of the sub-section provides an overview of the most prominent of the contextual elements found in the literature on engineering identity. A range of them recur in the empirical findings as investigated in Chapter 5 on the engineering students' own characterisation of their profession and in Chapters 6 through 8 more specifically focusing on sustainability and societal challenges.

Construction seems to be an important part of engineering; the technical activities are guided by the aim of building or making (material or immaterial) things – not by a wish to deconstruct, understand or explain technical functionality (Williams 2003, Pawley 2009). Carew and Mitchell (2008) suggest that construction activities correspond to the most basic level of needs in Maaslow's hierarchy being the primary motivation and raison d'être for the engineering profession. Mitcham (2001) points out the dual nature of construction encompassing both a requirement of technical skills and a range of creative and aesthetic competencies.

Creativity is part of the design discourse that is widely understood as an important engineering paradigm. Design is often a very inclusive concept that comprises a creative branch, as well as a process-oriented focus on professional engineering skills such as communication and project management and a more institutionalised way of considering e.g. the surrounding environment, legislation, policy and end users in the engineering construction process (Crawley et al. 2007, Kilgore et al. 2010, Christensen & Ernø-Kjølhede 2008, Schrøder 2006, Di Gironimo 2011, Pawley 2009, Williams 2003, Beder 1998). Williams (2003) relates design to an entrepreneurial engineering approach. Much literature discussing the engineering profession emphasises entrepreneurship, innovation, market-orientation and the consideration of profitability as important contextual engineering competencies (Jamison & Holgaard 2008, Christensen & Ernø-Kjølhede 2008, Jamison 2012, TA 2009, Sheppard et al. 2009a, Kolmos 2006, Jørgensen 2007, Henriksen 2006, Holgaard et al. 2006, Crawley et al. 2007).

Another fundamental aspect of engineering practice seems to be problem solving. Not only is the solution of problems with a practical relevance and impact important to the self-understanding of the profession's societal role and purpose, the actual practice of dealing with problems, how to conceive of them, how to delimit them, how to deconstruct and approach them etc. is at the forefront of much of the theory on engineering education and engineering studies (ABET 2006, Abraham 2006, Atman et al. 2007, Bowden 2004, Christensen et al. 2009, Crawley et al. 2007, Hansen 2006, Henriksen 2006, Holgaard et al. 2006, Jamison 1997, Jørgensen 2007, Kilgore et al. 2007, Sheppard et al. 2009a, TA 2009, Williams 2003). In Denmark, the two most influential engineering education paradigms, Problem-Based Learning (PBL) and Conceive-Design-Implement-Operate (CDIO) each present a way of solving engineering problems (Crawley et al. 2007, Edström & Kolmos 2012, Lehmann et al. 2008). Nonetheless, it is not always clear what is meant with "a problem". The nature, scope and complexity of a problem are not clear-cut, which equally applies to the nature of the stakeholders of the problem-solving activities, often referred to as "the society". Furthermore, the emphasis on problem-solving activities seems to ignore "bad" technology, e.g. in military fields (Pawley 2009, see also Mitcham 2009). The engineering student approaches to societal problem solving and the concept of sustainability are explored in Chapters 6 through 8.

3.4.2 Attributes Institutionalising Professions in Society

Some of the attributes of professionalism seem to characterise the way in which professionalism is institutionalised in society. The first two attributes of this type concern the vertical structuring of the professions in society, whereas the following attributes describe more hierarchical/stratifying mechanisms structuring different professions and non-professional occupations alike (see Harrits 2011 for more elaboration of this analytical distinction).

3.4.2.1 Specialisation and Division of Labour

Specialised tasks are also a profession attribute (Sciulli 2009, 2010). The provision of a specialised work force is among the functions of the professions. The professionalisation process involves a functional specialisation in the social division of labour characteristic of industrialised societies (Parsons 1939, Larson 2013, Abbott 1988, Freidson 2001). In theory, the functional differentiation of labour assumes a differentiation of heterogeneous fields of work into different specialised occupations or professions, each attending to internally homogenous functions. The specialisation of a profession implies a high degree of knowledge regarding its particular field of expertise.

> A professional man is held to be "an authority" only in his own field (Parsons 1939: 460).

In comparison to other professions, engineering stands out as specialised, but not internally homogenous. The engineering knowledge base is less homogenous than that of most other occupations labelled as professions, and, similarly, the role of engineers in the functional division of labour is more diverse according to the variety of different types of engineers (Meganck 2003, Larson 2013).

> There was not ... one earlier type out of which the modern engineer developed, nor one single functional area ... but different specializations which separately gave rise to present-day engineering specialities (Larson 2013: 26).

This fragmented nature of the engineering profession and the labour that constitutes it possibly contributes to a blurring of the professional engineering identity; in particular of its unity and coherence. The professional engineering identity, as it is conceived of by the engineering students, is investigated and related to the theoretical discussion of its coherence in Chapter 5. The conceived threats to the engineering profession cause some engineering education policy making in favour of a conservative insistence on traditional engineering deeds (RAE 2007). On the other hand, a countermovement seems to be gaining ground in engineering education theory and policy, calling for a more generic approach to the social function of the profession, emphasising interdisciplinary skills, cross-fertilisation and hybridisation (Jamison et al. 2011). As the uncertainty about future requirements has become a precondition (Bourg 2003, Bauman 2001, Brante 1988), continual efforts to adapt to new requirements are becoming increasingly important; specialisation turns into a career-long project emphasising the concepts of CPD, continual professional development, and LLL, life-long learning (Evetts 1998, Christensen et al. 2006, Wenger 1998, Hjort 2008, Hjort 2004, Lave and Wenger 1991).

3.4.2.2 Professional Relation to State and Market

The professions' affiliation with state or market is discussed in attributive theoretical approaches. In Anglo-American profession research, a profession is more of a "true profession" if its members belong to the private sector and operate freely on the market (Bennion 1969). This argument is intricately related to its national labour market context and the times in which it is stated. As Larson writes:

> The model of profession … was originally shaped by the historical matrix of competitive capitalism. Since then, the conditions of professional work have changed, so that the predominant pattern is no longer that of the free practitioner in a market of services, but that of the salaried specialist in a large organization (Larson 2013: xviii).

The three professions often described as "traditional" are Medicine, Law and Clergy (Perrucci 1971, Freidson 1983). These professions have contributed remarkably to the formation of Western nation states. Engineers and the state are still mutually dependent on one another in the same way as other professions. The engineers perform the function of contributing to the solution of a range of state problems. At the same time, the state exercises a symbolic power over the engineering education system that secures the legitimacy and exclusivity of the engineering profession (Harrits & Olesen 2012).

In the Scandinavian context, "where market control is less central", as Saks (2012: 4) points to, the so-called semi-professions, such as nurses, teachers and social workers, continue to be crucial elements of the welfare state (Etzioni 1969, Dahle 2008, Evetts 2011 & 2008, Brante 1988). The interrelated nature of state and profession in these countries includes the professions' crucial importance for policy implementation and social cohesion, on the one hand, and the state-authorised privileges and exclusivity of the professions on the other (Harrits & Olesen 2012). This means that the notion of a professional third logic does not stand in direct opposition to neither state nor market, as is the case in Freidson's ideal descriptions (2001).

A somewhat disputed parameter for professionalism is whether or not employee status (as opposed to self-employment) discredits an occupation's professional aspirations (Bennion 1969). The reason for attributing higher professional status to self-employed members of an occupation is the conviction that self-employment leads to reduced dependency on one's employer and maximised liability to the clients (Bennion 1969). On the other hand, depending on an earned salary in a so-called entrenched position (Sciulli 2010, Sciulli 2009) may not bring about less dependency than the dependency of attracting a satisfactory amount of clients/customers/problems and perhaps also workforce to continue to be self-employed. As Freidson (2001) points out, the subordination of occupations to either managers or customers involves reduced autonomy, which makes the professional status, with its own third logic, such an attractive alternative. The degree to which the profession has control over its own work and acts in autonomy on the labour market thus seems to be a considerably more important profession attribute than the employment status in itself.

The professional project aims at market shelters or monopoly (Larson 2013) and the power to assert the professional position in jurisdictional disputes (Abbott 1988). According to Abbott (1988), professional actions can be construed as navigating in a system of professions with work at the centre. The professions are socially divided and relate to their work in what is termed "jurisdiction". Professions make jurisdictional claims through public opinion, in the legal arena or at the workplace. This means that different professions compete with various means to win the jurisdiction, the formal or informal right to acclaim some areas of work "their" work, "their" field of expertise, and exclude or subordinate other professionals (Abbott:1988: 59ff). Abbott (1988) provides an example of an interprofessional division of labour between engineers and architects:

> Although architects retain full division over the design of buildings, they increasingly divide their work with lawyers, various types of engineers, and even accountants. Each of these groups – particularly the engineers – takes full responsibility for its part of the assembly of a buildable building. The architect retains control of the design and overall oversight of the project, and normally negotiates the construction itself with the builder and the client. This apparent reduction in the jurisdiction of architects – who one hundred years ago did their own engineering – reflects the developing complexity of the task (Abbott 1988: 73).

The engineering profession stands out from most other professions in Denmark in terms of its loose coupling with the state; neither state nor market affiliation is characteristic of engineers which makes sector criteria an inadequate profession attribute in a Danish context. The occupationally controlled labour market (Freidson 2001) mediating between these two sectors is characterised by horizontal ways of shifting career position in a movement towards more central roles in the social network or shifts to other workplaces as opposed to a bureaucratic career path offering vertical movement – advancement – in firm hierarchy as a result of promotion. This profession's internal division of labour points out a dilemma of particular importance to many engineers between their discipline and the advancement to supervision and management jobs (Freidson 2001, Abbott 1988, Beder 1998); a dilemma specifically addressed in many new engineering education curricula, which seek to include management among the disciplinary aspects, possibly resulting in a widening of the engineers' professional jurisdiction or a blurring of the image of their profession. The role of such a management/leadership focus in the professional engineering identity as construed by the students is further elaborated on in Chapter 5. Various aspects of market orientation and public service orientation are included in the survey to probe the influence and prevalence of such perspectives within the engineering student professionalism construal. Among other skills and abilities, the engineering students are asked to assess the importance of business ability to engineering in Chapter 4. Economy and profit are also found to play a role in the engineering student understanding of sustainability (Chapter 6) and for how they approach sustainability as future engineers (Chapter 7).

3.4.2.3 Power, Prestige and Privilege

Professional knowledge is linked to central societal functions, which makes it an esteemed resource (Parsons 1939). As a consequence of the professional exclusivity and unequal knowledge distribution between members and non-members of a specific profession, there is also an unequal power relation between them (Larson 2013, Vågan & Grimen 2008, Freidson 1971: 28). Knowledge-determined power is at the core of much research within the sociology of professions, and power aspects are considered to challenge knowledge as the field's main perspective (Paquette 2012, Harrits & Olesen 2012). Apart from the economic, political and legal sources of social power, the professions also hold symbolic or discursive power, since the exclusivity of their knowledge gives them the power to determine "truth" in public (Brante 2011, Bertilsson 1999, Abbott 1988: 62, Saks 2012 and 2010).

The privileged position of the professional consists of a monopoly of competence and a shelter for market forces (Larson 2013) as well as *"... direct control by specialized workers themselves of the terms, conditions, goals, and content of their particular work."* (Freidson 2001: 60, see also Evetts 2009, Abbott 1988: 60). Furthermore, due to its status as the prime knowledge bank in the specific professional field, the profession is also fairly immune to lay judgment on matters referring to its field; only professionals can rightly evaluate the quality of their peer professionals' work (Greenwood 1957, Freidson 2001, Christensen 2003, Vågan & Grimen 2008). The power and privileged position of professionals is subjected to study as well as critique. Most notably, perhaps, in the works of Foucault (for instance on surveillance and punishment (Foucault 1995a) and mental illness (Foucault 1995b)) and Larson (2013: xix) who in retrospect in the recent introduction to the 1977 publication *The Rise of Professionalism,* explains that *"Experts were suspect."* Among other things, Larson (2013) critically reviews the convergence of the ruling classes with professionals.

The professions receive a high status and authority in return for their importance to society. Occupations listed as professions are traditionally endowed with considerable prestige (Parsons 1939, Harrits & Olesen 2012, Larson 2013, Brante 2011). Considerable symbolic value is attributed to the professions, in part due to their construed monopoly of certain types of knowledge rooted in academia, which legitimise them and lend a cultural value to them (Abbott 1988: 52ff). *"Sometimes professional groups are also elites with strong political links and connections …"* (Evetts 2011: 6). Traditionally, professionals have had high status and economic resources (Larson 2013). This is the focus of critical studies of the mechanisms of social closure (Abbott 1988, Witz 1990, Dæhlen & Svensson 2008, Bourdieu 1987, Saks 2012) as well as of Bourdieu's (1987, 1988, 1995a) field theory, emphasising the positional forces of professional agents with their specific forms of capital.

The engineering profession generally upholds high societal prestige, as wage levels and more popular credibility measurements indicate (e.g. Radius 2010, Rosendal 2013a). Prestige markers and socially acknowledged symbolic value emerge as a factor among a minor part of the engineering students' characterisation of the professional engineering identity, as presented in Chapter 5. Such societal valuation is partly related to the motivation to study engineering, which is encompassed in the empirical investigation and analyses presented in Chapters 4 and 7. The ambivalent societal implications of technological development may pose a threat to the professional pride and societal status of the engineers, as presented and discussed in Chapter 6.

Perrucci (1971) points out engineering as a particular profession with comparatively low levels of social power in terms of limited possibilities to *"determine what he works on and how he works on it"* (Perrucci 1971: 124) and a lack of exclusive jurisdiction, meaning that non-engineers are not excluded from engineering work (Perrucci 1971, Meganck 2003).

Given that engineering students – not professionals – are under investigation in this study, eventual power aspects lie not in the actual execution of professional engineering.[22] Instead, a critical discussion of the interplay of the engineering education system and engineering students in the learning process that ideally should contribute to the provision of future engineers with a sense of societal responsibility and urge inculcated in their professional identity can be found in Chapter 9.

3.4.2.4 Professional Training and License

Educating the professions is an influential endeavour that secures and controls recruitment and (re-) production of the profession. In an ideal-typical professionalism power over professional education resides within the profession under state-authorisation.

> Unlike a purely technical education, ideal-typical professional training provides or requires prior exposure to high culture in the form of advanced general education (Freidson 2001: 121).

License or certification granted by a state or professional association in a formalised exchange relationship serves as a gatekeeper to many professions (Dingwall 1983). Licensing is a way of securing that practising professionals have the necessary level of knowledge or the required professional education. It characterises professional work from non-work spheres, secures professional exclusivity and legitimises a professional authority (Greenwood 1957, Dingwall 1983: 5).

An important implication of professional education is its contribution to the professional identity formation, which is, however, a process involving subsequent work place or community socialisation and stretching considerably into the professional trajectory (Axelsson 2008, Evetts 1998, Christensen et al. 2006, Wenger 1998, Hjort 2008, Hjort 2004, Lave and Wenger 1991).

The engineering title is not protected in Denmark. Anyone can call themselves an engineer. Only the specific educational title, e.g. “Master of Science in Engineering” or “Bachelor in Engineering”, not directly relating to actual work, is legally protected.

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[22] Social mobility and the intergenerational influence on the educational decision making of engineering students may be a focus of further research, since self-reported socio-demographic data on the respondents’ parents are available, although not included within the scope of this dissertation.

Until recently, all Danish higher education programmes including those in engineering education, had to be accredited. Since July 2013, the accreditations have been awarded on institutional level instead (Hansen forthcoming). It is too early to assess the eventual effects of this change e.g. on the prestige of the educations.

3.4.3 Profession-Internal Attributes

The last group of attributes of professionalism I will present based on the review of sociology of professions literature focuses on profession-internal characteristics of professionalism.

3.4.3.1 Professional Association

Self-organisation (Flexner 2001), collegial form of organisation (Sciulli 2010 and Sciulli 2009) and representative institute (Bennion 1969) are among the listed professional attributes. The formation of professional associations is considered an important professionalisation strategy. To gain status as a profession, members of an occupation may form associations (Larson 2013, Abbott 1988). These professional associations often play an active role in policy and decision-making in relation to licensing as well as in the education system. The creation of an association is one of multiple social strategies of a profession that contributes to the status and exclusivity of the profession. Historically, the professional association has been activated in the jurisdictional battlefield between different professions in the effort to both expand market opportunities and shelter a profession from the occupations competing with it for a role in its market (Larson 2013, Freidson 2001).

Danish engineers have a relatively weak professional association when viewed in the light of formal professional strategic behaviour. There is no mandatory membership of the only all-encompassing Danish engineering association, IDA (Ingeniørforeningen i Danmark; in English: The Danish Society for Engineers) nor does it have any licensing mandate. It is a trade union for technical and scientific professionals, albeit with an explicit aim of influencing policy making. Moreover, a range of organisations such as the Danish Association of Consulting Engineers (Foreningen af Rådgivende Ingeniører), the Danish Association of Dairy Engineers (Dansk Mejeriingeniørforening), Danish Geo-technical Society (Dansk Geoteknisk Forening), Engineers Without Borders and the Danish Concrete Society (Dansk Betonforening) represent more specialised interests within the engineering profession or the disciplines to which it relates. An exclusive, professional focus of these organisations is not found. On the contrary, membership is inclusive, interest-based.

3.4.3.2 Responsibility and Service

The public service motivation of professionals is a very fundamental part of "being professional" and an oft-mentioned profession attribute (Parsons 1939) along with formal and informal rules of appropriate, professional behaviour (Greenwood 1957). The professed "good behaviour" of the professional person is a *quid pro quo* for the socially granted authority and status of the profession. Professional ethics can be informal and unwritten, but many professions have institutionalised codes of conduct, perhaps most notably the Hippocratic Oath within medicine. Professions are given privileges, social authority and generally a large degree of freedom in their work practise including the performance of discretionary judgement in return for the fiduciary responsibilities charged upon them (Freidson 2001, Grimen & Molander 2008, Pahuus & Eriksen 2011, Sciulli 2009, Parsons 1952).

> … the right of discretion implies being trusted, being committed, even being morally involved in one's work (Freidson 2001: 34).

Professionals are even morally obligated to "claim the right to make choices for their patrons, to be independent of them, even to violate their wishes" (Freidson 2001: 122).

Danish engineers as a profession do not share a common code of conduct. This does not rule out that some may be employed in firms that have formulated such ethical regulations, although most likely valid for a more inclusive group than the professional engineers. As a profession attribute, this characteristic is not found among Danish engineers.

Engineers hold a considerable responsibility for technological progress and the development of modern day society. After the atrocities of the Second World War, when unquestioning engineers contributed to the development of military and extermination technology, engineering professionals received criticism (Freidson 2001: 129ff, Bomke 2003). Ethical obligations do seem relevant instruments in society's exchange relationship with the professions. And as a response to the risks posed to society by industry and technical innovations, the formation of ethical codices pertaining to engineering have become increasingly common. These codices emphasise the ethical obligations of an engineer going beyond serving state interests; an engineer should serve general society and mankind (Ambler 2009, Downey et al. 2007, Mitcham 2009, Wisnioski 2009).

The seemingly inappropriate absence of a formal ethical obligation of Danish engineers is possibly related to the fact that practising engineers have a more complex relation to clients/customers/end users than a physician[23], for instance, which renders it difficult to hold someone professionally responsible for eventual misconduct, regardless of any formal codex. Larson (2013: 26-27) argues that conflicting loyalties and responsibilities have become common ingredients in engineering practice. However, the complex practical context does not make ethical conduct less important. Herkert (2009) calls for a distinction between micro-ethics – an individual responsibility – and macro-ethics – desired collective concerns of the engineering profession – for instance in relation to climate change, intergenerational equity and international justice. Herkert (2009) argues that the macro-ethical perspective has been somewhat overlooked and must be addressed by engineering education.

Professional public service orientation and a professional responsibility will be further addressed in Chapters 6 through 9. Chapter 6 finds and discusses an example of a dilemma that places the engineering students between seemingly irreconcilable rationales, and Chapter 8 assesses the relative prevalence of different views on the engineering role in society.

3.4.3.3 A Community of Discourse

The conception that members of a profession have cultural traits in common and can be considered a community is widespread (Greenwood 1957, Larson 2013, Sciulli 2009, 2010, Flexner 2001). *"A profession is a brotherhood ..."*, Flexner (2001: 155) comments.

In general, culture is considered an important identity aspect (Barnett 2009, Christensen et al. 2006, Gee 2000, Lave & Wenger 1991, Wenger 1998) and studies of cultural aspects of the engineering identity are manifold (Allie et al. 2008, Becker 2010, Bowden 2004, Christensen et al. 2006, Christensen & Ernø-Kjølhede 2008, Downey et al. 2007, de Graaff 2009, Godfrey & Parker 2010, Jungert 2011, Loui 2005, Mann et al. 2009, Mitcham 2009, Williams 2003, Wisnioski 2009, Sheppard et al. 2009a). Cultural or community aspects of a profession encompass the symbolic meaning ascribed to a range of profession-specific approaches or practices, ways of thinking or being. These intangible aspects neither deal with the purpose nor the actual tasks of the profession, pertaining instead to the lifeworlds of the professional.

[23] A comparison of engineering with the medical profession project is found in Larson's (2013: 25ff) influential contribution. As a footnote to her comparison, the rise of a new (sub-?)profession within the field of bio-engineering or life sciences may be on its way to challenge the boundaries and jurisdictions of both medicine and engineering. At the same time, this is a very value-laden field which emphasises the need for ethical guidelines (e.g. Bertilsson 1999).

Such cultural elements of the professional identity are considered discursively constructed in interaction with others in communities (Allie et al. 2008, Case 2004, Gee 2000, Jungert 2011, Stevens et al. 2008, Lave & Wenger 1991, Wenger 1998). The engineering students under investigation in this dissertation are not – yet – members of a community of engineering; they may have acquired a sense of belonging to a community of engineering students at the time of the second intervention. This means that their discourses are not consistent with those of practising engineering professionals. They are only at the early stages of inculcating (Fairclough 2003) engineering discourse and participate in the periphery of the professional community of practice (Lave and Wenger 1991); given that such a community can be identified. They aspire to become full members of a community of professionals (Brown & Duguid 2001). Analysing their discourse, opinions and values provide no insight into the identity of engineering professionals. Rather, it shows how engineering students – prospective engineers – conceive of professional engineering; how they construe and anticipate the professional engineering identity to be. The engineering student surveys serve as a starting point, identifying this peripheral perspective on the professional identity.

The focus on professions as communities of discourse also involves the notion of professional identity as something that is socially produced and reproduced in part by means of speech acts[24] – certain types of communication – of discourse. In order to become a full member of the profession, the novices undergo a socialisation process whereby the professional discourse is inculcated in them (Gee 2000, Allie et al. 2008, Fairclough 1989, 1992, 1995, 2003, Atman & Nair 1996, Kilgore et al. 2010, Wenger 1998)[25]. These language patterns become intricately interwoven in their ways of thinking, their culture, hence Brown & Duguid's reference to the learning process as enculturation (Brown & Duguid 1991: 48). Becoming an engineer is often considered an identity formation process involving an acquisition of engineering discourse and engineering ways of thinking and doing (Atman et al. 2008, Brown & Duguid 2001, Case 2004, Christensen et al. 2006, Godfrey & Parker 2010, Jungert 2011, Stevens et al. 2004, Wenger 1998). The identity formation and its socio-cultural processes are also referred to as *Bildung*, a German notion focusing on holistic, personal development and democratic

[24] For more on the concept of speech as acts see Austin (1997) and Searle (1971).
[25] The underlying assumption of the dissertation – that it is meaningful to consider engineering students sources of information about their views – relies on similar notions of common patterns of language. See Chapter 2 on the methodological foundation of the thesis.

citizenship and relating to professional responsibility (Christensen et al. 2006, Solbrekke 2008).

Certain notorious cultural characteristics or stereotypes are given attention in engineering identity literature, since they are suspected of negatively affecting the attractiveness of an engineering education in the eyes of potential new students (e.g. Becker 2010, Faulkner 2007, Lee 2005, Tonso 2007). The stereotypical trait most often discussed in this manner is that of an engineer as a narrow-minded, anti-social nerd (Tonso 2007, Jungert 2011, Avila & Arias 2007). Godfrey & Parker (2010) identify a number of other cultural engineering characteristics in their New Zealand-based case study. One is a certain way of thinking characterised by the use of mathematics like a language much similar to what Pawley (2009) identifies among ten faculty members at a school of engineering at an American university. Secondly, Godfrey & Parker (2010) find the engineering way of thinking marked by a form of communication based on visual or graphic elements rather than words. They also point to an experience of hardship and endurance in relation to the demanding workload and a high degree of difficulty as "tests of manhood" contributing to the exclusivity and status of the engineering profession in the eyes of the engineering students (Godfrey & Parker 2010). Bomke (2003) and Jungert (2011) also compare the role of hardship and endurance with symbolic initiation rites that contribute to the common understanding of engineering as a demanding field exclusively for particularly talented people.

Engineers are often described as belonging to a male community with gendered cultural characteristics ascribed to it.[26] A range of welfare professions are also gendered, but female. These are sometimes referred to as semi-professions. This is a highly value-laden notion, assessing these types of occupations against the "real", full professions that are all mainly male (Dahle 2008). Authority and power (once "naturally" found among men) are often unconsciously interpreted as masculine traits, which can be an obstacle for women crossing over into male professions, and professions turning from male into female professions lose prestige and status (Dahle 2008, Hølge-Hazelton 2004, Dæhlen & Svensson 2008, Evetts 2011, see also Witz 1990).

[26] The gendering of the field of engineering opens up a large potential for gender-focused studies. This focus has not been pursued as an objective in itself within the scope of this dissertation, although the collected data does hold potentials of exploring gender perspectives, as presented in Kolmos et al. 2013. Sex is an important control variable, however, and gender differences are analysed.

The engineering student discourse and cultural characteristics of the engineering profession, as the students construe them are the focus of Chapter 5.

3.5 The Concept of Professional Identity

This section will address the issue of professional *identity* more specifically. Research on professional identity formation spans a range of approaches to identity, e.g. in psychology and cognitive learning theories (Heggen 2008, Wenger 1998, Lave and Wenger 1991). In higher education research, professional identity is not very densely covered, as Trede et al. (2012) find in their review. From a sociological perspective, theory on professional identity is a fractured landscape rather than a neat, coherent unity. Professional identity can be construed and approached in a variety of ways. This section establishes an overview of some of the fractions forming the landscape when focusing on professional identity. Hereby, some of the aforementioned general approaches to professions are summarised.

3.5.1 Functionalist Perspective

Functionalist notions of a profession are restrictive and delimit occupations that do not meet certain requirements for the acquisition of this label, hence the term “list approach”. The listed profession attributes are largely rooted in the characteristics of law and medicine that are among the occupations traditionally conceived as professions (Perrucci 1971). Functionalist studies of professional identity emphasise the role of professionals as a social elite crucial to societal cohesion and with a socially recognised prestige (e.g. Parsons 1939). Functional approaches to professions have been criticised, however, for an excessive reliance on actual, but contingent developments. Allegedly, they fail to provide a (historic/cultural) context-independent understanding of professions and are intolerant toward institutional and societal challenges in modern day societies marked by rapid change (Fauske 2008, Bertilsson 1999).

3.5.2 Interactionist Perspective

A more inclusive concept of professional identity is found among interactionist contributions to sociology, where professional identity seems to be a more dynamic concept developing under collective influence in the actual social context. Within these types of approaches, professional identity has to do with individual career choices as well as social trajectory and highlights the inner life of professional groups and the cultural dimension of work life (Paquette 2012). The identity concept has an immanent dual meaning, since it underlines both the cohesive nature of a "self" – what one identifies with – and the notion of something other than "self" that is inherently different. Jenkins (2006) investigates this interrelation of individual and social groups in the formation of an identity. Bourdieu (1995a, 1995b, 1988 and 1987) focuses on the social mechanisms and distinctions used to position such a "self" in social fields.

3.5.3 Power Perspective

A variety of profession studies share a focus on power. This composite focus sheds light on the strategic, political and institutional roles of professional identity as well as its historic emergence (see Larson 2013 for professionalisation as a *"professional project"*), the interest groups influencing it and the disciplinary processes of socialisation reproducing it (e.g. Foucault 1995a, 1995b, Bourdieu 1987, Macdonald 1995, Leicht & Fennell 2001, Paquette 2012).

3.5.4 French Sociology of Labour Perspective

In French Sociology of Labour, professional identity has played a main role in the nexus between collective identities and new individualistic values of the workplace.

> … professional identities represent patterns of negotiation between an individual's social aspirations, desires, expectations, and the different forms of socialization one encounters. Professional identities are inherited, learned, attributed, and sometimes rejected by the individuals who enter a professional world. Professional identity is, as such, a double operation that consists of both identifying with and establishing a distinction from certain values and norms (Paquette 2012: 10).

3.5.5 Behavioural and Cultural Perspectives

Both behavioural and cultural approaches contribute to the understanding of identities in the professional/workplace context. The collective values and norms of a profession are at the centre of some professional identity conceptions investigating what constitutes professional communities and a professional conduct, sometimes at an individual level sometimes at organisational levels (Paquette 2012, Wenger 1998). A more recent discursive[27] turn includes studies on professional discourse, cultural inculcation or the socialisation of professional identity and narrative professional identity (Evetts 2011, Bomke 2003, Wenger 1998, Paquette 2012, Olesen 2001, 2006).

> This shared professional identity … is associated with a sense of common experiences, understandings and expertise, shared ways of perceiving problems and their possible solutions. This common identity is produced and reproduced through occupational and professional socialization by means of shared educational backgrounds, professional training and vocational experiences, and by membership of professional associations … and institutes where practitioners develop and maintain a shared work culture (Evetts 2011: 4-5).

3.5.6 Professional Identity in this Study

In the current study, an inclusive conception of professional identity has been a priority. The investigation of engineering students in their first encounter with the professional field as it is presented to them not by professionals in practice but by the education institutions by means of curricula, culture etc. provides insight into the early stages of the professional identity formation of these future engineers. The first data collection in advance of their actual studies is considered to identify their conception of the engineering identity construed as prior understandings, expectations and pre-conceptions of professional engineering and its societal role. A preliminary picture of engineering student understandings of the professional engineering identity at the end of their first year is provided in Chapter 5 on the basis of their keywords characterising an engineer. Chapter 4 focuses on engineering student assessments of the skills it takes to become a successful engineer, whereas the Chapters 6 through 8 deal with the role of sustainability and societal challenges in these emerging professional identities.

A fundamental challenge to educational institutions, as well as the individuals passing through them, is the expectation that a professional identity can no longer be a static phenomenon; perhaps a multitude of shifting pro-

[27] What Evetts (2011) identifies as a "discourse of professionalism" is not concurrent with my characterisation of a discursive turn. After a critical analysis, Evetts (2011) concludes that the term "professionalism" is used as a strategic, disciplinary tool in management and other occupational settings. Hence, from my point of view, this perspective is tied more closely to power aspects of professional identity studies, whereas my referral to a discursive turn comes closer to what Evetts (2011:4) considers a focus on "… shared professional identity".

fessional identities or roles may better suit a fluid world. Identity formation becomes an ever-changing, dynamic process marked by continual adaptation, mobility and change in order to meet requirements of the labour market, as well as societal challenges at large (Bauman 2001, Bourg 2003, Jamison & Heymann 2012, Jamison & Mejlgaard 2010, Jamison 2009, Konkola et al. 2007, Trede et al. 2012, Buckingham 2008). Bauman (2001) claims that identities have become "liquid", open to constant creation and recreation.

The dynamic nature of the societal challenges facing the workforce seems to be especially pertinent to the engineering profession due to the omnipresence and influence of technology in modern societies, which places a large responsibility upon engineers as technology professionals (Buch 2012, Buch 2011, Jamison 1997, Jamison 2012, Jamison & Heyman 2012, Jamison & Mejlgaard 2010, Petroski 2008, Sheppard et al. 2009a, Williams 2003, Wisnioski 2009).

3.6 Engineering as "Failed Profession"?

This section discusses some of the implications of theorising about engineering through the sociology of professions perspective and summarises the theoretical contribution of the chapter to the rest of the dissertation.

In spite of its oft-mentioned status as among the "full" professions, engineering seems not to be anywhere near medicine or law when it comes to fulfilling the criteria of the list approaches. This causes Brante (2011:8; 1988:125) to refer to engineering as a "failed profession". With an attributive measure, this referral does not seem inadequate. The field of engineering in Denmark is not characterised as an archetypical profession in terms of cognitive dimensions, institutionalising dimensions or internal characteristics.

Engineering may have a close relation to scientific and other knowledge forms, but engineering knowledge is not particularly homogeneous, since the engineering field is divided into a multitude of branches with their own specialised fields of knowledge.

Considering the societal impact of technology, the engineers have not been accordingly successful at their professional project. They have neither succeeded in safeguarding their jurisdiction and exclusivity nor been granted particularly enviable power and privilege in the market or in a bureaucratic context. Danish engineers do not have any formal licensing, and their professional association is weak compared to other labour market forces.

Engineers stand out from most professions when judged by their occupational orientation. They are considered more subordinate to market forces than other professions. The role of economic profit is therefore less marginalised in their professional practice. Their capability of controlling their professional market is limited due to the subordination to industrial development, considerations of accounting and business profit. Hence, economic profit becomes an important motive for engineers (Larson 2013: 29).

Furthermore, dealing with risks is inherent to professional practice. – The risk of miscalculations causing the bridge to collapse, the risk of misjudging the consequences of an intervention, the risk of discovering adverse effects of the seemingly harmless chemicals used in industrial production, the risk of contributing to local recession and the unemployment of certain groups (Bertilsson 1999, Layton 1986, Beck 1997). Hence, professional dilemmas between the diverse orientations by which the engineers may feel obligated seem increasingly relevant for this profession.

The engineering image appears to be schizophrenic; on the one hand, the engineering profession is acknowledged for its importance and influence in society, on the other hand, a negative, prejudiced conception of the engineer, still, prevails.

> It is debatable whether or not engineers are such a homogeneous group that they can be studied in aggregate. It is far from clear that a civil engineer designing sewerage works in a government department has anything in common with an electrical engineer commissioning a power station or a mechanical engineer testing a new product for a private company. What reason is there to suppose that these engineers have similar personal characteristics and backgrounds, experience similar workplace constraints, hold similar ideologies and values, or subscribe to the same idea of professionalism? (Beder 1998: 13).

The combined theoretical perspectives have provided some preliminary answers to the questions about what engineering could be, and how normative ideals of sustaining society could interrelate with conceptions of professional engineering identity.

Thus, the theoretical contribution from sociology of professions presented and discussed in this chapter provides a frame of reference for understanding and discussing engineering student navigation in this landscape of contingent, definitional positions.

On this background, the professional engineering identity from the point of view of newly enrolled engineering students will be investigated empirically. What do they anticipate engineering to be about? What professional role do they foresee for themselves? What role do societal challenges play in these imagined identities? Can a collective professional engineering identity be identified and sustained that includes all of the diverse engineering fields at the same time as it succeeds in excluding interrelated non-engineering fields? Or is the engineering profession at risk of de-professionalising or defragmenting into sub-professions?

4.
What Does It Take to Become a Good Engineer? Identifying Cross-National Engineering Student Profiles According to Perceived Importance of Skills

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5.
Narrow-Minded Nerd or Indispensable Source of a Future-Proof Society? Engineering Students on Their Professions

Abstract
The unflattering notion "nerd" is often associated with the engineering profession. In this article engineering descriptions made by future engineers are examined and a far more nuanced and positive understanding of the role of the engineer in a complex society is uncovered, although with variation between students from different educational environments.
Engineering education theorists suggest that the professional engineering identity is disappearing or defragmenting. By means of quantitative and qualitative textual analysis of survey-based keywords it is investigated how a year group of Danish engineering students conceive of an engineer and if they share common conceptions of the engineering identity.

Keywords: profession, societal role of engineers, engineering identity, engineering students, survey analysis

Introduction
Engineering professionals, faculty members and researchers have been involved in an ongoing debate on the engineering identity. When considering the purpose of engineering a range of questions arise as to how to define and delineate those others that engineers should be in service of. And when focusing on the conduct of engineering it becomes clear that the perspectives and demands are too many to make it possible to encompass them all in one engineering curriculum. Agreement on what skills and practices characterise an engineer and the engineering work regardless of discipline can hardly be found. Williams (2003) envisages *"...engineering's loss of identity."* The acclaimed increase in the fuzziness of engineering identity is in part a result of changes in technology's disciplinary boundaries and the changed role of technology in society. The dawn of the so-called techno-science has blurred the demarcation line between technology and science and made the required skills to work with technology less obvious. The fields of technology and science can be considered to transcend traditional, disciplinary boundaries. At the same time, technology plays a very active and omnipresent role in society, nowadays, which puts demands on technology professionals to engage in public debates, to involve other citizens and stakeholders in the engineering problem solving processes. The demand on engineers for professional responsibility prevails. (Buch 2012, Buch 2011, Jamison 1997, Jamison 2012, Jamison & Heyman 2012, Jamison & Mejlgaard 2010, Petroski 2008, Sheppard 2009, Williams 2003, Wisnioski 2009).

"The world is so heavily shaped by collective technological interventions into nature that the dividing line between nature and human-influenced environments is becoming blurred, and new fields such as bioengineering and nanotechnology may erase the line altogether. Indeed, an emerging problem for the public at large is how modern society is to manage and actively adapt itself to new habitats enabled by these "blurred" technologies." (Sheppard 2009; xviii).
Conflicting interests and opinions on what engineering is and on the required engineering skills for the future are by some believed to be a threat to the professional engineering identity. (Christensen & Ernø-Kjølhede 2008, Jamison & Heyman 2012, Petroski 2008, Williams 2003, Wisnioski 2009).

"Engineering has evolved into an open-ended Profession of Everything in a world where technology shades into science, art, and management.... All the forces that pull engineering in different directions--toward science, toward the market, toward design, toward systems, toward socialization--add logs to the curricular jam.
Inevitably the profession formerly known as engineering will multiply into a much wider variety of grades, types, and levels because engagement with technology has far outgrown any one occupation." (Williams 2003).

Jamison (2012) emphasises three of the challenges that specifically confront engineering and engineering education: An *environmental challenge* demanding a concern for environmental protection, resource exploitation and climate change, a *technoscientific challenge* implying a new interplay of science, knowledge creation and technology, and various *societal challenges* resulting from the permeation of science and technology into society and requiring engineers to behave socially responsible. Buch (2011 & 2012) mentions three very similar challenges. They both identify market-orientation and business discourse as one strategy within engineering education to meet external demands from potential engineering employers. This strategy responds to the environmental challenge with green growth as its catchphrase (Jamison 1997, Jamison 2012). Both Jamison (2012) and Buch (2011 & 2012) see a tendency for the engineering education system to develop new fields or subfields within science and technology to widen the scientific basis of the profession(s) of engineering. They also point to a response strategy that calls for a so-called hybrid imagination to overcome the tendencies within engineering of disintegration and expansion at the same time. This hybrid imagination transcends traditional disciplinary boundaries and combines *"...scientific-technical skills and competencies with a sense of social responsibility or global citizenship."* (Jamison & Mejlgaard 2010).

Different ways of delimiting and defining engineering identity in Danish as well as international research are found to address three main areas: the engineer as belonging to a profession that serves a certain purpose, the engineer as undertaker of engineering which is a certain field, involving certain practices and requiring certain types of knowledge and competency and the engineer as someone with certain cultural chararacteristics or ways of being.

Wishes of mastering and exploiting nature and its resources for civilisation's purposes were traditionally part of engineering identity per se, and technical development was considered a means to this purpose (Wagner 2006, Jamison 1997, Bowden 2004, Jamison & Heymann 2012). Engineering identity was closely linked to a technical paradigm coined by an optimistic confidence in the internal forces of progression and industrial development (Wisnioski 2009). Today, serving a greater societal good is to a large extent considered part of the engineer's professional identity (Ambler 2009, Downey et al 2007, Mitcham 2009, Wisnioski 2009).

A range of practices, knowledge forms and competencies are considered specific to engineers and institutionalised in the engineering profession (Pawley 2009). Natural science and technology form the core and the object of engineering activities (Christensen & Ernø-Kjølhede 2008, Downey et al 2007, de Graaff 2009, Harrits & Olesen 2012, Heymann 2009, Jamison & Heymann 2012, Pawley 2009, Williams 2003), but the importance of contextual or non-technical activities seems to be increasingly acknowledged (ABET 2006, Abraham 2006, Armstrong et al 2007, Atman & Nair 1996, Carew & Mitchell 2008, Christensen et al 2009, Christensen & Ernø-Kjølhede 2008, Crawley et al 2007, Di Gironimo 2011, Hansen 2006, Henriksen 2006, Holgaard et al 2006, Jamison 2012, Jamison 2009, Jamison & Holgaard 2008, Jamison & Mejlgaard 2010, Jørgensen 2007, Kilgore et al 2010, Kolmos 2006, Pawley 2009,

Schrøder 2006, Sheppard 2009, TA 2009, Williams 2003) although some dispute and hesitation can still be found (RAE 2007, Christensen et al 2009).
Descriptions of engineering-specific culture encompass the symbolic meaning ascribed to intangible aspects that do not deal with neither the purpose nor the actual conduct of engineering but pertain to the lifeworlds of an engineer (Allie et al 2008, Becker 2010, Bowden 2004, Christensen et al 2006, Christensen & Ernø-Kjølhede 2008, Downey et al 2007, de Graaff 2009, Godfrey & Parker 2010, Jungert 2011, Loui 2005, Mann et al 2009, Mitcham 2009, Sheppard et al 2009, Stevens et al 2008, Tonso 2010, Wenger 1998, Williams 2003, Wisnioski 2009). The identity formation and its socio-cultural processes are also referred to as bildung, a german notion which focuses on holistic, personal development and democratic citizenship and relates to professional responsibility (Christensen et al 2006, Solbrekke 2008). In literature on engineering identity, generally, uncertainty is perhaps the most certain element of engineering (Bourg 2003, Bowden 2004, Jamison 1997, Lehmann et al 2008, Sheppard 2009).

Research focus

The present article investigates engineering identity as it is experienced by engineering students on the pathway to engineering. The aim is to give an insight in how they themselves characterise an engineer and to explore whether they have common conceptions of an engineering identity across the eight engineering education institutions and the many different engineering degree programmes they represent. Hereby it is also the aim to contribute to the still not overwhelming amount of research on the societal role of technology professionals from within their professional perspective.

By means of both quantitative and qualitative approaches to engineering students' keywords stated to characterise an engineer the paper will analyse the following two research questions:

- *How do future engineers in Denmark conceive of the engineering identity?*
- *And can a consistent understanding of the engineering identity be identified at all among the many diverse engineering students?*

The methods applied to collect and analyse data are presented below, followed by the results section. A discussion of the findings in the light of theoretical views on engineering identity is given subsequently, followed by concluding remarks.

Methods

This section describes the methods deployed to collect and analyse the empirical data gathered to provide information on actual first year engineering students' conception of an engineer – however fleeting and volatile these may be.
The collected data consists of responses in the form of maximum three keywords written by 1036 engineering students to an open-ended question asking them to express their views on what an engineer is. The exact wording of the question was: *"State maximum three keywords which – to you – characterize an engineer"*. The question formed part of a web-administered survey optionally in Danish or English reaching all 3183 Danish engineering students from the – then – eight different engineering education institutions in the year group that initiated their education in the fall term 2010.

One third of the students within this year group answered to the open-ended question. The representativity of the respondents to the total population of the engineering student year group was examined. A slight overrepresentation of female students was found with 28% females among those who provided keywords against 24% women in the total year group. Out of 107 different engineering degree programmes in total, 103 are represented. It was checked that the variety of different engineering degree programmes in Denmark were adequately represented, but the results have not been divided into disciplinary fields in order to maintain statistical power of the findings.

The data were collected in May 2011 when the engineering students were about to finalise their first academic year.

The student keywords were coded using computer assisted qualitative data analysis software. An open type of coding process was applied following a grounded, explorative approach without previously formulated hypotheses as a basis of the categories. This is a demanding way of coding, since it requires a recoding of all the material every time a new category is taken into use (Andersen et al 2010: 177 ff). The qualitative coding was used as a basis for text searches that include several specific formulations in both Danish and English and words with obvious spelling errors in one category. In the results section concrete criteria for the inclusion of words in categories are mentioned. Subsequently, quantitative coding was undertaken to assess the relative prevalence of the categories derived at via qualitative coding or text search procedures among the entirety of respondents and among students from different engineering institutions when adequate. Controls were undertaken for gender interaction effects.

Results

The analysis shows some recurring patterns within the student responses. Not one single, stereotypical engineering identity trait appears among the students. Instead, five general ways of characterising an engineer are identified. The first sees an engineer as someone who is occupied with creating things. The second considers an engineer someone with a certain disciplinary focus. The third focuses on the societal importance of the engineering profession. The fourth characterises an engineer by means of a certain approach within engineering. Finally, a fifth way to characterise an engineer emphasises the business and commercial orientation of an engineer. The five engineering identity foci are presented and discussed in the following section. Where students from different institutions divide in their ways of characterising an engineer, these tendencies are also presented.

1) Creating things

The most common pattern of engineering descriptions is characterised by the focus on the engineer as someone who creates or constructs something. From one engineering discipline to another there is of course a great variety in what it is exactly that the engineer creates. Being inventive and creative in concrete processes of building, designing or constructing artefacts or in terms of inventing new ideas in the abstract is a distinguishing character of an engineer according to more than 40% of the respondents (42% of the 1036 responding students, total population is 3183 students).

The focus on creation is operationalised as a category of keywords including references to the word creativity and to words relating to invention, design and getting ideas. Words with obvious spelling errors are included.

Design plays a prominent role in literature on engineering identity and history (Crawley et al 2007, Kilgore et al 2010, Christensen & Kjølhede 2008, Schrøder 2006, Di Gironimo 2011, Pawley 2009, Williams 2003). Apparently, this concept has not gained foothold among the first year engineering student conceptions of engineering identity. Only three direct references to design were made by the students. A design discourse has not (yet?) become inculcated in these students as a part of their conception of an engineer's professional identity. Therefore no separate design category was constructed. The three students mentioning design are included in the overall creativity category, due to the familiarity of the concepts and the common focus on the creation process. The design term could also be construed as a referral to certain processes that are regarded important aspects of the conduct of engineering (e.g. Crawley et al 2007). The characteristics of the engineering approach and engineering ways of doing will be dealt with in depth in subsection 4 of the results section.

Innovation could also be conceived of as a process of creation; due to the emphasis on economic growth within innovation literature (Lundvall 2002, Jamison 1997, Jamison & Holgaard 2008, Jørgensen 2009) the keyword is dealt with in in subsection 5 on business/commercial aspects of the engineering characteristics. Referrals to innovation are reported separately, though.

The creation aspect of the engineering profession is by one student summarised with the keyword *"Gaffer tape"*. In its own humourous way this brings to mind someone tinkering with makeshift solutions and encompasses what the students consider an important engineering trait; namely the wish to create or invent something practical.

2) Scientific core

One out of every four respondents utilises a science or technology focused keyword to describe an engineer. The specific words cover variations of terms stemming from the words math, science, theory, numbers and calculation expressed in either Danish or English. Examples are *"mathematical"* or *"scientist"*.

Apparently, natural science and technology is considered an integral part of the engineering identity to a large part of the engineering students (26% of the respondents).

Engineering's scientific core is not the only disciplinary focus of the engineering students. Many use narrower disciplinary keywords to characterise an engineer. These include words like *"buildings"*, *"bridges"*, *"concrete"* (in Danish: "beton" referring to a material type only), *"programming"* or *"roads"*. These engineering students seem to identify engineers with the specific artefacts they construct. Especially engineering students from VIA University College (8% of the responding students from this institution as compared to 2% in average) describe engineers in this way.

The focus on a scientific core characterising an engineer sometimes goes hand in hand with a range of negatively loaded keywords as *"narrow-mindedness"*, *"geek"* and *"nerd"*. Keywords including the terms geek or nerd were used by 3% of the students. The somewhat dull engineering image that relates to these words definately is present among the students who have nonetheless decided to pursue an engineering education themselves. If a nerd in a Danish context is considered a masculine characteristic as found in an ethnographic study in the U.S. (Tonso 2007), the construal of an engineer as a nerd might relate to the opinion of 7 (5 of which were male) students that an engineer is a *"man"*. This might suggest that the engineering culture still is rather masculine, although some institutions and some engineering disciplines have succeeded in attracting much closer to equal shares of women than the average 24%.

One student mentions *"lonely"* among his distinguishing engineering keywords which might imply that to him the "nerdiness" comes with high costs. The same goes for a few students who find an engineer *"boring"*. There is evidence to suggest, though, that there is also a positive side to the narrow, technical-scientific image of an engineer. As one of the respondents puts it, an engineer is: *"Nerdy in the good way"* [translated]. This might indicate that the students acknowledge some of the positive aspects ascribed to a specialised, disciplinary focus which is reflected in the wide-spread use of words assigning dedication, engagement and thoroughness to the engineering professionals.

The disciplinary focus that the students consider characteristic of an engineer underlines the importance of codified, technical and scientific knowledge to their perception of the engineering identity. Not only do the engineering students consider this specific form of knowledge an integral part of the engineering identity, they also ascribe a certain level of knowledge to being an engineer. An engineer is by 22% of the engineering students described as *"smart"*, *"clever"*, *"intelligent"*, *"knowledgeable"* and similar positive adjectives. Apparently, the students find an engineer's level of talent or knowledge higher *"...than average"* as one student expresses it. This emphasis of a challenging disciplinary level corresponds to the findings of Godfrey & Parker (2010) in New Zealand and might contribute to a legitimisation of the engineering profession (Harrits & Olesen 2012).

Although reflected by no student keywords directly, one aspect of formal knowledge seems to be of less importance to the engineering students. The analysis of their responses made clear that there were quite a few grammar or spelling errors. Systematic coding of spelling errors excluding nordic ways of spelling a word or obvious typing errors showed that 13% of the engineering students had at least one spelling error among their three keywords. Of course this finding must not be overinterpreted. A filling in of a web-survey does not invite for the highest degree of attention and care in the fulfillment of grammar and spelling standards. Nonetheless, the finding of this large number of spelling errors does lead to a questioning of whether this could be an indication of a more general tendency for students who are weak in their written communication skills to be attracted to engineering. This would correspond to the finding by Godfrey & Parker (2010) of an engineering culture characterised by visual or graphical elements and a highly mathematically based language at the expense of word-based forms of communication. A preferral of visual instead of non-written communication forms was also found among several of the students who did a pilot testing of the survey before deployment.

3) Societal importance

The engineering descriptions in this sub-section comprise a variety of keywords with a reference to the engineer's societal importance in common. Societal importance is found in three different ways, namely as external appreciation of an engineer, as a practical focus of the actual engineering work and as emphasis of the potential societal benefit of engineering work.

A small part of the keywords (used by 2% of the responts) within this pattern of responses has to do with external status and appreciation and is reflected in keywords describing the quality and respectability, the high wage levels and the job security of the professional engineer.

A large part of what is here considered societal importance has to do with the students' underlining of the practical relevance and real-life implications of the problems that an engineer is confronted with. The use of keywords as *"problem solving"*, *"solution-orientation"*, *"applicability"*, *"practice"* and *"realism"* is found in the characteristics of an engineer provided by 30% of the engineering students. This indicates that the engineering identity aspect that opposes itself to science by means of the practical purpose of the engineering activities is alive and kicking among the engineering students. The same counts for the ideal conception of an engineer as someone in service of the society. The practical outcome and relevance is considered highly important to an engineer.

[Table 1]

As shown in Table 1, especially the students that in 2010 were already embedded in the Aarhus University as a small minority among non-engineers seem to understand their future professional identity much in the light of the practical and application-oriented aim. This could be due to their status as engineering students in a highly natural science-oriented surrounding which could have given this aspect of the engineering identity a stronger focus, since the professional identity formation is assumed to take place in processes of interaction with others (Allie et al 2008, Case 2004, Gee 2000, Lave & Wenger 1991, Wenger 1998).

In a similar line of argument, the three institutions where the students are the least likely to mention practical problem solving as an engineering characteristic are all institutions situated outside of university settings and offering non-academic types of engineering education only which could have led to a downplaying of the construal of practical problem solving as a particular characteristic of their profession because it is a common concern for everyone at these institutions.

Four percent of the students in the year group assign a particular responsibility to the engineering profession by describing an engineer as someone who plays an important role for societal development and future. They emphasise that an engineer is indispensable to society with words such as *"importance"*, *"(societal) responsibility"*,*"sustainability"* or *"prevention"*. And a couple of students use a little more words to explain that an engineer is someone who "*provides a link between the society and the scientists"* and who *"fulfils the needs of others"*. These keywords point to a more extreme comprehension of the engineering identity than that of the students emphasising practical problem solving in that these students not only focus on the practical character of engineering; they underline that engineering work is of crucial importance to sustaining society.

4) The engineering approach

Another pattern among the engineering student responses was a tendency to describe an engineer by certain ways of approaching the job. The engineering students try to outline what the process of conducting engineering work is about or what kind of approach it requires. Several aspects of what engineering is are encompassed in the descriptions of the engineering approach.

One recurring way of describing an engineer focuses on the individual's way of thinking and doing when conducting engineering activities. This approach that can be summarised as a rational approach was operationalised to include keywords stemming from the words logical, critical, systematical, analytical, reflective, objective, structural and methodical. To be able to approach a specific engineering task in ways characterised like this is a highly generic competency. The finding of this way of describing an engineer among 15% of the engineering students indicates that "doing engineering" does involve a certain common core in spite of disciplinary differences between certain types of engineering fields. A rational approach and way of thinking is considered an engineering-specific trait by the students. In the extreme, being rational is often considered a rather insensitive trait, and a few students do characterise engineers with terms that imply such a lack of human sensitivity, namely as *"cold"* and *"calculating"*. The word "calculating" in itself has a double meaning that encapsulates this exact opposition between a rational approach – here examplified with the conduct of calculations – and a negative, social behaviour. A more peculiar keyword that might also relate to the rational image of an engineer is *"atheist"*. Being a true engineer apparently does not relate well to religion according to the engineering student using this keyword. He probably considers religion an example of irrational belief.

Communication is often mentioned as an important part of the engineering approach (ABET 2006, Christensen et al 2009, Crawley et al 2007, Holgaard et al 2006, Kilgore et al 2010, Kolmos 2006, Christensen & Ernø-Kjølhede 2008, Schrøder 2006, Di Gironimo 2011, Pawley 2009, Sheppard 2009, TA 2009, Williams 2003). An average of 2% of the students mention words relating to communication as characteristics of an engineer. This gives too small values to compare all institutional differences in detail– the differences found are not statistically significant and may be random. But the University of Southern Denmark stands out with almost 6% of its engineering students characterising an engineer as someone with a communicative approach. Further research is needed to support any hypothesis that this could be a consequence of an SDU first-year curriculum targeting communication to a larger extent or in a more successful way than at the other institutions. The issue of cooperation represents an important aspect of engineering identity to many of the engineering students. 14% of the respondents mention words like *"teamwork"*, *"teamplayer"*, *"group oriented"*, *"collaboration"* or *"cooperation"* to describe an engineer. Generally, the engineering students expect cooperation to play a large role for an engineering professional. Table 2 shows that engineering students from Aalborg University are the most inclined to describe engineers in terms of collaboration. This is perhaps not surprising, since the teaching and learning approach of Aalborg University is problem-based learning (PBL) which is highly oriented towards group work (Jamison & Mejlgaard 2010, Lehmann et al 2008).

[Table 2]

It is not possible to defer from the keywords what kind of collaboration the engineering students expect to become involved in as professionals. Do they for instance consider an engineer's teamwork a matter of working with other engineers, other professionals or with end users and citizens? In any case, the emphasis of interaction and acknowledgement of the importance of relations to other people for practising engineering is almost as strong an engineering identity aspect among the students as the before-mentioned rational approach which is a much more individual undertaking characterised by systematic, logic and analytic ways of doing and thinking.

5) Business/commercial focus

Referral to business or commercial aspects makes up a general pattern among the ways of the students to describe an engineer. Although it is the least widespread of the five general tendencies, more than one fifth of the students display it. The commercial references come in many different ways. The keywords include Danish and English forms of the words *"business"*, *"market"*, *"entrepreneurship"*, *"leadership"*, *"management"* and *"innovation"*.

[Table 3]

As shown in Table 3, there is large variety in the prevalence of the commercial focus between the schools. The fact that the Institute of Business and Technology at Aarhus University (AU-HIH) has the highest share of students with a business focus is not surprising, since business – as the name of the institution points to – is an explicit specialisation of engineering educations offered here. It is less obvious, though, that the remaining two institutions now also affiliated with Aarhus University (AU and IHA) share this higher than average student focus on business and commercial aspects of the engineering identity. For these three institutions the business/commercial focus is largely an emphasis on management/leadership which in Danish translates to only one word (ledelse). See Table 4.

[Table 4]

The Technical University of Denmark and the Copenhagen Engineering College are the engineering institutions where students are the least likely to use business or commercial terms and leadership/management terms to describe an engineer. Students from both institutions seem to be much more likely to refer to the scientific core of the engineering identity, and DTU students also to construe an engineer as someone enacting a creative process of construction. This difference in focus might be what is reflected in a higher tendency of DTU students to use the concept of innovation to describe an engineer than what you would expect if this term was merely to be construed as a business-oriented keyword. See Table 5. Among students from the Copenhagen Engineering College the prevalence of the innovation term is also closer to average. Results here should be cautiously interpreted, though, due to a smaller sample size from this institution.

{Table 5]

Innovation relates to a business-focused discourse identified in litterature on the engineering profession (Christensen & Ernø-Kjølhede 2008, Crawley et al 2007, Henriksen 2006, Holgaard et al 2006, Jamison 2012, Jamison & Holgaard 2008, Jørgensen 2007, Kolmos 2006, TA 2009, Sheppard 2009). At the same time, it is also related to creativity and the process of construction where the focus might not be so much on value creation as it is on the ”newness” and ”inventiveness” encompassed in the innovation concept. It remains to be explored exactly what the students mean by the innovation referral, though. The use of the perhaps somewhat hyped term in itself does not tell whether the students consider the innovative engineering identity a matter of business-orientation, creativity or something else.

Loss of Professional Identity? – Not Among Engineering Students!

The identification of a profession-based ideal of serving the society in engineering identity literature is reflected by a large number of students mainly in terms of a construal of an engineer as someone occupied with practical problem solving. The societal relevance and applicability of engineering work is highlighted. Some even consider an engineer crucial to societal sustainability and emphasise the professional responsibility of an engineer.

This section discusses the findings presented in the results section of the ways for engineering students to describe an engineer in the light of the theoretically based concern for engineering identity which seems to have passed over Danish engineering students at this level of their education.

The use of science and scientists as counterparts in the process of construing engineering is reflected by the engineering students' inclusion of keywords referring to a scientific-technical core in combination with the application-orientation of engineering also reflected in the problem solving purpose they refer to. The students do not try to detach themselves from "pure science", though, and there are no negations in terms of emphasis of what engineering is not considered to be.

Engineering literature presents a variety of different – and sometimes competing – contextual practices, knowledge forms and competencies of acclaimed importance to engineering. The focus on creating things is the most prevalent way for the students to describe what engineering conduct is about. Design on the other hand, is almost absent from student keywords which may suggest that this term is added to the students' conception of the engineering identity at a later stage in their professional identity formation process. One could also question if the design aspect is overrated in literature as compared to its weight in the identity of engineering professionals, but the engineering students do emphasise both the aspect of creating and inventing things and of planning, approaching and managing the problem solving process which does suggest that the absence of the concept is merely a question of whether or not to apply the label of design.

Professional skills are not uniformly referred to by the students, but specific ways of doing are described as engineering characteristics by the students. An individual approach to engineering was identified among the student keywords along with the emphasis of group-based work relations underlining the importance of collaboration and – to a minor extent – communication. The individual approach is construed as a logical, rational, systematical way of thinking and approaching engineering activities including critical reflection.

Students from institutions with an explicit focus on the commercial aspects are found to use commercial or market-oriented keywords to describe an engineer more often that students from other institutions mainly at the expense of the referrals to the scientific-technical engineering core.

Social responsibility plays a minor role in the engineering identity construals of the students and mainly indirectly via the emphasis of the societal importance and indispensability of an engineer, but direct mentioning of the role of the engineer in future-proofing the society is found among a few students. Ethics and social responsibility may not be expected to be the most prominent aspect of what an engineering student begin to identify with engineering during the very first year where a range of instrumental disciplines are often part of the curriculum. A range of other student descriptions of engineering culture were identified as more prevalent. One widespread way for the students to assign symbolic value to the engineering profession was to consider an engineer to have higher than average talent and intelligence. This of course has to do with a limited way of discursively constructing what talent and intelligence is focusing on the previously mentioned rational, logical approach to the scientific-technical field. A considerable amount of the students seem to think that an engineer is someone with a particularly high level of competence. This might contribute to their sense of professional pride once they begin to identify themselves as engineers. It might also hold a risk, though, that the experienced threshold level of entering and coming to belong in the engineering community might be overestimated by these students. If they are too unrealistic about how much talent it takes to be an engineer the risk that they will never make it as one increases.

The referrals to wage and other collectively recognised markers of the status and symbolic meaning this profession has in the general society are also aspects of engineering culture as the students see it. Less positive ways to culturally characterise an engineer are also expressed. Feelings of boredom and loneliness and the conception of engineers as cold, calculating and narrow-minded seem to go along with the image of a high level of talent for some of the engineering students which is sought encapsulated in the term nerd – also used by the engineering students themselves. But there is also a *"good way"* of being a nerd which focuses on the engineering culture as one of dedication, engagement and meticulousness.

In spite of theoretically founded fears that engineering identity is at risk of disappearing or defragmenting into a myriad of separate professional identities related to specific fields of science and technology, Danish engineering students from almost all different engineering degree programmes offered in the country seem to have a limited variety of ways to construe an engineer. Five overall areas of focus on the engineering identity coexist among the engineering students. Although students from different institutions give different emphases to the perspectives, it appears, the five engineering identity perspectives do not cause heavy disunity in the year group.

[Figure 1]

As shown in Figure 1, the most prevalent perspective of engineering underlines the role of an engineer in the creation of something. Between one fourth and half of the students at the eight different institutions describe an engineer with this focus.
Another highly prevalent perspective focuses on the scientific-technical core of engineering and the high level of specific talent within this field that the engineering students find characteristic of an engineer. These two perspectives can be considered fundamental pillars in the students' engineering construal which leads to their bottom position in the construction of the symbolic visualisation of the engineering identity as conceived by the students in Figure 2.

[Figure 2]

The pentagon visualising the five perspectives and their role in engineering identity has problem solving at its central element, since this seems to be an aspect that relates to all five perspectives. Problem solving might even be considered a central aspect across all institutions and disciplinary divisions of Danish engineers. Problem solving seems to be the aim made possible by acquisition of scientific knowledge, and the "thing" that an engineer creates has to provide a solution to a problem. To the engineering students emphasising the business/commercial perspective of engineering problem solving takes place in a market-context which demands for an economically profitable way of coming up with an engineering solution. The individual and the collective way of defining the engineering approach also both assume "a common third" (Husen 1984) functioning as the subject of the engineering activities; the problem that needs to be solved. The rational-logical approach and the collaborative approach are both ways of describing how an engineer solves problems.

The focus on societal importance which is given the top position in the construction of the house of engineering identity figure is the icing on the cake to some students. This perspective is more or less wideranging in the students' engineering identity construals. Practical implications, relevance and application-orientation is a common engineering denominator, but to some students the societal importance of an engineer encompasses contributing to a future-proof society. To stay within the metaphorical language, the societal importance of engineering is similar to the superstructure of the engineering identity house. The engineering identity does not collapse without this perspective, but it definately looks more well-rounded with it. The central problem solving focus can be considered to outline a minimum of societal involvement characterising all engineers, whereas the height of the pitch of the house may vary with the degree to which the societal importance of the problem solving engineering activities is highlighted.

Conclusion

In the eyes of engineering students, engineering identity seems to be a patchwork of coexisting identity perspectives differently emphasised by students from the 8 engineering education institutions. Indeed, a common conception of what characterises an engineer is possible to identify among the students, in spite of theoretical concerns that engineers are losing their professional identity.

Five perspectives on engineering identity are identified in various combinations among the student keywords describing an engineer. An engineer is considered to 1) create things, 2) have a high level of scientific-technical focus, 3) a specific approach characterised either by rationality or collaboration, 4) a consideration for the business/commercial context and to 5) be of utmost importance to societal progression and sustainability. Furthermore, problem solving is positioned as a central theme of the engineering students' construal of engineering identity, since problem solving connects all five perspectives.

Future engineers in Denmark do not conceive of an engineer in one uniform way. Instead they seem to refer to different aspects of what may be considered fundamental and superjacent structures of the engineering identity. Although students from different institutions seem to emphasise different elements of the engineering identity, there is no evidence to suggest that they are building entirely other identities. The patchwork identity may not be one entirely consistent identity agreed upon by students from all eight engineering education institutions, but the students do seem to find common ground and common central themes linking differently emphasised perspectives of what the engineering profession is about.

Acknowledgment

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Tables and figures

Table 1. Percentage focusing on practical problem solving with at least one of their keywords characterising an engineer

VIA (N=65)	20.0
AU-HIH (N=44)	25.0
IHA (N=146)	26.0
SDU (N=165)	27.9
AAU (N=217)	29.5
IHK (N=57)	33.3
DTU (N=298)	33.6
AU (N=44)	43.2
Total (N=1036)	29.9

*) See endnote for abbreviations.

Table 2. Percentage pointing to collaboration with at least one of their keywords characterising an engineer

VIA (N=65)	7.7
IHK (N=57)	8.8
DTU (N=298)	9.1
SDU (N=165)	12.1
IHA (N=146)	15.1
AU-HIH (N=44)	15.9
AU (N=44)	22.7
AAU (N=217)	24.0
Total (N=1036)	14.3

*) See endnote for abbreviations.

Table 3. Percentage with a business or commercial focus in at least one of their keywords characterising an engineer

DTU (N=298)	16.4
IHK (N=67)	21.1
SDU (N=165)	24.2
AAU (N=217)	24.4
VIA (N=65)	24.6
IHA (N=146)	26.7
AU (N=44)	29.5
AU-HIH (N=44)	38.6
Total (N=1036)	23.1

*) See endnote for abbreviations.

Table 4. Percentage with leadership/management as at least one of their keywords characterising an engineer

DTU (N=298)	3.0
IHK (N=67)	8.8
AAU (N=217)	10.1
SDU (N=165)	10.3
VIA (N=65)	10.8
IHA (N=146)	13.0
AU-HIH (N=44)	15.9
AU (N=44)	18.2
Total (N=1036)	9.1

*) See endnote for abbreviations.

Table 5. Percentage with innovation among their keywords characterising an engineer

IHK (N=67)	9,0%
VIA (N=65)	10,8%
AU (N=44)	11,4%
DTU (N=298)	12,1%

AAU (N=217)	14,3%
IHA (N=146)	14,4%
SDU (N=165)	15,2%
AU-HIH (N=44)	18,2%
Total (N=1036)	13,4%

*) See endnote for abbreviations.

Figure 1. The total prevalence of the five engineering student perspectives including subdivisions on engineering identity relative to eachother, percentages

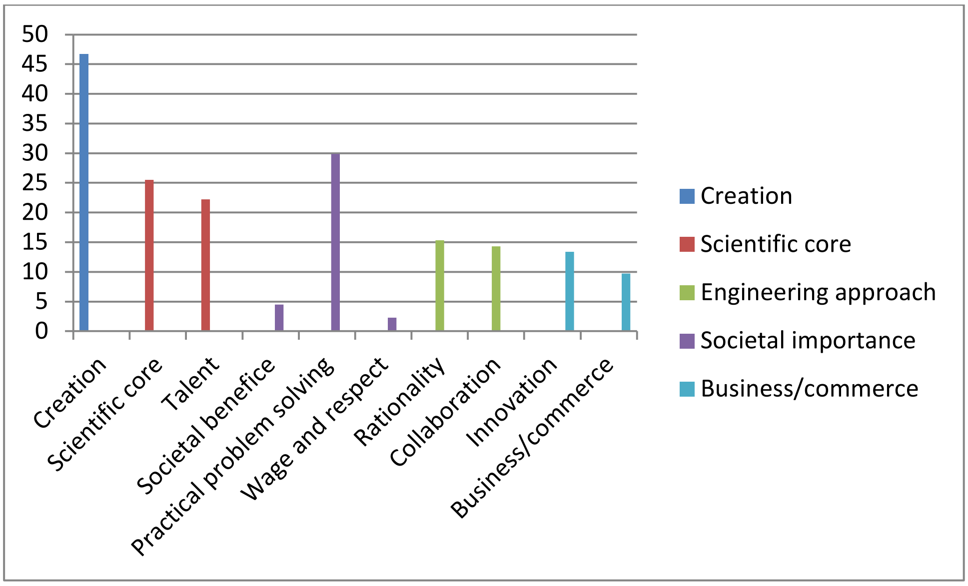
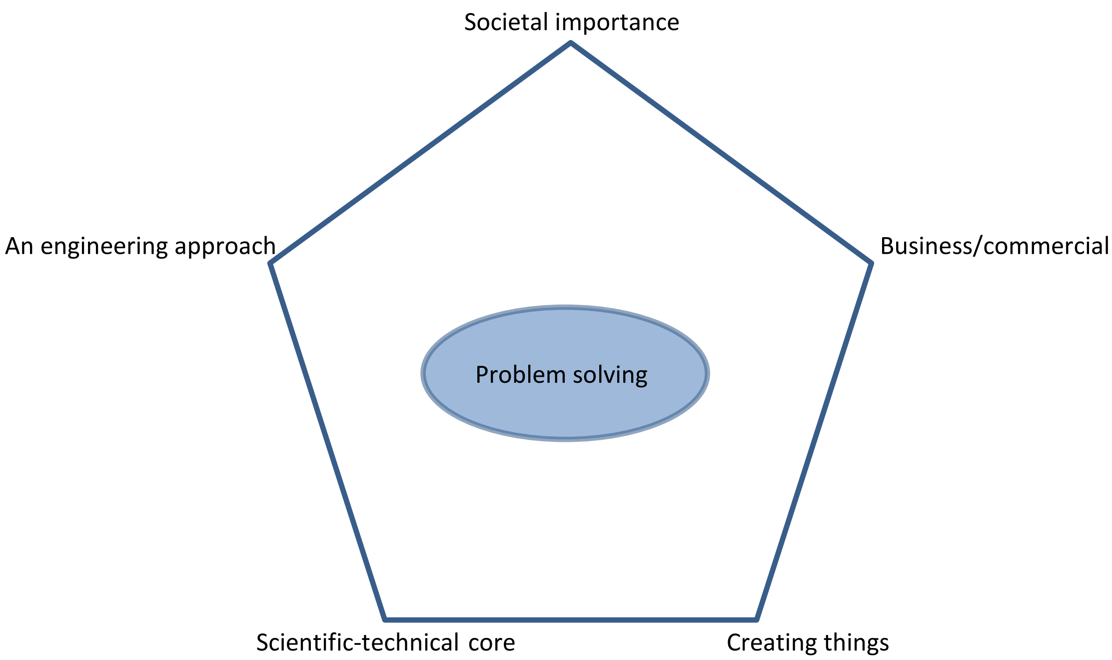


Figure 2. The House of Engineering Identity



* AAU is Aalborg University; AU stands for Aarhus University; AU-HIH – now AU Herning – refers to the Institute of Business and Technology at Aarhus University, before 2006 an Engineering College; DTU stands for the Technical University of Denmark; IHA is the Engineering College of Aarhus – now also part of Aarhus University; IHK is the Copenhagen Engineering College; SDU is University of Southern Denmark; VIA stands for VIA University College.

6.
An Engineering Dilemma: Sustainability in the Eyes of Future Technology Professionals

Science Engineering Ethics (2013) 19, 893–911

http://search.proquest.com.ez.statsbiblioteket.dk:2048/docview/1418096581/B56487BD54544DF7PQ/1?accountid=14468

7.
Engineering Students' Sustainability Approaches

European Journal of Engineering Education, Vol. 39, No. 3, 247–271

http://www.tandfonline.com.ez.statsbiblioteket.dk:2048/doi/pdf/10.1080/03043797.2013.8581038

8.
Preparing for Professionalism. How Engineering Students Experience the Role of Professional Engineers in Society

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Preparing for Professionalism. How Engineering Students Experience the Role of Professional Engineers in Society

Abstract

Higher education institutions are considered important actors to secure and provide a professionalised workforce, and they play a pivotal role in the formation of a professional identity among their graduates. Technology professionals such as engineers are confronted with blurred boundaries between and within different disciplinary fields and a virtually ubiquitous role of technology in an increasingly globalised society facing challenges like resource depletion, poverty, climate change and economic crisis. Engineers are expected to take on environmental, techno-scientific and socio-technical roles and to add contextual skills to their scientific and technical competencies along with social responsibility. Two-point surveys to all Danish engineering students in the 2010 cohort during their first year of enrolment were deployed in order to investigate their views on the role of engineers in society. The results indicate that student experiences run counter to some of the intentions for their professional identity development.

PAPER

Introduction

Providing a professionalised workforce prepared to play a role in sustaining and developing society seems to be a particularly challenging task for engineering education institutions. Engineers are confronted with blurred boundaries between and within different disciplinary fields and a virtually ubiquitous role of technology in an increasingly globalised society facing a range of challenges. This article addresses ways in which Danish engineering students conceive of their future professional role in society in the first month and at the end of their freshman year.

Theoretical base

A range of societal challenges sometimes referred to as "grand challenges"[1] threaten the existence of present societies[2]. Jamison (2012) points to three challenges that specifically confront engineering and engineering education: An *environmental challenge* demanding a concern for environmental protection, resource exploitation and climate change, a *techno-scientific challenge* implying a new interplay of science, knowledge creation and technology blurring the traditional disciplinary boundaries and creating new demands on engineers and various *socio-technical challenges* resulting from the permeation of science and technology into all aspects of contemporary life, requiring engineers to behave in a socially responsible way. These challenges have been responded to by higher education systems in contradictory ways; on the one hand, engineers are expected to add commercial and entrepreneurial skills to their scientific and technological competence and, on the other hand, they are expected to contribute to the development of more sustainable and socially useful technologies, which calls for an environmental consciousness and sense of social responsibility as part of their professional engineering identity. However, it is difficult to meet these expectations in one professional identity. These demands lead to fears that engineering identity is at risk of disappearing or defragmenting into a myriad of separate professional identities.[3]

Methods

Nation-wide, longitudinal, two-point web-administered surveys reaching the full population of the engineering student year group 2010 in their first month and again after their first year of studies serve as sources of empirical data. The surveys were deployed as part of the PROCEED[4] in order to investigate Danish engineering student experiences and anticipations of their future professional identity.

Results

For an engineer to tackle societal challenges, contextual elements of professional problem solving such as societal and global context, ethics and contemporary issues are generally considered pivotal. Nonetheless, these four issues were among the items that fewest students selected among their five most important items practicing engineering out of 20 items in total. And the four issues were selected even more rarely at the end of the freshman year. See Appendix for Tables.

Three roles of engineers in society each emphasising one of the theoretically based challenges, are ranked in relative importance by the engineering students. The environmental role has risen in importance among the engineering students over their freshman year relatively to the other two choices, and in the second survey the largest share of the students selects this role as the *most important*. At the same time, environmental contribution is selected by the largest share of respondents as the *least important* role of engineers in society .This division of the respondents is caused by differences across engineering degree programmes (e.g. environmental engineering students emphasising the environmental role as opposed to students within internet, software and communication technology) and gender differences (female students tend to find the environmental role of engineers in society more important than men). The socio-technical contribution of engineers to ensuring fair and responsible use of technology development is particularly pertinent among those studying internet, software and communication technology. In relative measures, though, this role becomes less important to engineering students of all programme types except biotechnology during their freshman year. This may be due to the abstract aspects of this role relating to philosophy of science, often not a large part of engineering curriculum until later in the study.

Creating an overview of complex interrelations between different scientific and technical fields is ranked as *most important* by more students at the end of the year than at the beginning. At the same time, more students than initially come to rank it as the *least important* role. In particular, students of environmental engineering tend to consider this techno-scientific role least important. Women are less inclined than men to rank techno-science as the most important engineering role, and this gender difference increases during the first year. An initial emphasis of this role comes with a larger-than-average-decrease in likeliness to include societal context among the most important engineering items over the first year. Instead, this group becomes more inclined to select the general top scoring items problem solving and teamwork among their five important engineering issues.

The engineering students assess their progress during the freshman year within different areas relating to societal challenges. Students with different priorities of the three societal roles of engineers appear to progress differently. After a year there is statistically significant difference in their assessed progress in the fields of social responsibility, societal context and environmental and economic optimisation. Students emphasising the environmental role of engineering experience a higher progress in the latter two, whereas those initially prioritising the socio-technical responsibility of engineers also come to experience the highest progress in social responsibility during their freshman year. When it comes to progress in personal and interpersonal competencies there is no statistically significant difference between the groups.

Between 38 and 75% of the students find that they have undergone no or little progress in the following fields: understanding of the role of technology in society, responsible use of technology, social responsibility, sustainability, knowledge on energy minimization, environmental impact assessment and knowledge of economics. In comparison, 24% experience little or no progress in their teamwork skills. It seems there is room for additional advances of the engineering students in contextual learning to address societal challenges.

Conclusion

There is a large variation in Danish engineering students' views on professional engineering and its contribution to society; environmental, techno-scientific and socio-technical emphases co-exist in different mixes at different types of engineering programmes. Consideration for societal challenges is included in the conceptualisation of professional engineering identity only to a minor extent. When environment imbues the anticipated professional role at the commencement of their education, the students experience a larger progress in fields relating to societal challenges. In general, though, the development of engineering freshman attitudes seems to run counter to educational intentions of contextual broadness and inclusion of consideration for societal challenges into the nascent professional identity which suggests that this area may need further attention.

Limitations

The findings are based on engineering student during the freshman year. Though the tendencies detected, may suggest directions of the development of the respondents' professional identity at the time of their graduation, conclusions are limited to the first year's development. Further research is required to assess actual attitudes at a later point in time.

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[1] ABET 2006, ABET 2004, Christensen et al 2009, Jamison 2012, Jørgensen 2007, NAE 2005, RAE 2007, Sheppard et al 2009, Sheppard et al 2008.
[2] ABET 2006, ABET 2004, Atman et al 2010, Christensen et al 2009, Christensen et al 2006, Crawley et al 2007, Haase 2012a, Haase 2012b, Haase et al 2013, Jamison 2012, Jamison 1997, Jamison et al 2011, Kleinman 2005, NAE 2010, NAE 2008, NAE 2005, NAE 2003, RAE 2007, Sheppard et al 2009, Sheppard et al 2010, Solbrekke 2008, TA 2009.
[3] Bourg 2003, Buch 2012, Buch 2011, Christensen et al 2009, Jamison 2012, Jamison 2009, Jungert 2011, Jørgensen 2007, Knight 2011, Lehmann et al 2008, Loui 2005, Mann 2009, Reid 2008, Trede et al 2012, Williams 2002.
[4] Programme of Research on Opportunities and Challenges in Engineering Education in Denmark, funded by the Strategic Research Council.

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Appendix

Table 1a Prioritisation of role of engineers in society

Role of engineers in society*, ranking of least to most important on a scale from 0 to 100		2010	2011
Problem solving related to climate change and environmental degradation	Mean: S.E.M:	44,9 7,1	49,9 8,2
Ensuring that technological development is utilised in a fair and responsible way	Mean: S.E.M:	54,7 7,0	49,8 7,5
Creating an overview of complex interrelations between different scientific and technical fields	Mean: S.E.M:	50,4 6,9	50,3 8,0
	N	3339	2666

Table 1b Prioritisation of role of engineers in society

Percentage selecting item as *most* important role of engineers in society*	2010	2011
Environment	29,4	35,7
Tech responsibility	38,1	32,5
Sci-tech overview	32,5	34,2
N	3339	2666

Table 1c Prioritisation of role of engineers in society

Percentage selecting item as *least* important role of engineers in society*	2010	2011
Environment	39,6	36,0
Tech responsibility	28,7	30,4
Sci-tech overview	31,8	33,6
N	3339	2666

* Question formulation: Prioritise between the statements below on the role of engineers in society. Please write 1 at the statement that you find most important, 2 at the second-most important statement and 3 at the third most important.
Engineers should contribute to solving problems related to climate change and environmental degradation. Engineers should contribute to ensuring that technological development is utilised in a fair and responsible way. Engineers should contribute to creating an overview of complex interrelations between different scientific and technical fields

Table 2a Selection of most important items practising engineering

Five most important items practising engineering	Percentage 2010	Percentage 2011
Ethics	7,0	5,2
Management skills	6,9	6,0
Contemporary items	9,2	6,4
Societal context	12,2	9,0
Global context	11,2	10,8
Design	13,0	12,5
Data analysis	14,5	13,8
Conducting experiments	10,7	14,5
Professionalism	19,6	17,7
Business knowledge	14,4	18,0
Leadership	18,5	18,9
Math	24,7	24,3
Science	26,0	25,5
Life-long learning	22,0	26,1
Communication	33,7	31,7
Engineering analysis	33,9	33,1
Engineering tools	32,2	34,0
Creativity	55,1	51,7
Teamwork	56,9	61,6
Problem solving	78,4	79,2
Total (five items selected)	500	500
N	3480	2945

Question formulation: Of the 20 items below, please put a check mark next to the FIVE you think are MOST IMPORTANT practising engineering.

Table 2b. Selection of most important items practising engineering by prioritised role of engineers in society at first survey deployment

Five most important items practising engineering, percentage	2010			2011		
	Environ-mental	Tech respon-sibility	Sci-tech	Environ-mental	Tech respon-sibility	Sci-tech
Problem solving	78,9	83,0	81,4	76,2	78,8	85,7
Teamwork	64,1	59,4	52,5	59,6	60,8	62,7
Creativity	51,0	61,5	54,2	55,0	50,5	55,7
Engineering tools	33,8	32,3	32,0	35,4	30,8	35,7
Engineering analysis	31,0	30,3	37,1	28,1	34,3	35,7
Communication	34,1	33,5	28,2	36,7	34,3	27,5
Life-long learning	21,7	23,3	25,1	29,6	23,8	27,5
Science	32,7	20,6	23,2	25,8	26,6	26,0
Math	23,6	23,8	22,4	25,6	23,1	25,0
Professionalism	17,2	17,1	20,3	13,9	19,7	15,8
Leadership	12,0	18,8	19,5	14,3	23,2	15,3
Business knowledge	11,7	16,9	15,1	15,6	16,0	17,5
Data analysis	14,6	12,5	17,2	12,6	14,8	14,7
Conducting experiments	12,0	7,2	10,4	14,1	11,2	13,6
Design	11,2	12,2	12,1	13,4	11,6	10,1
Global context	14,5	11,4	12,6	12,7	10,3	9,9
Societal context	12,9	11,8	15,0	9,9	10,1	7,6
Contemporary issues	10,2	10,4	7,7	8,8	6,7	5,4
Ethics	8,0	5,3	7,7	7,1	6,0	4,7
Management skills	4,8	8,9	6,4	5,5	7,5	3,9
Total (five items selected)	500	500	500	500	500	500
N	950	1108	927	872	1048	897

Only respondents responding to both questionnaires, weighted figures. Question formulation: Of the 20 items below, please put a check mark next to the FIVE you think are MOST IMPORTANT practising engineering.

Table 3a Self-assessed progress

Indications of progress within field, percentages, 2011	No or minor	Major	N
Knowledge of economics	74,5	7,5	2621
Environmental impact assessment	65,7	9,0	2595
Knowledge on energy minimization	61,1	13,2	2604
Sustainability	51,3	10,1	2504
Social responsibility	43,1	14,5	2583
Responsible use of technology	41,8	13,3	2438
Understanding of the role of technology in society	38,3	20,8	2617
Problem identification	25,7	21,6	2623
Teamwork skills	23,6	28,4	2675

Question formulation: Assess your progress within the following areas since you started your engineering programme. Response options: Major progress, Some progress, Minor progress, No progress, Do not know. Additional items are: Idea creation, Individual written assignments, Career planning, Conflict management, Laboratory experimenting, Oral communication, Organisational talent, Project management, Teamwork skills, Self-reflexivity, Ability to work independently, Written communication, Rote learning. Do not know-answers are treated as missing values.

Table 3b Self-assessed progress

Indexed scale ranging from 0-100		Interpersonal competencies[i]	Societal context[ii]	Personal competencies[iii]	Societal responsibility (single item)	Environmental & Economic Optimisation[iv]
Environ-ment	Mean: SEM: N:	55,8 0,7 749	54,4 0,9 718	51,1 0,7 784	48,2 1,1 814	37,2 0,9 805
Tech respon-sibility	Mean: SEM: N:	55,9 0,7 884	49,9 0,9 855	50,6 0,6 942	51,9 1,0 920	33,1 0,8 916
Sci-tech overview	Mean: SEM: N:	56,9 0,7 750	50,4 0,8 766	50,4 0,7 795	47,1 1,0 808	32,4 0,9 788

*) Index consisting of the items Conflict management, Oral communication, Organisational talent, Problem identification, Project management, Teamwork skills and Self-reflexivity, Cronbach's alpha reliability test =0.85
**) Index consisting of the items Responsible use of technology, Sustainability and Understanding of the role of technology in society, Cronbach's alpha reliability test =0.76
***) Index consisting of the items Individual written assignments, Career planning, Ability to work independently, Written communication and Rote learning, Cronbach's alpha reliability test =0.75
****) Index consisting of the items Environmental impact assessment, Knowledge on energy minimization and Knowledge of economics, Cronbach's alpha reliability test =0.72

Question formulation: Assess your progress within the following areas since you started your engineering programme. Response options: Major progress, Some progress, Minor progress, No progress, Do not know. Do not know-answers are treated as missing values.

9. The Contribution of the Thesis

This chapter connects the findings of the dissertation and brings to the fore how engineering students conceive of engineers, how they conceive of sustainability and societal challenges, and what professional role they take on in response to these challenges. This chapter concludes the thesis and discusses the implications of its findings in light of diverse theoretical contributions from socio-cultural technology studies, engineering education research, literature on education for sustainable development, learning theories and the sociology of professions. The theoretical and empirical analyses of the dissertation are critically synthesised which involves the inclusion of the level of discourse and social practice.

The two-point web-administered surveys with embedded open-ended questions were used to investigate engineering student approaches to professional engineering identity and the role of sustainability and societal challenges in these identity conceptions. A comprehensive literature review informed the development of the engineering student surveys, as described in detail in Chapter 7. The collected data was analysed with mixed methods in order to describe, explore and explain the research questions.

The first part of this chapter is structured chronologically, and commences with two sections following up on the findings of each round of surveys, followed by sections that conclude and discuss the contribution of the dissertation in a more synthesised manner.

The final section outlines possible ways to pursue further lines of inquiry on the basis of the dissertational work.

9.1 Engineering Student Preconceptions

Three of the dissertation's articles (Chapters 4, 6 and 7) are based on the first survey, deployed in the very first month of the engineering students' enrolment. This section summarises how the students, at their first encounter with engineering studies, conceive of sustainability and professional engineering identity and what role sustainability issues seem to play in their professional endeavours.

The thesis' most comprehensive data analysis (Chapter 7) reduces the complexity of a range of questions surveying the competencies, interests, appreciation, engagement and practices of the students. The purpose of this analysis was to categorize students according to their capacities and tendencies for engaging with sustainable development. By means of cluster-ing procedures, three engineering student approaches to sustainability were inductively derived on the basis of their response patterns.

The first of the identified approach clusters is rather weak in terms of addressing sustainability. Rather, this math/science-focused group of students is distinct from the others by virtue of its narrowly focused math/science skills and technology interests, although they also express an average level of appreciation for collaborative problem solving. The math/science approach cluster is below average levels of, for instance, environmental engagement and in their preparedness to incorporate ethics, contemporary issues and other aspects relating to social sustainability into engineering activities. They also report the lowest levels of competency, knowledge and interest in issues other than technology.

The second cluster approaches sustainability with an all-round focus and confidence. They are top-scoring in all dimensions, including those addressing narrow math/science/technical aspects, interpersonal and professional competencies and the dimensions addressing environmental, societal or global issues.

The sustainability approach of the third cluster is characterised by higher-than-average engagement with environmental aspects in combination with interpersonal and professional issues, interests and skills related to business/commercial aspects, and above-average self-estimated levels of knowledge about global, intercultural and interpersonal aspects of engineering. At the same time, this "soft" cluster has below-average levels of a narrow math/science/technical focus.

The cluster analysis identifies three different types of preconceived approaches as a basis for the development of a capacity for engagement with sustainability. This may prompt engineering education institutions to tailor their educational strategies and teaching more directly to each ideal type approach in order to strengthen their ambition to provide engineers able to address societal challenges.

Asking the engineering students to describe sustainability generally activates responses implying their position within the field of engineering (Chapter 6). More than one third of the entire year group provided an answer to how they understand the concept of sustainability, and although they had only just commenced their professional education, they related to the question from the point of view of a "future engineer". The engineering students mainly include environmental aspects of sustainability in their construal of the concept. The aspects of ethical and socially responsible behaviour are considered external to their future professional jurisdiction.

The students make use of a range of metaphors when characterising sustainability. Sustainability is explained by means of an efficient machine, a cycle, balance, profitability and a condition or state (of mind). These metaphors serve to emphasise the pursuit of profit and a rational logic underlying human action and simplify sustainability as a dual battle between good and bad, beneficial and harmful, or income and expenditures, at the expense of more complex notions of sustainability. They also downplay the role of human agency in relation to (technological) progress and development, attributing it independent autonomy instead, and construe sustainability as a barrier to such development.

The engineering students find themselves in a dilemma; stuck between romanticist and utilitaristic discourses serving as their conceptual frameworks. They hold two coexisting but conflicting views pertaining to the role of humans in the opposition between nature versus culture, civilisation or technology. On the one hand, they express a strong normative ideal about environmental sustainability; how nature should be unharmed by human exploitation. On the other hand, they are, to a large extent, motivated to commence an engineering education because they are fascinated by technology, which in their construal of it involves exploitation of nature. They blame technological progress for negative environmental effects that have caused nature's actual state to be far from their romanticist ideals.

The engineering students discursively dissociate themselves from a part in this dilemma and try to avoid an open conflict. To the majority, the two coexisting, oppositional worldviews are not reconciled. Instead, environmental sustainability is construed as separate from their professional pursuit.

The vast majority of the engineering students seem to avoid picturing a future professional role relating to sustainability and nature, since this collocation activates opposing values that are difficult to reconcile. However, a few engineering students actually use a reformulated technology construal as a way to overcome this dilemma and pursue an engineering career relieved of its heavy burden. They construe technology as a potential means to overcome environmental challenges and adhere to a "green" version of engineering.

The desire to provide engineers that are able to address societal challenges is not a uniquely Danish phenomenon. Rather, engineering education systems worldwide are attentive to the widening demands on future engineers. It is widely acknowledged that engineers must be skilled at more than mathematics and science. A more specific tuning in to the skills and competencies that engineering students deem important to successful engineering is the basis of an identification of four engineering student profiles that are found in Denmark and the US alike. The four profiles are based on student estimations of the importance of math/science skills and interpersonal and professional skills, respectively, and students with differing profiles distinguish from each other in much the same way across national contexts. Two groups have a specialised focus on one of the skill types, one group has a double focus (implying above-median level estimates of the importance of both types of skills to successful engineering), and one group is below median levels of both estimates. The identified profiles differ from each other and are comparable across the two nations in terms of confidence, motivation and their different gender compositions. This may suggest a more general basis for refraining from considering engineering students to be a homogeneous group. Rather, they may fruitfully be targeted as four profiles requiring different educational approaches to support and/or develop a double focus. Whereas the double-focused engineering students may need challenges and affirmation to fuel their high levels of confidence and motivation, the students with the lowest levels of importance estimates of the two skill types have an entirely different profile, which may require support of their self-efficacy.

Moreover, the finding that mentoring is a surprisingly high motivator for female Danish engineering students in spite of the lack of a formalised mentoring system may point out a potential way of attracting more women to engineering.

9.2 Conceptions of professional engineering identity and the role of sustainability and societal challenges at the end of the freshman year

This section concludes on the findings of the second survey intervention (see Chapters 5, 8 and Appendices 11 and 12), deployed after the first year of education and on the tendencies that may begin to appear in the time span across the two interventions.

By the end of the first year, some of the respondents had abandoned engineering studies. A marginal overrepresentation of women among these dropouts compared to the total population was found. More notably, however, the double-focused engineering students – along with the students with the lowest levels of emphasis on both math/science skills and interpersonal and professional skills – were overrepresented among the dropouts. This may indicate that these two profiles could gain from more specifically targeted educational attention.

It was also found that the remaining engineering students generally downgraded their importance estimates of both types of skills, which seems to run counter to engineering education systems' intentions to provide well-rounded engineers with a capacity for both. The same can be asserted for the tendency of the engineering students to become less, instead of more, inclined to include certain contextual elements relating to societal challenges in their selection of the five most important issues from a list of 20. These issues included the global context, ethics, contemporary issues and societal context. Moreover, more than 40% of the respondents indicated no or minor progress within the fields of social responsibility, responsible use of technology, sustainability and environmental impact assessment.

Three overall professional roles of engineers were formulated to tap directly back into the societal challenges to the engineering profession as outlined by Jamison (Hård & Jamison 2005, Jamison et al 2011, Jamison 2013, Boersen & Botin 2013). Over the first year, the share of students ranking the socio-technologically responsible role the most important decreases in favour of a larger acknowledgment of the environmental focus of the engineer, which is a particularly popular first choice among female engineering students. Fair and responsible use of technological development may seem more abstract and distant to the engineering students, at least compared to some of the environmentally related engineering problems that may have been emphasised in the engineering students' curricula over the first year. Moreover, disciplines such as philosophy of science, directly addressing issues of societally responsible use and development of technology, are often not part of an engineering programme until later. An engineering role emphasising the techno-scientific overview seems to increasingly divide the engineering students, since this role is selected as the most important as well as the least important role more often at the second intervention.

Analysis of engineering student keywords used to characterise an engineer does not find one narrowly conceived professional engineering identity construal by the end of their first year. Nor can a multitude of engineering identities be identified. Rather, different mental constructions are found that could be conceptualised as a "house" of professional engineering identity. Its foundation consists of technological/scientific core disciplines and the drive to create. A certain engineering approach and a business/commercial focus serve as superjacent structures that can take various forms, and the importance of societal involvement in the engineering identity determines the height of the pitch of the house. This is proposed as a potential framework for particular actualisations of professional engineering identities.

Although it is a fairly void notion, at least at this stage of the engineering students' educational trajectory, problem solving may serve as a central theme of the professional engineering identity, bringing its dimensions together.

9.3 The Identity Crisis Reconsidered

This section critically discusses the findings relating to the conception of the professional engineering identity.

Internal and external pressure on the engineering profession and its jurisdiction lead to engineering education debates about the engineering identity. The segregation of new engineering disciplines from old ones and the emergence of entirely new disciplines borrowing from both engineering and science (such as nano- or biotechnology) obliterate the borderline territory of the engineering profession and may threaten the existence of one common and coherent professional engineering identity. At the same time, societal challenges demand a widening of technological appropriation. Technology permeates into most aspects of everyday life in both developed and developing countries. These confusing tendencies of simultaneous expansion and disintegration result in an uncertainty that may be the most certain element of engineering (Bourg 2003, Bowden 2004, Jamison 1997, Lehmann et al 2008, Sheppard et al 2009a). Engineers seem to be thrown into a process of re-examining and re-legitimising their professional identity and societal responsibility.

However, engineering student conceptions of the engineering profession are fairly traditional – at least in the freshman year of the Danish cohort investigated. The students definitely adhere to a construal of engineering as something that is based on particular knowledge acquisition (Chapters 4 and 5). This cognitive content of the profession generally involves math/science skills, although a small drop in the importance assessment of these kinds of skills for engineering occurs among the students over their freshman year. The engineering students acknowledge to a large extent that interpersonal skills like communication and cooperation are important for successful engineering. At an aggregate level, the assessed importance of these skills neither increases nor decreases during the freshman year (Appendix 11).

The engineering students come to perceive math/science skills as somewhat less important for successful engineering after their first academic year than they initially thought. This suggests that their experiences with engineering studies have opened their eyes to other skills that may begin to challenge the initial top priority of math/science skills (Appendix 11).

However, the over-time development suggests that a double focus with emphasis on both types of skills becomes less instead of more prevalent among the engineering students over their first year (Appendix 11). Double-focused students who initially had high importance assessments of both types of skills tended to downgrade their perceptions of the importance of both interpersonal and professional skills and math/science skills. Furthermore, the double-focused engineering students are overrepresented among the drop-outs (Appendix 12). This could indicate that the engineering students begin to socialise into the norms and perceptions prevailing in the engineering student community[28] – or they leave it.

A scientific core and disciplinary focus is also emphasised by a large fraction of the engineering students when they are asked to characterise an engineer, as found in Chapter 5. Four other general ways of characterising an engineer are also identified. An engineer is considered to be someone who is occupied with creating things or who has a certain approach to their work practices involving emphases on individual logical reasoning as well as cooperation. Some engineering students focus on the societal functions of the engineering profession, and some characterise an engineer by means of their business and commercial orientation. The metaphor I have used to describe the engineering identity construal among the freshmen surveyed is a house, based on sci-tech and a creative drive, extended to varying degrees by a certain approach, a business/commercial focus and/or a sense of societal importance – sometimes even a professional obligation to sustain society. At the centre of this house is the concept of problem solving (an admittedly 'fluffy' concept).[29] Although the five dimensions of construing the professional engineering identity do not form a neat, coherent unitary whole, there

[28] See also Atman et al 2008 for more on the role of discipline-specific discourse learning among engineering students.

[29] The concept of problem solving could be considered a floating signifier. A floating signifier is a term used in semiotics to refer to signifiers that are not linked in a structurally stable way to meaningful content (the signified), as is normally the case (Hjelmslev 1943, Saussure 1991). Laclau (2002) points to the importance of oppression and struggle for power (hegemony) in the quest to fill such a void signifier with (certain contested ideological/political) meaning. The term is also used to denote a positively valued signifier that can be used to lend positive value to other signifiers to which it is linked. Laclau & Mouffe (2002) refer to this process as a chain of equivalence, whereas Fairclough (2003) would point to underlying assumptions about association. However, in the students' references to problem solving, the signifier largely remains empty, but positively valued.

is no indication sustaining the expectation of an entirely fragmented conception of the professional engineering identity among the students. As I interpret their answers, the practical function of the profession and its focus on solving real-life problems serve as a central nexus (see also Sheppard et al 2009a on engineering problem solving), connecting the various approaches to engineering. Although a societal role is an integral part of the professional engineering identity for some engineering students, this role mainly has to do with this practical aspect, related to real-life relevance of engineering problem solving.

Some potential identity conflicts can be found in the engineering students' characterisations of an engineer. The first relates to the potential conflict between the economic rationale that may be implied in a business/commercial focus and the intention to do social good involved in the notion of societal importance. This dilemma, however, is internalised in the ideal type professionalism (Freidson 2001), and both Freidson (2001) and Jamison (Hård & Jamison 2005, Jamison et al 2011, Jamison 2013) would consider a continual balancing of such opposing demands or logics an important aspect of (engineering) professionalism.

Another potentially conflicting identity dimension relates to the conceived engineering approach that encompasses both a collective and an individual focus that may not always pull in the same direction. The individual approach consists of an analytic, rational, systematic and critical way of thinking and doing in engineering that may not always coincide with the collective approach, emphasising collaboration and teamwork.

A balancing of generalisation and specialisation is inherent in professionalism (Freidson 2001: 115) and is also found in the student conceptions of engineering identity in the form of referring to being a specialist versus the construal of being a generalist with wide societal relevance. These two opposite tendencies may involve an identity conflict. This conflict is additionally complicated by the ambivalent values that are attributed to being a specialist. On the one hand, specialised knowledge and skills connote talent. On the other hand, it is also linked to the "nerdy" image of engineers as socially inept, which may influence some engineering students' descriptions of an engineer as being "boring" or "lonely".

For the engineering profession, the risk of fragmentation may be overrated. Despite the profession's lack of robustness in attributive measures and the theoretically founded fear that the profession will degrade or dissolve into paraprofessional fields and move away from any core professional content, it seems a common core of engineering can be identified with various "add-on"s, at least among the freshman students. Rather than disappearing, the engineering profession is perhaps becoming a patchwork profession or a hyphenated profession with varying degrees of adherence to the multitude of aspects offered in the professional field of engineering in general.

9.4 Engineering as a Professional Field

In this section the dissertation's contribution to the understanding of the engineering profession is discussed.

The demarcation of the engineering profession has been challenged from within as well as from external sources. However, defining engineering's boundaries with other professions is not in itself the objective of this dissertation. Nor is it an intention to contribute to the debate about demarcating professions in opposition to occupations. No decisive argument for or against engineering's status as a profession has been found. As Harrits (2011) argues, however, an interesting but often overlooked potential of profession research is a synthesis of theoretical understanding of professions with everyday use and construal of the concept of being "professional"; actual processes of demarcation and of construal become objects of analysis. The theoretical ambition of this dissertation has been to contribute to the understanding of engineering in just this way; by combining theoretical perspectives on engineering and professions with analysis of actual approaches to the identity and societal role of an engineer among engineering students who have only recently begun an educational trajectory that may eventually lead to careers as professional engineers.

The theoretically identified identity crisis of the engineers and their difficulties in defining their profession in relation to others within and outside of it is parallel to the processes of distinction involved in identifying a field that is a central question in Bourdieu's field theory (Bourdieu 1995a, 1995b, 1988, 1987). A field is a system of relations or, perhaps more precisely, of relative positions. The processes of demarcating are important in this theoretical perspective, since the act of demarcating or distinguishing is an act of positioning oneself in relation to something else. This – often symbolic – act constitutes the social field (Bourdieu 1995b). The structure of a field involves a vertical and a horizontal dimension, respectively. The horizontal dimension has to do with the functional division of labour within the field (Harrits 2011).

In the case of the engineering field, this points to divisions in engineering tasks and different branches or types of engineering such as mechanical engineering, business development engineering, arctic technology and more. It entails different types of what Bourdieu would refer to as professional capital, hence the symbolic possessions that condition the access to a certain field, here for instance an engineering education or some of the other professional attributes discussed in Chapter 3. This involves a distinction between different types of knowledge and knowledge production. The balance between these various functional aspects of the engineering field is what has been disturbed by the acknowledgement of new demands on engineers brought by societal challenges. Routinized technological work tasks are increasingly passed over to technicians or outsourced to countries with low wage levels; intercultural collaboration and project management tasks increase in pertinence as engineering tasks. The need to include interpersonal and professional skills in the understanding of what it takes to be a good engineer (Chapter 4); the increased awareness that engineers must be able to address contextual aspects in their technical problem solving and reflexively work with the difficult, intangible fact that technology is intertwined with its context; and the urgency of thinking and working sustainably (Chapters 6 and 7) all contribute to the challenging task of identifying what an engineer really is (Chapter 5). The same holds for the intra-professional division of labour between the many branches of engineering and the division of labour between engineers and other professions or occupations. An increased segregation of new fields of technology and new, mixed disciplinary fields such as nano-, bio- and health technology contribute to a blurring of boundaries within the field of engineering and between engineering and neighbouring disciplinary fields.

The functional division of labour within the field of engineering also encompasses the distinction between engineers of a vocational type (who used to be educated at engineering colleges) and engineers with a longer, more academically oriented education from a university. Another potential distinction in the field of engineering could be made between public and private sector employees.

Other than these horizontal, functionally oriented divisions within the field, an important structural characteristic is the vertical division between different engineering professionals according to the amount of professional capital they have or are considered to have. The individual's position in the field is determined by his or her share of capital of the "right" types. The functionally determined distinction between types of engineering capital and the social stratification relating to status and legitimate position in the field are interrelated aspects, and determining what is "right" according to field logic is subject to constant negotiation – potentially even power struggles – in the field. The logics of the particular field, its doxa, are the rules of the game with which engineering students are probably not yet familiar. These unwritten rationales are, however, related to the logic of the social field in general.

To understand a profession as a field is particularly helpful as an instrument to understand the value-laden legitimate role that professional engineers are expected to play in society. The ideals of professionalism involving self-sacrifice and altruistic motives to serve public interests (Parsons 1939, 1952, Freidson 2001, Evetts 2011, Larson 2013) would, in a Bourdieusian framework, be symbolic capital asserted and enacted as lifestyle indicators in a larger field of power.

There may be different positionings in this professional field. Engineering students are expected to belong at the periphery or maybe still outside of the actual professional field. Despite their peripheral position to the engineering field, they have a seemingly strong discursively constructed image of the profession. However, this image may be challenged when their position in relation to other actors in and around the engineering professional field changes during the course of their educational progression and as they cross into the labour market and become practising engineering professionals.

9.5 Soft Skills as a Threat to Professional Position?

In spite of a general agreement on the need for future engineers to be broad thinking and hybrid, a fairly traditional knowledge regime focusing primarily on "hard core" scientific and technical competencies seems to prevail in the engineering student construal of professional engineering.

To engineering students, the engineering profession is very much a science-based profession. Although the downside of the fundamental, scientific disciplines is related to the nerdy image they cast upon engineers, they also have a much more positive function in the engineering students' self-conception. The math/science disciplines are assessed as particularly demanding, which contributes to the exclusivity of the profession. The experience of hardship and endurance in relation to the demanding workload of the science and technology disciplines and the high degree of difficulty of these subjects are seen as "tests of manhood", ritualising the professional initiation.[30] Passing the exams in these subjects during the engineering education is construed as a special threshold or initiation rite. If you make it this far, if you endure the difficulties of these subjects, then you are considered par-

[30] The linking of endurance of math/science subjects to masculine values as a test of manhood brings about some cultural consequences for engineering identity that may constrain the room for feminine engineering identities to develop. See Blickenstaff 2005, Dæhlen & Svensson 2008, Faulkner 2007, Godfrey & Parker 2010, Hølge-Hazelton 2004, Kolmos et al 2013, Lee 2005, Morozow et al 2008 for more on gender issues within STEM.

ticularly talented and worthy of belonging in the field of professional engineering (Chapter 5).

A great deal of the professional status and legitimacy of the engineer is based on the symbolic value attributed to this particular area of the engineering knowledge base. Although the engineering students come to consider these subjects less important to engineering practice during their freshman year, the subjects seem to serve an important internal, symbolic function in the engineering field as a marker of normative value, status and identity. To some extent, the engineering profession legitimises itself by means of the demanding image of the "hard core", sci-tech subjects (Chapter 5 and 8). Regardless of eventual misconceptions about the complexity level of the so-called "soft" skills, the professionally legitimising function of the "hard" subjects may involve a barrier to the inclusion of "soft" skills in the engineering identity. Certain types of knowledge and skills bear with them more prestige in the engineering field – and perhaps in broader areas of society, as Henningsen and Liestøl (2013) assert in a parallel discussion about the construal of excellence in academia.

This way of legitimising the profession may bolster the self-confidence of the engineering students making it through to graduation, but it is also likely to be an obstacle to the stated objectives of engineering education systems of attracting more women to the engineering profession and of providing engineering professionals able to address the challenges of a dynamic, global society.[31] Integrating the demand for interpersonal and self-reflexive development and other contextual aspects into the practical learning architecture of engineering education programmes and engineering student communities seems imperative to foster a hybrid imagination among future engineering professionals. The apparent symbolic value of math/science skills among the engineering students underlines the potential risks related to neglecting the value and appreciation for these skills which emphasises the priority of such an integrative educational strategy over the mere adding of soft subjects to curriculum.

The notion of problem solving presents itself as an interesting concept that may bear the potential of bridging the prestige gap between "hard" and

[31] A comparison of the students who responded to the first survey and later within their freshman year decided to leave this line of studies with the rest of the group shows a marginal overrepresentation of women among the dropouts. Furthermore, students who initially have a double focus, with emphasis on the importance of both "hard" and "soft" skills to engineering are also overrepresented among the dropouts occurring during the first year of engineering studies, as previously mentioned (See Appendix 12).

"soft", since it is a highly emphasised, though fairly void, concept. A self-reflexive, critical filling of this notion with meaning relevant in an engineering-specific professional practice may also serve as useful to help future engineers in forming an identity that encompasses sustainability. At least in relation to environmental sustainability, the engineering students seem to think that the engineering identity is burdened with guilt (Chapter 6), which may involve a risk of demotivating them.

9.6 The Educational Dilemma: Intentionality versus Participation

Listings of the skills required from future engineers (Chapters 3, 4 and 7) and in particular the skills needed to address societal challenges and enhance sustainable development (Chapter 7) involve an ideal understanding of the learning process that breaks with traditional transfer thinking. (Engineering) education for sustainability and hybrid imagination as an engineering-specific ideal professionalism emphasise the democratic, participatory, self-critical, reflexive, experience-based processes involved in learning. This means that higher education institutions cannot transmit certain curricula or knowledge 'packages' into the heads of their students. A hypodermic needle metaphor for transferral must, from this point of view, be rejected. Learning is a much more student-centred way of looking at an internal self-development process occurring in specific contexts and collective interrelations. Learning is about becoming as much as it is about knowing. This self-development process focusing on action competency stretches out in time to include a person's entire life span. Learning is not just a process for pupils or students; learning happens at work and at home and is an ongoing endeavour to continually nurture (Breiting 2011, Brown & Duguid 2001, Brown & Duguid 1991, Christensen et al 2006, Gough & Scott 2007, Hetmar 2011, Lahn & Jensen 2008, Lave & Wenger 1991, Læssøe 2011, Læssøe 2009, Reid et al 2008, Scanlon 2011, Scott & Gough 2010, Sheppard et al 2009a, Sfard 1998, Sterling 2001, Säljö 2003, Wals & Jickling 2002, Wenger 1998).[32]

[32] For this particular purpose, a simplification of the approaches to learning has taken place. The mentioned theorists all oppose an unquestioned acquisition/transfer-focused understanding of learning and adhere to elements of a learning construal comprised of the participation metaphor. However, they do not understand learning in exactly the same way and have different emphases on, for instance, social/collective versus individual learning. For further discussion of the details of particular approaches to the learning process and their implications cf. Hager & Hodkinson 2011.

> Learning cannot be designed. Ultimately, it belongs to the realm of experience and practice. It follows the negotiation of meaning; it moves on its own terms. It slips through the cracks; it creates its own cracks. Learning happens, design or no design (Wenger 1998: 225)

For higher education institutions – as for workplaces striving to become learning organisations – the task involved in institutionalising learning processes consists of designing social infrastructure that supports and facilitates student engagement and development. Institutionalised attempts to support participatory learning have been accused of serving as the mere masking of a maintained institutional control over the status quo (Anderson 1998). Education institutions have also been criticised for their inertia in responding to these new paradigms for learning through reforming institutional practices, cultures and infrastructures (Hager & Hodkinson 2011).[33]

The participation-based learning construal seems to have resonated particularly well with professionally oriented educations (Christensen et al 2006, Lahn & Jensen 2008, Reid et al 2008, Scanlon 2011, Sheppard et al 2009a). By means of so-called legitimate peripheral participation in professional communities of practice, novice participants are expected to develop into full-fledged proficient status through a socialisation process (Lave & Wenger 1991).

When learning, as a consequence of the participatory metaphor, is depicted as a matter of "becoming", the focus on "content" elides, as Barnett (2009) and Sfard (1998) point to. A synthesising approach to learning encompassing both the need to acquire certain concepts orchestrated in an authoritative way by a teacher and a participatory facilitation of learning as student self-development in communities of practice has also been argued for (Allie et al 2009, Barnett 2009, Sfard 1998, Stevens et al 2008). A decentralisation of learning opens up the question of how to maintain control of the learning process. Proponents of participatory learning would claim that control over learning was never in the hands of the educational institutions. However, the institutionalisation of teaching for educative purposes does involve intentions about what learners' desired outcome should be. The mere listing of what we hope that our future engineers are able to accomplish is an exercise of exclusion whereby some skills are deemed desirable, others

[33] The two paradigms for teaching and learning in engineering education, problem/practice-based learning (PBL) and the CDIO Initiative (conceive, design, implement, operate) both seek to enhance participatory elements in actual pedagogy. For a comparative presentation and discussion of the two perspectives cf. Edström & Kolmos 2012.

left out. The fact that we want engineering students to become engineers of a certain kind involves a contingent, normative aspect.

The ideals of professional self-sacrifice and altruistic motives to serve public interests (Parsons 1939, 1952, Freidson 2001, Evetts 2011, Larson 2013) are normative elements of professionalism. Freidson (2001) termed these a “third logic”, distinguished from bureaucratic managerialist logic on the one hand and the customer-directed commercial logic of the free market on the other.

A variety of concerns compete for a role in engineers’ self-conception of their professional role and purpose. The acknowledgement of diverse logics impacting the professional engineer and his or her ideal role of contributing to societal sustainment has resulted in the ideal of a hybrid response strategy calling for a conscious professional acknowledgment of engineering’s social function and potential societal impact (Buch 2012 & 2011, Hård & Jamison 2005, Jamison 2013, 2012 & 1997, Jamison et al 2011). This ideal of a hybrid professional engineering identity is considered an engineering-specific version of Freidson’s “third logic”.

Alternative norms could have prevailed. Alternative ideologies could question or deconstruct the baseline assumptions about the role of man in nature, technology in society, the professional role of engineers, and the implications of economic, political and environmental conditions (see Walters 2010 for further discussion). Furthermore, the very nature of the knowledge that professions take pride in being based upon – as produced, reproduced and legitimised by the education institutions themselves – involves contingent mechanisms of control that potentially problematise professional access and democracy. As Larson (2013) points out, professional power coincides to a great degree with elite social status.

Hence, engineering education systems exercise – at the very least – a discursive and symbolic power by virtue of designing an infrastructure to facilitate engineering learning. And it matters how engineering education systems address their task of providing engineers capable of administering their potential professional power. The engineering education systems have an inherent intentionality that they need to balance with the demand for a participatory design of the learning infrastructure in order to fulfil their societal role of providing qualified engineers that are technical experts as well as empowered scientific citizens with a hybrid imagination.

9.7 Hybrid Imagination among Engineering Students?

Like other professionals, engineers are morally obligated to act as responsible citizens in every aspect of their work practice. The demanded societal role of future engineers encompasses the ability to think broadly (Christensen et al 2009, Christensen et al 2007, Sheppard et al 2009a and 2009b, Crawley et al 2007, Knight 2011, Lehmann et al 2008, Sheppard et al 2010, Atman et al 2010) and enact scientific citizenship (Mejlgaard 2006) with a contextual inclusivity and reflexivity based on professional *Bildung* (Christensen et al 2006) – all encompassed in the term hybrid imagination (Jamison et al 2011, Jamison 2012) as I have referred to it. Unfortunately, the actual professional identity construal of the engineering students cannot be considered to live up to this normative ideal of professionalism encompassing a self-reflexive professional pursuit of sustaining society (that is, sustainability).

The engineering students try to avoid personal and professional responsibility and their professional identity construal is clearly challenged by the concept of sustainability, activating in them a sense of remorse as a response to the negative side effects of technological progress. The disciplinary field is intrinsically motivating, and technical narrowness is found throughout, which is consistent with stereotypical engineering prejudices.

However, the stereotypes do not dominate the picture. Most engineering students do acknowledge that there is a lot more to engineering than math/science skills. It might even be considered a positive finding that a few engineering students are actually capable of discursively constructing a nascent professional identity that reconciles the technology fascination with love of nature and reformulates an ideal of green engineering very close to a hybrid notion of the professional engineering identity.

Hybrid imagination is a complex and difficult concept involving many levels of competencies. It cannot be expected among engineering students as early as their freshman year. And dealing with non-knowledge alongside knowledge, as Sørensen (2013) emphasises as a condition of science and knowledge-based work, means that there is no right answer, even for professionals. A hybrid imagination might even be considered an entirely unattainable ideal. However, abandoning the ideal and settling for a minimum level of sustainability in the engineering educations – an add-on (Jamison et al 2011, Scott and Gough 2010, Vare and Scott 2007) to traditional disciplines – would generally hinder truly integrative sustainability learning. That level of sustainability education is generally short-term and indisposed to making the necessary break with traditional learning paradigms and turning to participatory, facilitative learning conceptions instead (Scott and Gough 2010, Vare and Scott 2007).

Although they are few, the examples of engineering students taking on the responsibility for ensuring the appropriate use of new technological developments are encouraging. One way of supporting such students and facilitating their trajectory and sustainability pursuits might be through a clearer discursive linking of sustainability to the fairly void concept of problem solving, which seems to be a possible back door that would give sustainability access to the house of professional engineering identity.

9.8 Further Research

In correspondence with my claim of science's cumulative nature, the contribution of this thesis opens the door for further research. Some examples are outlined below.

The data collection undertaken as part of this PhD project was designed with the purpose of encompassing a variation of other research questions stemming from the PROCEED group. This means that the survey data include material that has not come to be analysed within the scope of this dissertation. For instance, investigating gender issues or issues of social mobility and intergenerational influence on the educational decision making of engineering students would be possible based on the collected data, but was not included within the scope of this dissertation. The comprehensive amount of data collected implies that more questions could be pursued. Furthermore, the results give rise to new research questions.

An obvious starting point could be to provide more descriptive data analysis on the basis of the engineering student answers. Merely presenting engineering teachers with student answers to various questions triggers an immediate response from the point of view of the educational system. This further suggests ideas about how to cumulatively add on to the knowledge provided here. As an employee at VIA has suggested to me, it would be interesting to compare the differences in conception of the engineering focus between engineering students at different institutions with their institutions' own educational strategies and self-conception from the point of view of their managing directors.

A testing of more general occurrence and relative prevalence of the five qualitatively identified dimensions of professional engineering identity would further contribute to the understanding of the engineering identity.

Finally, revisiting the engineering students with new rounds of surveys would expand the time span to cover their entire educational trajectory and follow them into their early careers. To my knowledge, no such study has previously taken place, and it seems a fruitful source of providing entirely new knowledge about engineering students' boundary-crossing processes and their impact on professional identity formation.

Summary

Engineers are morally obligated to act as responsible citizens in their work practice. Their appropriation of science and technology has massive potential implications for societal development and sustainability. The demanded societal role of future engineers encompasses the ability to think broadly and enact scientific citizenship with a contextual inclusivity and reflexivity based on professional *Bildung* – all contained in the term hybrid imagination (Jamison 2013, Hård & Jamison 2005) serving as an engineering-specific version of Freidson (2001)'s ideal professionalism.

By means of mixed methods analyses of surveys with open and closed-ended questions deployed in two waves to an entire year group of engineering students in Denmark it is found, that the occupational values and the actual professional identity construal of the engineering students cannot be considered to live up to the normative ideal of professionalism encompassing a self-reflexive professional pursuit of sustaining society and addressing its challenges.

Various attempts to map the engineering student construal of professional engineering identity and engineering student dispositions in relation to societal challenges contribute to informing the engineering education system about prerequisites and potentials for more specific targeting of the educational strategies to groupings of students with distinct capacities for developing sustainability approach.

The dissertation cumulatively builds upon previous research in a US context (most notably the APPLES) and writing by Jamison (most recently Jamison 2013) calling for a hybrid imagination among engineering from a socio-cultural perspective to science and technology.

The engineering student conceptions of professional engineering do not give support to engineering education research characterising engineering identity as in risk of defragmenting. As other professionals, engineers are under pressure by a range of epochal shifts in society along with grand societal challenges. However, first year engineering students' ideas about engineers and their societal role seem rather unaffected, although sustainability issues places them in an archetypical dilemma between nature and technology.

The engineering students try to avoid personal and professional responsibility and their professional identity construal is clearly challenged by the concept of sustainability, activating in them a sense of remorse as a response to the negative side effects of technological progress. The disciplinary field is

intrinsically motivating, and technical narrowness is found throughout, which is consistent with stereotypical engineering prejudices.

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Although they are few, the examples of engineering students taking on the responsibility for ensuring the appropriate use of new technological developments are encouraging. One way of supporting such students and facilitating their trajectory and sustainability pursuits might be through a clearer discursive linking of sustainability to the fairly void concept of problem solving, which seems to be a possible back door that would give sustainability access to the house of professional engineering identity.

Dansk resumé

Ingeniører har en forpligtelse til at udvise et særligt ansvar i deres arbejde. Det kan have massive konsekvenser for den samfundsmæssige udvikling og bæredygtighed, hvordan ingeniører håndterer ansvaret for at sikre den rette anvendelse af videnskab og teknologi. Den normative idealforestilling om, hvad fremtidige ingeniører skal kunne omfatter evnen til at tænke bredere end de snævre disciplinære fagområder, til at udvise videnskabeligt medborgerskeb og inkludere kontekstuelle faktorer og selvrefleksion på baggrund af en professionel dannelse. Dette er alt sammen indeholdt i ideen om en hybrid ingeniøridentitet (Jamison 2013, Hård & Jamison 2005), der i denne afhandling forstås som en ingeniør-specifik parallel til Freidson's (2001) idealtypiske professionalisme.

Spørgeskemaundersøgelser af en hel årgang ingeniørstuderende i Danmark med åbne og lukkede spørgsmål og brug af både kvantitative og kvalitative tilgange indikerer, at ingeniørstuderendes opfattelse af ingeniørens professionelle identitet og faglige værdier ikke lever op til de normative idealforestillinger om professionalisme, der omfatter en selv-refleksiv professionel stræben efter at adressere samfundsmæssige udfordringer og bæredygtighed.

På forskellig vis kortlægges ingeniørstuderendes forståelse af ingeniøridentiteten og deres dispositioner i relation til bæredygtighed og samfundsmæssige udfordringer, hvilket bidrager til at kvalificere ingeniøruddannelsessystemets muligheder for at målrette deres uddannelsesstrategiske tiltag nøjere til forskellige grupperinger af studerende på baggrund af deres prædispositioner og potentiale for udvikling af en bæredygtig faglighed.

Afhandlingen baserer sig kumulativt på tidligere amerikanske studier (særligt APPLES) og på Jamison's (senest Jamison 2013) forestilling om den hybride ingeniøridentitet set fra et socio-kulturelt perspektiv på videnskab og teknologi.

De ingeniørstuderendes forestillinger om at være ingeniør understøtter ikke en ingeniøruddannelsesteoretiske karakteristik af professionen som en profession i risiko for at opløses. Som andre professioner er ingeniørerne udsat for en række pres og udviklingsmæssige strømninger tillige med de globale, samfundsmæssige udfordringer. Forestillingerne om ingeniørens samfundsmæssige rolle og betydning hos de førsteårsstuderende på ingeniøruddannelserne i Danmark er dog relativt upåvirkede af disse tendenser. Selvom bæredygtighedsproblematikker placerer dem i et arketypisk dilemma mellem natur og teknologi, prøver de ingeniørstuderende at undgå at skulle forholde sig personligt og professionelt ansvarligt. Deres opfattelser af den professionelle ingeniøridentitet bliver udfordret af bæredygtighedsbegrebet, der aktiverer en kollektiv skyldfølelse i dem på teknologiens vegne over de negative konsekvenser af den teknologiske udvikling. Samtidig giver den teknologiske faglighed dem en iboende tilfredsstillelse og motivation for studiet, og et snævert teknisk fokus er udbredt, hvilket stemmer overens med stereotypiske fordomme om ingeniører.

Stereotyperne udgør dog ikke den altoverskyggende del af billedet. De fleste ingeniørstuderende anerkender, at ingeniørfaget er meget mere end matematiske og naturvidenskabelige dyder. Måske er det ligefrem en positiv overraskelse, at der allerede på førsteårsniveau kan findes ingeniørstuderende, som er i stand til diskursivt at italesætte en spirende professionel identitet, som forener teknologifascination med omsorg for naturen og reformulerer et ideal om en grøn ingeniørgerning, der lægger sig tæt op af den hybride ingeniøridentitet.

Eksemplerne på sådanne ingeniørstuderende, der påtager sig et ansvar for den teknologiske udvikling og anvendelse i samfundet, er opløftende, selvom de er få. Og en måde at understøtte de ingeniørstuderende i at udvikle sig hen imod en bæredygtig, hybrid ingeniøridentitet kunne gå gennem en klarere diskursiv sammenknytning af bæredygtighed og problemløsningskonceptet, der fremstår som en relativt tom betegner, der kunne bane vejen for en stærkere kobling af bæredygtighed til den professionelle ingeniøridentitet.

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Appendices

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14b) Professor Sheri Sheppard, Stanford University
14c) Professor Anette Kolmos, Aalborg University
14d) Centre Director Niels Mejlgaard, Aarhus University

Survey to newly enrolled Engineering Students in Denmark

You answer the questions by clicking the box at the answer you want to give.

At the bottom of the window you can follow the progression of the questions and move back and forth in the questions. Answering the questions will take approximately 15 min.

Your responses are saved along the way, so if you happen to be interrupted, you can access the questionnaire again via the link you have received.

Please remember to answer the questionnaire before Friday, 1 October 2010. The winner of DKK 10 000 will be contacted directly soon after Monday, 1 November 2010. You enter the draw once you have answered the questions and clicked 'Finish'.

Thanks in advance for your participation!

**

1. We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you:

	Not a reason for my choice of education	Minimal reason for my choice of education	Moderate reason for my choice of education	Major reason for my choice of education	Do not know
Technology plays an important role in solving society's problems	☐	☐	☐	☐	☐
Engineers make more money than most other professionals	☐	☐	☐	☐	☐
My parent(s) would disapprove if I chose a major other than engineering	☐	☐	☐	☐	☐
Engineers have contributed greatly to fixing problems in the world	☐	☐	☐	☐	☐
Engineers are well paid	☐	☐	☐	☐	☐
My parent(s) want me to be an engineer	☐	☐	☐	☐	☐
An engineering degree will guarantee me a job when I graduate	☐	☐	☐	☐	☐
A faculty member, academic advisor, teaching assistant or other university affiliated person has encouraged and/or inspired me to study engineering	☐	☐	☐	☐	☐
A non-university affiliated mentor has encouraged and/or inspired me to study engineering	☐	☐	☐	☐	☐
A mentor has introduced me to people and opportunities in engineering	☐	☐	☐	☐	☐
I feel good when I am doing engineering	☐	☐	☐	☐	☐
I like to build stuff	☐	☐	☐	☐	☐
I think engineering is fun	☐	☐	☐	☐	☐
Engineering skills can be used for the good of society	☐	☐	☐	☐	☐
I think engineering is interesting	☐	☐	☐	☐	☐
I like to figure out how things work	☐	☐	☐	☐	☐
Constructing new solutions fascinates me	☐	☐	☐	☐	☐

2. Please indicate how strongly you disagree or agree with each of the statements:

	Disagree strongly	Disagree	Agree	Agree strongly	Do not know
Creative thinking is one of my strengths	☐	☐	☐	☐	☐
I am skilled at solving problems that can have multiple solutions	☐	☐	☐	☐	☐
A mentor has supported my decision to study engineering	☐	☐	☐	☐	☐

**

3. Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself.

	Lowest 10%	Below average	Average	Above average	Highest 10%	Do not know
Self confidence (social)	☐	☐	☐	☐	☐	☐
Leadership ability	☐	☐	☐	☐	☐	☐
Public speaking ability	☐	☐	☐	☐	☐	☐
Math ability	☐	☐	☐	☐	☐	☐
Science ability	☐	☐	☐	☐	☐	☐
Communication skills	☐	☐	☐	☐	☐	☐
Ability to apply math and science principles in solving real world problems	☐	☐	☐	☐	☐	☐
Business ability	☐	☐	☐	☐	☐	☐
Ability to perform in teams	☐	☐	☐	☐	☐	☐
Critical thinking skills	☐	☐	☐	☐	☐	☐
Wish to find new solutions	☐	☐	☐	☐	☐	☐

4. How important do you think each of the following skills and abilities is to becoming a successful engineer?

	Not important	Somewhat important	Very important	Crucial	Do not know
Self confidence (social)	☐	☐	☐	☐	☐
Leadership ability	☐	☐	☐	☐	☐
Public speaking ability	☐	☐	☐	☐	☐
Math ability	☐	☐	☐	☐	☐
Science ability	☐	☐	☐	☐	☐
Communication skills	☐	☐	☐	☐	☐

Ability to apply math and science principles in solving real world problems	☐	☐	☐	☐	☐
Business ability	☐	☐	☐	☐	☐
Ability to perform in teams	☐	☐	☐	☐	☐
Critical thinking skills	☐	☐	☐	☐	☐
Wish to find new solutions	☐	☐	☐	☐	☐

5. You have been asked to design a playground. You have a limited amount of time and resources to gather information for your design. From the following list, please put a check mark next to the FIVE kinds of information you would MOST LIKELY NEED as you work on your design:

☐ Availability of materials
☐ Body proportions
☐ Budget
☐ Handicapped accessibility
☐ Information about the area
☐ Labor availability and cost
☐ Legal liability
☐ Maintenance concerns
☐ Material costs
☐ Material specifications
☐ Neighborhood demographics
☐ Neighborhood opinions
☐ Safety
☐ Supervision concerns
☐ Technical references
☐ Utilities

6. Of the 20 items below, please put a check mark next to the FIVE you think are MOST IMPORTANT practicing engineering

☐ Business knowledge
☐ Communication
☐ Conducting experiments
☐ Contemporary issues
☐ Creativity
☐ Data analysis
☐ Design
☐ Engineering analysis
☐ Engineering tools
☐ Ethics
☐ Global context
☐ Leadership
☐ Life-long learning
☐ Management skills
☐ Math
☐ Problem solving
☐ Professionalism
☐ Science
☐ Societal context
☐ Teamwork

7. Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer:

	Not at all prepared	...	Somewhat prepared	...	Very well prepared
Business knowledge	☐	☐	☐	☐	☐
Communication	☐	☐	☐	☐	☐
Conducting experiments	☐	☐	☐	☐	☐
Contemporary issues	☐	☐	☐	☐	☐
Creativity	☐	☐	☐	☐	☐
Data analysis	☐	☐	☐	☐	☐
Design	☐	☐	☐	☐	☐
Engineering analysis	☐	☐	☐	☐	☐
Engineering tools	☐	☐	☐	☐	☐
Ethics	☐	☐	☐	☐	☐
Global context	☐	☐	☐	☐	☐
Leadership	☐	☐	☐	☐	☐
Life-long learning	☐	☐	☐	☐	☐
Management skills	☐	☐	☐	☐	☐
Math	☐	☐	☐	☐	☐
Problem solving	☐	☐	☐	☐	☐
Professionalism	☐	☐	☐	☐	☐

Science	☐	☐	☐	☐	☐
Societal context	☐	☐	☐	☐	☐
Teamwork	☐	☐	☐	☐	☐

8. Prioritise how important the issues below are to you using the numbers from 1-5. Please write 1 at the issue that you find most important, 2 at the second-most important issue, etc.

To prevent pollution	___
To ensure resources for future generations	___
To generate economic growth in Denmark	___
To combat global climate changes	___
To improve living conditions of people in developing countries	___

9. Prioritise between the statements below on the role of engineers in society. Please write 1 at the statement that you find most important, 2 at the second-most important statement and 3 at the third most important.

Engineers should contribute to solving problems related to climate change and environmental degradation	___
Engineers should contribute to ensuring that technological development is utilised in a fair and responsible way	___
Engineers should contribute to creating an overview of complex interrelations between different scientific and technical fields	___

10. Please rate your interest in the fields listed below:

	Very interested	Somewhat interested	Not interested	Do not know
Working environment	☐	☐	☐	☐
Biofuel	☐	☐	☐	☐
Ethics	☐	☐	☐	☐
Engineering projects in developing countries	☐	☐	☐	☐
Research communication	☐	☐	☐	☐
Global division of labour	☐	☐	☐	☐
Innovation	☐	☐	☐	☐
Intercultural communication	☐	☐	☐	☐
Entrepreneurship	☐	☐	☐	☐
Climate change	☐	☐	☐	☐
Air pollution	☐	☐	☐	☐
Human rights	☐	☐	☐	☐
Modelling	☐	☐	☐	☐
Technology transfer	☐	☐	☐	☐
The interplay between different technological systems	☐	☐	☐	☐
Theory of science	☐	☐	☐	☐
Growth strategies	☐	☐	☐	☐

11. How do you rate your knowledge on the following topics:

	Not heard of	Heard of but could not explain	Have some knowledge	Know a lot
Working environment	☐	☐	☐	☐
Biofuel	☐	☐	☐	☐
Ethics	☐	☐	☐	☐
Engineering projects in developing countries	☐	☐	☐	☐
Research communication	☐	☐	☐	☐
Global division of labour	☐	☐	☐	☐
Innovation	☐	☐	☐	☐
Intercultural communication	☐	☐	☐	☐
Entrepreneurship	☐	☐	☐	☐
Climate change	☐	☐	☐	☐
Air pollution	☐	☐	☐	☐
Human rights	☐	☐	☐	☐
Modelling	☐	☐	☐	☐
Technology transfer	☐	☐	☐	☐
The interplay between different technological systems	☐	☐	☐	☐
Theory of science	☐	☐	☐	☐
Growth strategies	☐	☐	☐	☐

12. Now there will be some statements that people have made about science, technology or the environment. For each statement, please tell me how much you agree or disagree.

	Totally agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Totally disagree	Do not know
Thanks to scientific and technological advances, the Earth's natural resources will be inexhaustible	☐	☐	☐	☐	☐	☐
Science and technology can sort out any problem	☐	☐	☐	☐	☐	☐
Science and technology cannot really play a role in improving the environment	☐	☐	☐	☐	☐	☐
The applications of science and technology can threaten human rights	☐	☐	☐	☐	☐	☐
New inventions will always be found to counteract any harmful effect of scientific and technological developments	☐	☐	☐	☐	☐	☐
The benefits of science are greater than any harmful effects it may have	☐	☐	☐	☐	☐	☐

13. And now, there will be a few questions on how you *engage* with science and technology. Do you…?

	Yes, regularly	Yes, occasionally	No, hardly ever	No, never	Do not know
Watch or listen to media programmes about scientific or technologic issues?	❑	❑	❑	❑	❑
Talk to friends or family about scientific or technologic issues?	❑	❑	❑	❑	❑
Attend public meetings or debates about science and technology?	❑	❑	❑	❑	❑
Sign petitions or join street demonstrations on matters of nuclear power, biotechnology or the environment?	❑	❑	❑	❑	❑
Donate money to fundraising campaigns for medical research such as research into cancer?	❑	❑	❑	❑	❑
Participate in the activities of a non-governmental organisation dealing with science and technology related issues?	❑	❑	❑	❑	❑

14. Now, there will be a few questions on how you engage with *environmental questions*. Do you...?

	Yes, regularly	Yes, occasionally	No, hardly ever	No, never	Do not know
Watch or listen to media programmes about environmental questions?	❑	❑	❑	❑	❑
Talk to friends or family about environmental questions?	❑	❑	❑	❑	❑
Discuss environmental questions as part of your education?	❑	❑	❑	❑	❑
Attend public meetings or debates about environmental questions?	❑	❑	❑	❑	❑
Donate money to support of environmental questions?	❑	❑	❑	❑	❑
Participate in the activities of a non-governmental organisation dealing with environmental questions?	❑	❑	❑	❑	❑

15. Below are some questions focusing on your *consumption habits*.

	Yes, regularly, even if the price is somewhat higher	Yes, if the price is the same or marginally higher	No, hardly ever	No, never	Do not know
Do you choose products on the basis of ethical or environmental considerations?	❑	❑	❑	❑	❑
Do you buy fair trade products?	❑	❑	❑	❑	❑
Do you buy organic products?	❑	❑	❑	❑	❑

16. How would you characterise sustainability? Please describe in your own words how you understand the concept:

17. What is sustainability about in your opinion? Please indicate the items listed below that you find related to the concept of sustainability.

❑ Ethics
❑ Global context
❑ Law
❑ Technological context
❑ Natural context
❑ Life-long learning
❑ Politics
❑ Societal context
❑ Social responsibility
❑ Economic context

18. To what extent do you regard your educational institution an organisation with a focus on sustainability?

❑ Very much
❑ To some extent
❑ To a minor extent
❑ Not at all

❑ Do not know

19. How would you rate your abilities within the listed fields:

	Very good	Fairly good	Not very good	Poor	Do not know
Project management	❑	❑	❑	❑	❑
Rote learning	❑	❑	❑	❑	❑
Teamwork skills	❑	❑	❑	❑	❑
Individual written assignments	❑	❑	❑	❑	❑
Idea creation	❑	❑	❑	❑	❑
Organisational talent	❑	❑	❑	❑	❑
Conflict management	❑	❑	❑	❑	❑
Laboratory experimenting	❑	❑	❑	❑	❑
Oral communication	❑	❑	❑	❑	❑
Ability to work independently	❑	❑	❑	❑	❑
Written communication	❑	❑	❑	❑	❑

**

20. To what extent have you had experience with group-based project work?

❑ Very much
❑ To some extent
❑ To a minor extent
❑ Not at all
❑ Do not know

21. Have you previously received education in environmental issues?

❑ Yes
❑ No
❑ Do not know

21a. Please indicate at which levels you have received education in environmental issues?

❑ Primary or lower secondary school
❑ Upper secondary school or youth education programme
❑ Higher education
❑ Other

22. Have you previously received education in sustainability?

❑ Yes
❑ No
❑ Do not know

22a. Please indicate at which levels you have received education concerning sustainability?

❑ Primary or lower secondary school
❑ Upper secondary school or youth education programme
❑ Higher education
❑ Other

**

23. Please indicate whether you agree or disagree in the following attitudes towards different subjects?

	Agree	Neither agree nor disagree	Disagree
Natural science makes it possible to act on an objective basis	❑	❑	❑
Social science provides insight necessary for the development of technology	❑	❑	❑
Philosophy makes it possible to make a critical analysis and comparison of different subjects	❑	❑	❑
Language and literature provide access to understanding relations between humans and technology	❑	❑	❑
Mathematics provides access to a universal 'language' for all sciences	❑	❑	❑
Social science is a subject dominated by attitude where all views are of equal value	❑	❑	❑
Natural science subjects provide the instruments for understanding the world and develop technology	❑	❑	❑
It is possible to give an objective account of historic developments	❑	❑	❑
It is possible to govern technological progress based on insights in economic matters	❑	❑	❑

24. What is your educational background?

❑ Upper secondary school or high school
❑ Business, commercial or technical college
❑ Other___________________

25. How many people aged 15 years or more live in your household, yourself included?

____

26. How many children aged 0 to 14 years old live in your household?

____

27. Please indicate the highest level of education completed by your mother.

- ☐ Elementary school (primary and lower secondary school)
- ☐ Upper secondary school or high school
- ☐ Business, commercial or technical college
- ☐ Vocational training (e.g. builder, carpenter, electrician or corresponding level)
- ☐ Short term further education (e.g. real estate agent, information technologist, police officer or corresponding level)
- ☐ Medium lenght higher education (e.g. BSc, BA degree, nurse, school teacher or corresponding level)
- ☐ Master's level degree (MSc, MA degree or similar)
- ☐ PhD level degree (postgraduate or graduate degree programme)
- ☐ Other__________________

28. Please indicate the highest level of education completed by your father.

- ☐ Elementary school (primary and lower secondary school)
- ☐ Upper secondary school or high school
- ☐ Business, commercial or technical college
- ☐ Vocational training (e.g. builder, carpenter, electrician or corresponding level)
- ☐ Short term further education (e.g. real estate agent, information technologist, police officer or corresponding level)
- ☐ Medium lenght higher education (e.g. BSc, BA degree, nurse, school teacher or corresponding level)
- ☐ Master's level degree (MSc, MA degree or similar)
- ☐ PhD level degree (postgraduate or graduate degree programme)
- ☐ Other__________________

29. Does/Did any of your family have a job or a university qualification in natural science, technology or engineering (for instance, physics, chemistry, biology, medicine)?

- ☐ Yes, your father
- ☐ Yes, your mother
- ☐ Yes, another member of your family
- ☐ No, no one in your family

30. Do any of your immediate family members hold an engineering degree?

- ☐ No
- ☐ Yes

30a. What/which family member(s):

- ☐ Father or stepfather
- ☐ Mother or stepmother
- ☐ Brother or stepbrother
- ☐ Sister or stepsister
- ☐ Other

31. Do you hold a Danish citizenship?

- ☐ Yes
- ☐ No

31a. In which geographical area are you a citizen?

- ☐ Nordic countries
- ☐ (Other) Europe
- ☐ US
- ☐ (Other) North or Central America
- ☐ South America
- ☐ Asia
- ☐ Africa
- ☐ Australia or Oceania

Once you have completed the questionnaire remember to press 'Finish'. After that your responses can no longer be changed and you enter the draw to win DKK 10.000.
Thank you for your participation.

FOR THE ENGLISH VERSION, PLEASE CLICK THE FLAG BELOW

Spørgeskemaundersøgelse af alle danske ingeniørstuderende årgang 2010

Du besvarer spørgsmålene ved at klikke på boxen ved det svar, du vil afgive.

Nederst i vinduet kan du orientere dig om, hvor langt du er nået i spørgeskemaet og bladre frem og tilbage mellem spørgsmålene. Det tager ca. 15 minutter at besvare spørgsmålene.

Dine indtastninger bliver løbende gemt, så hvis du bliver forstyrret undervejs, kan du vende tilbage til din besvarelse ved hjælp af det link, du har fået tilsendt.

Husk at seneste frist for besvarelsen er fredag den 1. oktober 2010. Vinderen af de 10.000 kroner udtrækkes mandag den 1. november 2010 og får direkte besked hurtigst muligt herefter. Du deltager i lodtrækningen, når du har besvaret spørgsmålene og trykket på "Afslut" til sidst.

God fornøjelse!

På forhånd tak for hjælpen!

1. Vi er interesserede i at vide, hvorfor du har valgt at uddanne dig til ingeniør. Angiv hvor stor indflydelse de følgende faktorer har haft for dit valg af uddannelse

	Ingen indflydelse på mit valg af uddannelse	Begrænset indflydelse på mit valg af uddannelse	Nogen indflydelse på mit valg af uddannelse	Afgørende indflydelse på mit valg af uddannelse	Ved ikke
Teknologi spiller en vigtig rolle for løsningen af samfundets problemer	☐	☐	☐	☐	☐
Ingeniører tjener flere penge end folk i de fleste andre stillinger	☐	☐	☐	☐	☐
Mine forældre ville ikke bryde sig om det, hvis jeg valgte en anden uddannelse	☐	☐	☐	☐	☐
Ingeniører har bidraget afgørende til at løse problemer i verden	☐	☐	☐	☐	☐
Ingeniører får en god løn	☐	☐	☐	☐	☐
Mine forældre vil gerne have at jeg skal være ingeniør	☐	☐	☐	☐	☐
En ingeniøruddannelse vil garantere mig et job, når jeg bliver færdiguddannet	☐	☐	☐	☐	☐
En underviser, studievejleder eller en anden med tilknytning til mit nye uddannelsessted har opfordret eller inspireret mig til at læse til ingeniør	☐	☐	☐	☐	☐
Jeg er blevet opfordret eller inspireret til at læse til ingeniør af en person uden tilknytning til min uddannelsesinstitution	☐	☐	☐	☐	☐
En person, jeg har tillid til, har introduceret mig for personer og muligheder inden for ingeniørfeltet	☐	☐	☐	☐	☐
Jeg har det godt med at udføre ingeniørrelaterede aktiviteter	☐	☐	☐	☐	☐
Jeg kan godt lide at bygge ting	☐	☐	☐	☐	☐
Jeg synes, at ingeniørfaget er sjovt	☐	☐	☐	☐	☐
Ingeniørkompetencer kan bruges til gavn for samfundet	☐	☐	☐	☐	☐
Jeg synes, at ingeniørfaget er interessant	☐	☐	☐	☐	☐
Jeg kan godt lide at finde ud af, hvordan ting virker	☐	☐	☐	☐	☐
Jeg er fascinereret af at konstruere nye løsninger	☐	☐	☐	☐	☐

**

2. Angiv hvor enig eller uenig du er i følgende udsagn

	Meget uenig	Uenig	Enig	Meget enig	Ved ikke
Kreativ tænkning er en af mine styrker	☐	☐	☐	☐	☐
Jeg er god til at løse problemer som har mange mulige løsninger	☐	☐	☐	☐	☐
En person, som jeg har tillid til, har støttet min beslutning om at starte på ingeniørstudiet	☐	☐	☐	☐	☐

3. Vurder dig selv på hvert af de følgende områder i forhold til dine medstuderende på ingeniøruddannelsen. Vi er interesserede i det mest nøjagtige bud på, hvordan du ser dig selv i forhold til:

	Blandt de dårligste 10%	Under gennemsnittet	Blandt gennemsnittet	Over gennemsnittet	Blandt de bedste 10%	Ved ikke
Selvsikkerhed	☐	☐	☐	☐	☐	☐
Lederevner	☐	☐	☐	☐	☐	☐
Evne til at tale i forsamlinger	☐	☐	☐	☐	☐	☐
Matematiske evner	☐	☐	☐	☐	☐	☐
Videnskabelige evner	☐	☐	☐	☐	☐	☐
Kommunikative evner	☐	☐	☐	☐	☐	☐
Evne til at anvende matematik og videnskab til at løse "real life" problemer	☐	☐	☐	☐	☐	☐
Forretningstalent	☐	☐	☐	☐	☐	☐
Evne til at arbejde i teams	☐	☐	☐	☐	☐	☐

Evne til at tænke kritisk	☐	☐	☐	☐	☐	☐
Lyst til at finde nye løsninger	☐	☐	☐	☐	☐	☐

4. Angiv hvor vigtige du mener hver af de følgende evner og kompetencer er for at blive en succesfuld ingeniør

	Ikke vigtigt	I nogen grad vigtigt	Meget vigtigt	Helt afgørende	Ved ikke
Selvsikkerhed	☐	☐	☐	☐	☐
Lederevner	☐	☐	☐	☐	☐
Evne til at tale i forsamlinger	☐	☐	☐	☐	☐
Matematiske evner	☐	☐	☐	☐	☐
Videnskabelige evner	☐	☐	☐	☐	☐
Kommunikative evner	☐	☐	☐	☐	☐
Evne til at anvende matematik og videnskab til at løse "real life" problemer	☐	☐	☐	☐	☐
Forretningstalent	☐	☐	☐	☐	☐
Evne til at arbejde i teams	☐	☐	☐	☐	☐
Evne til at tænke kritisk	☐	☐	☐	☐	☐
Lyst til at finde nye løsninger	☐	☐	☐	☐	☐

5. Forestil dig, at du bliver bedt om at designe en legeplads. Du har begrænset tid og begrænsede ressourcer til at skaffe dig viden. Sæt kryds ved de <u>fem</u> ting i listen, som du finder det <u>mest vigtigt</u> at indhente information om:

☐ Tilgængelighed af materialer
☐ Kroppens proportioner
☐ Budget
☐ Adgangsforhold for handicappede
☐ Information om området
☐ Arbejdskraftens tilgængelighed og pris
☐ Juridiske forpligtelser
☐ Vedligeholdelseshensyn
☐ Materialeomkostninger
☐ Tekniske specifikationer for materialer
☐ Nabolagets demografi
☐ Nabolagets holdninger
☐ Sikkerhed
☐ Hensyn til tilsyn eller overvågning
☐ Tekniske hensyn
☐ Adgang til offentlige forsyningsværker

6. Sæt kryds i nedenstående liste ved de <u>fem</u> emner, du synes er <u>mest vigtige</u> for ingeniørarbejdet.

☐ Kendskab til erhvervslivet
☐ Kommunikation
☐ Udførelse af eksperimenter
☐ Samfundsaktuelle emner
☐ Kreativitet
☐ Dataanalyse
☐ Design
☐ Ingeniørteknisk analyse
☐ Ingeniørfaglige redskaber
☐ Etik
☐ Globale sammenhænge
☐ Ledelse
☐ Livslang læring
☐ Organisatoriske færdigheder
☐ Matematik
☐ Problemløsning
☐ Professionalisme
☐ Videnskab
☐ Samfundsmæssige sammenhænge
☐ Teamwork/samarbejde

7. Angiv hvor godt du føler dig forberedt på at anvende hvert af de følgende emner i et stykke ingeniørarbejde?

	Slet ikke forberedt	...	Noget forberedt	...	Rigtig godt forberedt
Kendskab til erhvervslivet	☐	☐	☐	☐	☐
Kommunikation	☐	☐	☐	☐	☐
Udførelse af eksperimenter	☐	☐	☐	☐	☐
Samfundsaktuelle emner	☐	☐	☐	☐	☐
Kreativitet	☐	☐	☐	☐	☐

Dataanalyse	☐	☐	☐	☐	☐
Design	☐	☐	☐	☐	☐
Ingeniørteknisk analyse	☐	☐	☐	☐	☐
Ingeniørfaglige redskaber	☐	☐	☐	☐	☐
Etik	☐	☐	☐	☐	☐
Globale sammenhænge	☐	☐	☐	☐	☐
Ledelse	☐	☐	☐	☐	☐
Livslang læring	☐	☐	☐	☐	☐
Organisatoriske færdigheder	☐	☐	☐	☐	☐
Matematik	☐	☐	☐	☐	☐
Problemløsning	☐	☐	☐	☐	☐
Professionalisme	☐	☐	☐	☐	☐
Videnskab	☐	☐	☐	☐	☐
Samfundsmæssige sammenhænge	☐	☐	☐	☐	☐
Teamwork/samarbejde	☐	☐	☐	☐	☐

8. Vælg hvor vigtige emnerne nedenfor er for dig ved hjælp af tallene 1-5. Skriv 1 ved det mest vigtige, 2 ved det næstvigtigste, osv.

At forhindre forurening ___

At sikre ressourcer til fremtidige generationer ___

At skabe økonomisk vækst i Danmark ___

At bekæmpe de globale klimaforandringer ___

At forbedre forholdene for mennesker i ulandene ___

9. Prioritér mellem nedenstående udsagn om ingeniørers rolle i samfundet. Skriv 1 ved det, der for dig er mest vigtigt, 2 ved det næstvigtigste og 3 ved det tredjevigtigste.

Ingeniører skal være med til at løse problemer omkring klimaforandringer og forringelse af miljøressourcer ___

Ingeniører skal være med til at sikre, at teknologiske fremskridt bliver udnyttet ansvarligt og retfærdigt ___

Ingeniører skal være med til at skabe overblik over komplekse sammenhænge mellem forskellige videnskabelige og teknologiske fagområder ___

10. Angiv hvor interesseret du er i følgende emner:

	Meget interesseret	Lidt interesseret	Ikke interesseret	Ved ikke
Arbejdsmiljø	☐	☐	☐	☐
Biobrændstof	☐	☐	☐	☐
Etik	☐	☐	☐	☐
Ingeniørprojekter i udviklingslande	☐	☐	☐	☐
Forskningsformidling	☐	☐	☐	☐
Global arbejdsdeling	☐	☐	☐	☐
Innovation	☐	☐	☐	☐
Interkulturel kommunikation	☐	☐	☐	☐
Iværksætteri	☐	☐	☐	☐
Klimaforandringer	☐	☐	☐	☐
Luftforurening	☐	☐	☐	☐
Menneskerettigheder	☐	☐	☐	☐
Modellering	☐	☐	☐	☐
Teknologioverførsel	☐	☐	☐	☐
Teknologiske systemers samspil	☐	☐	☐	☐
Videnskabsteori	☐	☐	☐	☐
Vækststrategier	☐	☐	☐	☐

11. Hvordan vil du vurdere din viden om følgende emner?

	Har aldrig hørt om	Har hørt om, men kan ikke forklare	Har nogen viden om	Ved meget om
Arbejdsmiljø	☐	☐	☐	☐
Biobrændstof	☐	☐	☐	☐
Etik	☐	☐	☐	☐
Ingeniørprojekter i udviklingslande	☐	☐	☐	☐
Forskningsformidling	☐	☐	☐	☐
Global arbejdsdeling	☐	☐	☐	☐
Innovation	☐	☐	☐	☐
Interkulturel kommunikation	☐	☐	☐	☐
Iværksætteri	☐	☐	☐	☐
Klimaforandringer	☐	☐	☐	☐
Luftforurening	☐	☐	☐	☐
Menneskerettigheder	☐	☐	☐	☐
Modellering	☐	☐	☐	☐
Teknologioverførsel	☐	☐	☐	☐
Teknologiske systemers samspil	☐	☐	☐	☐
Videnskabsteori	☐	☐	☐	☐
Vækststrategier	☐	☐	☐	☐

12. Her kommer nogle udsagn om videnskab og teknologi. Angiv hvor enig eller uenig du er i hvert udsagn

	Fuldstændig enig	Tilbøjelig til at være enig	Hverken enig eller uenig	Tilbøjelig til at være uenig	Fuldstændig uenig	Ved ikke
Takket være videnskabelige og teknologiske fremskridt vil jordens naturlige ressourcer være uudtømmelige	❑	❑	❑	❑	❑	❑
Videnskab og teknologi kan løse et hvilket som helst problem	❑	❑	❑	❑	❑	❑
Videnskab og teknologi kan ikke rigtig spille nogen egentlig rolle i forbedring af miljøet	❑	❑	❑	❑	❑	❑
Anvendelserne af videnskab og teknologi kan være en trussel mod menneskerettighederne	❑	❑	❑	❑	❑	❑
Nye opfindelser vil altid blive udviklet til at modvirke alle skadelige følger af videnskabelig og teknologisk udvikling	❑	❑	❑	❑	❑	❑
Fordelene ved videnskab er større end alle skadelige virkninger den måtte have	❑	❑	❑	❑	❑	❑

13. Nu kommer der nogle spørgsmål om hvor *engageret* du er inden for videnskab og teknologi. Hvor ofte:

	Ja, regelmæssigt	Ja, indimellem	Nej, næsten aldrig	Nej, aldrig	Ved ikke
Ser eller hører du programmer om teknologi eller videnskabelige emner i medierne?	❑	❑	❑	❑	❑
Taler du om videnskabelige emner eller teknologi med venner og familie?	❑	❑	❑	❑	❑
Deltager du i offentlige møder eller debatter om videnskab og teknologi?	❑	❑	❑	❑	❑
Skriver du under på underskriftsindsamlinger eller deltager i gadedemonstrationer i forbindelse med atomkraft, bioteknologi eller miljøet?	❑	❑	❑	❑	❑
Donerer du penge til støttekampagner for medicinsk forskning som f.eks. Kræftens bekæmpelse?	❑	❑	❑	❑	❑
Deltager du i aktiviteter arrangeret af ikke-statslige organisationer, der arbejder inden for videnskab og teknologi?	❑	❑	❑	❑	❑

14. Nu kommer der nogle spørgsmål om, hvor engageret du er inden for *miljøspørgsmål*. Hvor ofte:

	Ja, regelmæssigt	Ja, indimellem	Nej, næsten aldrig	Nej, aldrig	Ved ikke
Ser eller hører du programmer om miljøspørgsmål i medierne	❑	❑	❑	❑	❑
Taler du om miljøspørgsmål med venner og familie	❑	❑	❑	❑	❑
Diskuterer du miljøspørgsmål som led i undervisningen	❑	❑	❑	❑	❑
Deltager du i offentlige møder eller debatter om miljøspørgsmål	❑	❑	❑	❑	❑
Donerer du penge til støtte for miljøspørgsmål?	❑	❑	❑	❑	❑
Deltager du i aktiviteter arrangeret af ikke-statslige organisationer, som beskæftiger sig med miljøspørgsmål?	❑	❑	❑	❑	❑

15. Nu kommer der nogle spørgsmål om dine *forbrugsvaner*. Hvor ofte:

	Ja, regelmæssigt også selvom prisen er noget højere	Ja, hvis prisen er den samme eller kun en smule højere	Nej, næsten aldrig	Nej, aldrig	Ved ikke
Vælger du produkter ud fra etiske eller miljømæssige spørgsmål	❑	❑	❑	❑	❑
Køber du fairtrade-varer	❑	❑	❑	❑	❑
Køber du økologiske varer	❑	❑	❑	❑	❑

16. Hvordan vil du karakterisere bæredygtighed? Skriv med dine egne ord, hvordan du forstår begrebet:

17. Hvad mener du bæredygtighed drejer sig om? Sæt kryds i nedenstående liste ved de emner, du forbinder med begrebet bæredygtighed.

- Etik
- Globale sammenhænge
- Jura
- Teknologiske sammenhænge
- Natur- og miljømæssige sammenhænge
- Livslang læring
- Politik
- Samfundsmæssige sammenhænge
- Social ansvarlighed
- Økonomiske sammenhænge

18. I hvor høj grad opfatter du din uddannelsesinstitution som en organisation, der har fokus på bæredygtighed?

- I høj grad
- I nogen grad
- I ringe grad
- Slet ikke
- Ved ikke

19. Hvordan vil du vurdere dine kompetencer på følgende områder?

	Rigtig gode	Nogenlunde	Ikke så gode	Dårlige	Ved ikke
Projektledelse	☐	☐	☐	☐	☐
Udenadslære	☐	☐	☐	☐	☐
Samarbejdsevne	☐	☐	☐	☐	☐
Individuelle, skriftlige opgaver	☐	☐	☐	☐	☐
Ideskabelse	☐	☐	☐	☐	☐
Organisationstalent	☐	☐	☐	☐	☐
Konflikthåndtering	☐	☐	☐	☐	☐
Laboratorieforsøg	☐	☐	☐	☐	☐
Selvstændigt arbejde	☐	☐	☐	☐	☐
Mundtlig formidling	☐	☐	☐	☐	☐
Skriftlig formidling	☐	☐	☐	☐	☐

**

20. I hvilket omfang har du erfaring med gruppebaseret projektarbejde?

- I høj grad
- I nogen grad
- I ringe grad
- Slet ikke
- Ved ikke

21. Har du tidligere fået undervisning omkring miljøspørgsmål?

- Ja
- Nej
- Ved ikke

21a. I hvilken sammenhæng har du fået undervisning i miljøspørgsmål?

- I folkeskolen
- På en ungdomsuddannelse
- På en videregående uddannelse
- Andet

22. Har du tidligere fået undervisning omkring bæredygtighed?

- Ja
- Nej
- Ved ikke

22a. I hvilken sammenhæng har du fået undervisning i bæredygtighed?

- I folkeskolen
- På en ungdomsuddannelse
- På en videregående uddannelse
- Andet

**

23. Hvor enig eller uenig er du i de følgende holdninger til forskellige fag?

	Enig	Hverken enig eller uenig	Uenig
Naturvidenskaben gør det muligt at handle på et objektivt grundlag	☐	☐	☐
Samfundsfag giver en indsigt, der er nødvendig for udviklingen af teknologi	☐	☐	☐
Filosofien gør det muligt kritisk at analysere og sammenligne forskellige fagområder	☐	☐	☐
Sprogfag og litteratur giver adgang til at forstå relationen mellem mennesker og teknologi	☐	☐	☐
Matematikken giver adgang til et universelt "sprog" for alle videnskaber	☐	☐	☐

Samfundsfag er et fag domineret af holdninger, hvor alle synspunkter kan være lige gode	❑	❑	❑
De naturvidenskabelige fag leverer instrumenterne til at forstå verden og udvikle teknologi	❑	❑	❑
Det er muligt at give en objektiv fremstilling af historisk udvikling	❑	❑	❑
Det er muligt at styre den teknologiske udvikling ud fra en indsigt i økonomiske forhold	❑	❑	❑

24. Hvad er din uddannelsesmæssige baggrund?

❑ Gymnasium eller hf (alment gymnasium)
❑ Hhx/htx (handels-/ teknisk gymnasium)
❑ Andet__________________

25. Hvor mange personer på 15 år og derover bor der i din husstand, inklusiv dig selv?

____

26. Hvor mange børn i alderen fra 0 til 14 år bor der i din husstand?

____

**

27. Hvilken uddannelsesmæssig baggrund har din mor? Angiv højeste, fuldførte uddannelse.

❑ Grundskole (folkeskole)
❑ Gymnasium eller hf (alment gymnasium)
❑ Hhx/htx (handels-/ teknisk gymnasium)
❑ Erhvervsfaglig uddannelse fx murer, tømrer og elektriker
❑ Kort, videregående uddannelse fx ejendomsmægler, datamatiker og politibetjent
❑ Mellemlang, videregående uddannelse fx sygeplejerske, folkeskolelærer, diplomingeniør og bachelor
❑ Lang, videregående uddannelse fx kandidatuddannelse og civilingeniør
❑ Forskeruddannelse/ph.d.-uddannelse
❑ Andet__________________

28. Hvilken uddannelsesmæssig baggrund har din far? Angiv højeste, fuldførte uddannelse.

❑ Grundskole (folkeskole)
❑ Gymnasium eller hf (alment gymnasium)
❑ Hhx/htx (handels-/ teknisk gymnasium)
❑ Erhvervsfaglig uddannelse fx murer, tømrer og elektriker
❑ Kort, videregående uddannelse fx ejendomsmægler, datamatiker og politibetjent
❑ Mellemlang, videregående uddannelse fx sygeplejerske, folkeskolelærer, diplomingeniør og bachelor
❑ Lang, videregående uddannelse fx kandidatuddannelse og civilingeniør
❑ Forskeruddannelse/ph.d.-uddannelse
❑ Andet__________________

29. Er der nogen i din familie, der har eller har haft et job eller en universitetsuddannelse inden for naturvidenskab, teknologi eller ingeniørfaget (fysik, kemi, biologi, medicin eller lignende)?

❑ Ja, din far
❑ Ja, din mor
❑ Ja, et andet familiemedlem
❑ Nej, ingen i din familie

30. Er der nogle af dine nærmeste slægtninge, der er ingeniører?

❑ Nej
❑ Ja

**

30a. Hvilke(t) familiemedlem:

❑ Far eller stedfar
❑ Mor eller stedmor
❑ Bror eller stedbror
❑ Søster eller stedsøster
❑ Andet

31. Har du dansk statsborgerskab?

❑ Ja
❑ Nej

31a. I hvilket område har du statsborgerskab?

❑ Norden
❑ Øvrige Europa
❑ USA
❑ Øvrige Nord- og Mellemamerika
❑ Sydamerika
❑ Asien

☐ Afrika
☐ Australien og Oceanien

Når du har besvaret spørgsmålene i spørgeskemaet, skal du huske at trykke på "Afslut", så deltager du i lodtrækningen om 10.000 kroner. Vær opmærksom på, at du herefter ikke kan rette i din besvarelse.

Tak for din besvarelse!

Survey: Engineering Students in Denmark from year group 2010

You answer the questions by clicking the box next to the response that you want to give.

You enter the draw to win one of 10 prizes of DKK 1,000 each, once you have answered the questions and submitted your response by clicking 'Finish'. The winners will be contacted directly soon after Friday, 1st July 2011.

At the bottom of the window you can follow the progress of the survey and move back and forth between questions. It will take approximately 15 minutes to complete the questionnaire.

Your responses will automatically be saved so if you are interrupted during completion, you can re-access the questionnaire via the link you have received.

Thank you for your time and participation!

Please indicate how strongly you disagree or agree with each of the statements:

	Disagree strongly	Disagree	Agree	Agree strongly	Do not know
Creative thinking is one of my strengths	☐	☐	☐	☐	☐
I am skilled at solving problems that can have multiple solutions	☐	☐	☐	☐	☐
I am happy to be an engineering student	☐	☐	☐	☐	☐
I have a clear picture of what kind of work I can get when I graduate as an engineer	☐	☐	☐	☐	☐
If I was to start my education today, I would not choose an engineering programme	☐	☐	☐	☐	☐
I like my study's practical approach to technology	☐	☐	☐	☐	☐
I like my study's theoretical approach to technology	☐	☐	☐	☐	☐

Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself.

	Lowest 10%	Below average	Average	Above average	Highest 10%	Do not know
Self confidence (social)	☐	☐	☐	☐	☐	☐
Leadership ability	☐	☐	☐	☐	☐	☐
Public speaking ability	☐	☐	☐	☐	☐	☐
Math ability	☐	☐	☐	☐	☐	☐

Science ability	☐	☐	☐	☐	☐	☐
Communication skills	☐	☐	☐	☐	☐	☐
Ability to apply math and science principles in solving real world problems	☐	☐	☐	☐	☐	☐
Business ability	☐	☐	☐	☐	☐	☐
Ability to perform in teams	☐	☐	☐	☐	☐	☐
Critical thinking skills	☐	☐	☐	☐	☐	☐
Wish to find new solutions	☐	☐	☐	☐	☐	☐

How important do you think each of the following skills and abilities is to becoming a successful engineer?

	Not important	Somewhat important	Very important	Crucial	Do not know
Self confidence (social)	☐	☐	☐	☐	☐
Leadership ability	☐	☐	☐	☐	☐
Public speaking ability	☐	☐	☐	☐	☐
Math ability	☐	☐	☐	☐	☐
Science ability	☐	☐	☐	☐	☐
Communication skills	☐	☐	☐	☐	☐
Ability to apply math and science principles in solving real world problems	☐	☐	☐	☐	☐
Business ability	☐	☐	☐	☐	☐
Ability to perform in teams	☐	☐	☐	☐	☐
Critical thinking skills	☐	☐	☐	☐	☐
Wish to find new solutions	☐	☐	☐	☐	☐

State maximum three keywords which - to you - characterize an engineer

____

____

____

State maximum three keywords which - to you - characterize <u>your</u> engineering education

____

____

____

Of the 20 items below, please put a check mark next to the FIVE you think are MOST IMPORTANT practicing engineering

☐ Business knowledge

☐ Communication

☐ Conducting experiments

☐ Contemporary issues

☐ Creativity

- ❑ Data analysis
- ❑ Design
- ❑ Engineering analysis
- ❑ Engineering tools
- ❑ Ethics
- ❑ Global context
- ❑ Leadership
- ❑ Life-long learning
- ❑ Management skills
- ❑ Math
- ❑ Problem solving
- ❑ Professionalism
- ❑ Science
- ❑ Societal context
- ❑ Teamwork

Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer:

	Not at all prepared	...	Somewhat prepared	...	Very well prepared
Business knowledge	❑	❑	❑	❑	❑
Communication	❑	❑	❑	❑	❑
Conducting experiments	❑	❑	❑	❑	❑
Contemporary issues	❑	❑	❑	❑	❑
Creativity	❑	❑	❑	❑	❑
Data analysis	❑	❑	❑	❑	❑
Design	❑	❑	❑	❑	❑
Engineering analysis	❑	❑	❑	❑	❑
Engineering tools	❑	❑	❑	❑	❑
Ethics	❑	❑	❑	❑	❑
Global context	❑	❑	❑	❑	❑
Leadership	❑	❑	❑	❑	❑
Life-long learning	❑	❑	❑	❑	❑
Management skills	❑	❑	❑	❑	❑
Math	❑	❑	❑	❑	❑
Problem solving	❑	❑	❑	❑	❑
Professionalism	❑	❑	❑	❑	❑
Science	❑	❑	❑	❑	❑
Societal context	❑	❑	❑	❑	❑
Teamwork	❑	❑	❑	❑	❑

How would you rate your abilities within the listed fields:

	Very good	Fairly good	Not very good	Poor	Do not know
Project management	❑	❑	❑	❑	❑

Rote learning					
Teamwork skills					
Individual written assignments					
Idea creation					
Organisational talent					
Conflict management					
Laboratory experimenting					
Oral communication					
Ability to work independently					
Written communication					

Assess your progress within the following areas since you started your engineering programme?

	Major progress	Some progress	Minor progress	No progress	Do not know
Responsible use of technology					
Sustainability					
Understanding of the role of technology in society					
Idea creation					
Individual written assignments					
Career planning					
Conflict management					
Laboratory experimenting					
Environmental impact assessment					
Oral communication					
Organisational talent					
Problem identification					
Project management					
Teamwork skills					
Self-reflexivity					
Ability to work independently					
Written communication					
Social responsibility					
Rote learning					
Knowledge on energy minimization					
Knowledge of economics					

Now there will be some statements that people have made about science, technology or the environment. For each statement, please tell me how much you agree or disagree.

	Totally agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Totally disagree	Do not know
Thanks to scientific and technological advances, the Earth's natural resources will be inexhaustible						
Science and technology can sort out any problem						

Science and technology cannot really play a role in improving the environment	☐	☐	☐	☐	☐	☐
The applications of science and technology can threaten human rights	☐	☐	☐	☐	☐	☐
New inventions will always be found to counteract any harmful effect of scientific and technological developments	☐	☐	☐	☐	☐	☐
The benefits of science are greater than any harmful effects it may have	☐	☐	☐	☐	☐	☐

And now, there will be a few questions on how you engage with science and technology. Do you…?

	Yes, regularly	Yes, occasionally	No, hardly ever	No, never	Do not know
Watch or listen to media programmes about scientific or technologic issues?	☐	☐	☐	☐	☐
Talk to friends or family about scientific or technologic issues?	☐	☐	☐	☐	☐
Attend public meetings or debates about science and technology?	☐	☐	☐	☐	☐
Sign petitions or join street demonstrations on matters of nuclear power, biotechnology or the environment?	☐	☐	☐	☐	☐
Donate money to fundraising campaigns for medical research such as research into cancer?	☐	☐	☐	☐	☐
Participate in the activities of a non-governmental organisation dealing with science and technology related issues?	☐	☐	☐	☐	☐

Prioritise how important the issues below are to you using the numbers from 1-5. Please write 1 at the issue that you find most important, 2 at the second-most important issue, etc.

To prevent pollution ___

To ensure resources for future generations ___

To generate economic growth in Denmark ___

To combat global climate changes ___

To improve living conditions of people in developing countries ___

Prioritise between the statements below on the role of engineers in society. Please write 1 at the statement that you find most important, 2 at the second-most important statement and 3 at the third most important.

Engineers should contribute to solving problems related to climate change and environmental degradation ___

Engineers should contribute to ensuring that technological development is utilised in a fair and responsible way ___

Engineers should contribute to creating an overview of complex interrelations between different scientific and technical fields ___

What is sustainability about in your opinion? Please indicate the items listed below that you find related to the concept of sustainability.

- [ ] Ethics
- [ ] Global context
- [ ] Law
- [ ] Technological context
- [ ] Natural context
- [ ] Life-long learning
- [ ] Politics
- [ ] Societal context
- [ ] Social responsibility
- [ ] Economic context

To what extent do you regard your educational institution an organisation with a focus on sustainability?

- [ ] Very much
- [ ] To some extent
- [ ] To a minor extent
- [ ] Not at all
- [ ] Do not know

When you have completed the questionnaire you must press 'Finish' to submit your response and enter the draw to win DKK 1,000.
Thank you for your participation!

FOR THE ENGLISH VERSION, PLEASE CLICK THE FLAG BELOW

Ingeniørstuderende årgang 2010: Spørgeskemaundersøgelse

Du besvarer spørgsmålene ved at klikke på boxen ved det svar, du vil afgive.

Du deltager i lodtrækningen om en af de 10 præmier på 1.000 kroner, når du har besvaret spørgsmålene og trykket på "Afslut" til sidst. Vinderne udtrækkes fredag den 1. juli 2011 og får direkte besked hurtigst muligt herefter.

Nederst i vinduet kan du orientere dig om, hvor langt du er nået i spørgeskemaet og bladre frem og tilbage mellem spørgsmålene. Det tager ca. 15 minutter at besvare spørgsmålene.

Dine indtastninger bliver løbende gemt, så hvis du bliver forstyrret undervejs, kan du vende tilbage til din besvarelse ved hjælp af det link, du har fået tilsendt.

God fornøjelse!

På forhånd tak for hjælpen!

Angiv hvor enig eller uenig du er i følgende udsagn

	Meget uenig	Uenig	Enig	Meget enig	Ved ikke
Kreativ tænkning er en af mine styrker	☐	☐	☐	☐	☐
Jeg er god til at løse problemer som har mange mulige løsninger	☐	☐	☐	☐	☐
Jeg er glad for at være ingeniørstuderende	☐	☐	☐	☐	☐
Jeg har et klart billede af, hvad jeg kan komme til at arbejde med, når jeg bliver færdig som ingeniør	☐	☐	☐	☐	☐
Hvis jeg skulle starte min uddannelse i dag, ville jeg ikke vælge en ingeniøruddannelse	☐	☐	☐	☐	☐
Jeg er glad for mit studies praktiske tilgang til teknologi	☐	☐	☐	☐	☐
Jeg er glad for mit studies teoretiske tilgang til teknologi	☐	☐	☐	☐	☐

Vurder dig selv på hvert af de følgende områder i forhold til dine medstuderende på ingeniøruddannelsen. Vi er interesserede i det mest nøjagtige bud på, hvordan du ser dig selv i forhold til:

	Blandt de dårligste 10%	Under gennemsnittet	Blandt gennemsnittet	Over gennemsnittet	Blandt de bedste 10%	Ved ikke
Selvsikkerhed	☐	☐	☐	☐	☐	☐
Lederevner	☐	☐	☐	☐	☐	☐
Evne til at tale i	☐	☐	☐	☐	☐	☐

forsamlinger						
Matematiske evner	☐	☐	☐	☐	☐	☐
Videnskabelige evner	☐	☐	☐	☐	☐	☐
Kommunikative evner	☐	☐	☐	☐	☐	☐
Evne til at anvende matematik og videnskab til at løse ”real life” problemer	☐	☐	☐	☐	☐	☐
Forretningstalent	☐	☐	☐	☐	☐	☐
Evne til at arbejde i teams	☐	☐	☐	☐	☐	☐
Evne til at tænke kritisk	☐	☐	☐	☐	☐	☐
Lyst til at finde nye løsninger	☐	☐	☐	☐	☐	☐

Angiv hvor vigtige du mener hver af de følgende evner og kompetencer er for at blive en succesfuld ingeniør

	Ikke vigtigt	I nogen grad vigtigt	Meget vigtigt	Helt afgørende	Ved ikke
Selvsikkerhed	☐	☐	☐	☐	☐
Lederevner	☐	☐	☐	☐	☐
Evne til at tale i forsamlinger	☐	☐	☐	☐	☐
Matematiske evner	☐	☐	☐	☐	☐
Videnskabelige evner	☐	☐	☐	☐	☐
Kommunikative evner	☐	☐	☐	☐	☐
Evne til at anvende matematik og videnskab til at løse ”real life” problemer	☐	☐	☐	☐	☐
Forretningstalent	☐	☐	☐	☐	☐
Evne til at arbejde i teams	☐	☐	☐	☐	☐
Evne til at tænke kritisk	☐	☐	☐	☐	☐
Lyst til at finde nye løsninger	☐	☐	☐	☐	☐

Skriv maksimalt tre stikord som for dig kendetegner en ingeniør

____

____

____

Skriv maksimalt tre stikord som kendetegner <u>din</u> ingeniøruddannelse

____

____

____

Sæt kryds i nedenstående liste ved de <u>fem</u> emner, du synes er <u>mest vigtige</u> for ingeniørarbejdet.

☐ Kendskab til erhvervslivet

☐ Kommunikation

- ☐ Udførelse af eksperimenter
- ☐ Samfundsaktuelle emner
- ☐ Kreativitet
- ☐ Dataanalyse
- ☐ Design
- ☐ Ingeniørteknisk analyse
- ☐ Ingeniørfaglige redskaber
- ☐ Etik
- ☐ Globale sammenhænge
- ☐ Ledelse
- ☐ Livslang læring
- ☐ Organisatoriske færdigheder
- ☐ Matematik
- ☐ Problemløsning
- ☐ Professionalisme
- ☐ Videnskab
- ☐ Samfundsmæssige sammenhænge
- ☐ Teamwork/samarbejde

Angiv hvor godt du føler dig forberedt på at anvende hvert af de følgende emner i et stykke ingeniørarbejde?

	Slet ikke forberedt	...	Noget forberedt	...	Rigtig godt forberedt
Kendskab til erhvervslivet	☐	☐	☐	☐	☐
Kommunikation	☐	☐	☐	☐	☐
Udførelse af eksperimenter	☐	☐	☐	☐	☐
Samfundsaktuelle emner	☐	☐	☐	☐	☐
Kreativitet	☐	☐	☐	☐	☐
Dataanalyse	☐	☐	☐	☐	☐
Design	☐	☐	☐	☐	☐
Ingeniørteknisk analyse	☐	☐	☐	☐	☐
Ingeniørfaglige redskaber	☐	☐	☐	☐	☐
Etik	☐	☐	☐	☐	☐
Globale sammenhænge	☐	☐	☐	☐	☐
Ledelse	☐	☐	☐	☐	☐
Livslang læring	☐	☐	☐	☐	☐
Organisatoriske færdigheder	☐	☐	☐	☐	☐
Matematik	☐	☐	☐	☐	☐
Problemløsning	☐	☐	☐	☐	☐
Professionalisme	☐	☐	☐	☐	☐
Videnskab	☐	☐	☐	☐	☐
Samfundsmæssige sammenhænge	☐	☐	☐	☐	☐
Teamwork/samarbejde	☐	☐	☐	☐	☐

Hvordan vil du vurdere dine kompetencer på følgende områder?

	Rigtig gode	Nogenlunde	Ikke så gode	Dårlige	Ved ikke
Projektledelse					
Udenadslære					
Samarbejdsevne					
Individuelle, skriftlige opgaver					
Ideskabelse					
Organisationstalent					
Konflikthåndtering					
Laboratorieforsøg					
Selvstændigt arbejde					
Mundtlig formidling					
Skriftlig formidling					

Vurder hvor stor din udvikling har været på følgende områder, siden du startede på ingeniørstudiet?

	Stor udvikling	Nogen udvikling	Lille udvikling	Slet ingen udvikling	Ved ikke
Ansvarlighed i teknologianvendelse					
Bæredygtighed					
Forståelse af teknologiens samfundsmæssige rolle					
Ideskabelse					
Individuelle, skriftlige opgaver					
Karriereplanlægning					
Konflikthåndtering					
Laboratorieforsøg					
Miljøvurdering					
Mundtlig formidling					
Organisationstalent					
Problemidentifikation					
Projektledelse					
Samarbejdsevne					
Selvrefleksion					
Selvstændigt arbejde					
Skriftlig formidling					
Social ansvarlighed					
Udenadslære					
Viden om hvordan energiforbrug kan minimeres					
Viden om økonomi					

Her kommer nogle udsagn om videnskab og teknologi. Angiv hvor enig eller uenig du er i hvert udsagn

	Fuldstændig enig	Tilbøjelig til at være	Hverken enig eller	Tilbøjelig til at være	Fuldstændig uenig	Ved ikke

		enig	uenig	uenig		
Takket være videnskabelige og teknologiske fremskridt vil jordens naturlige ressourcer være uudtømmelige	☐	☐	☐	☐	☐	☐
Videnskab og teknologi kan løse et hvilket som helst problem	☐	☐	☐	☐	☐	☐
Videnskab og teknologi kan ikke rigtig spille nogen egentlig rolle i forbedring af miljøet	☐	☐	☐	☐	☐	☐
Anvendelserne af videnskab og teknologi kan være en trussel mod menneskerettighederne	☐	☐	☐	☐	☐	☐
Nye opfindelser vil altid blive udviklet til at modvirke alle skadelige følger af videnskabelig og teknologisk udvikling	☐	☐	☐	☐	☐	☐
Fordelene ved videnskab er større end alle skadelige virkninger den måtte have	☐	☐	☐	☐	☐	☐

Nu kommer der nogle spørgsmål om hvor engageret du er inden for videnskab og teknologi. Hvor ofte:

	Ja, regelmæssigt	Ja, indimellem	Nej, næsten aldrig	Nej, aldrig	Ved ikke
Ser eller hører du programmer om teknologi eller videnskabelige emner i medierne?	☐	☐	☐	☐	☐
Taler du om videnskabelige emner eller teknologi med venner og familie?	☐	☐	☐	☐	☐
Deltager du i offentlige møder eller debatter om videnskab og teknologi?	☐	☐	☐	☐	☐
Skriver du under på underskriftsindsamlinger eller deltager i gadedemonstrationer i forbindelse med atomkraft, bioteknologi eller miljøet?	☐	☐	☐	☐	☐
Donerer du penge til støttekampagner for medicinsk forskning som f.eks. Kræftens bekæmpelse?	☐	☐	☐	☐	☐
Deltager du i aktiviteter arrangeret af ikke-statslige organisationer, der arbejder inden for videnskab og teknologi?	☐	☐	☐	☐	☐

Vælg hvor vigtige emnerne nedenfor er for dig ved hjælp af tallene 1-5. Skriv 1 ved det mest vigtige, 2 ved det næstvigtigste, osv.

At forhindre forurening ___

At sikre ressourcer til fremtidige generationer ___

At skabe økonomisk vækst i Danmark ___

At bekæmpe de globale klimaforandringer ___

At forbedre forholdene for mennesker i ulandene ___

Prioritér mellem nedenstående udsagn om ingeniørers rolle i samfundet. Skriv 1 ved det, der for dig er mest vigtigt, 2 ved det næstvigtigste og 3 ved det tredjevigtigste.

Ingeniører skal være med til at løse problemer omkring klimaforandringer og forringelse af miljøressourcer ___

Ingeniører skal være med til at sikre, at teknologiske fremskridt bliver udnyttet ansvarligt og retfærdigt ___

Ingeniører skal være med til at skabe overblik over komplekse sammenhænge mellem forskellige videnskabelige og teknologiske fagområder ___

Hvad mener du bæredygtighed drejer sig om? Sæt kryds i nedenstående liste ved de emner, du forbinder med begrebet bæredygtighed.

- ☐ Etik
- ☐ Globale sammenhænge
- ☐ Jura
- ☐ Teknologiske sammenhænge
- ☐ Natur- og miljømæssige sammenhænge
- ☐ Livslang læring
- ☐ Politik
- ☐ Samfundsmæssige sammenhænge
- ☐ Social ansvarlighed
- ☐ Økonomiske sammenhænge

I hvor høj grad opfatter du din uddannelsesinstitution som en organisation, der har fokus på bæredygtighed?

- ☐ I høj grad
- ☐ I nogen grad
- ☐ I ringe grad
- ☐ Slet ikke
- ☐ Ved ikke

Når du har besvaret spørgsmålene i spørgeskemaet, skal du huske at trykke på "Afslut", så deltager du i lodtrækningen om en af de 10 præmier på 1.000 kroner.

Tak for din besvarelse!

Survey: Engineering Students in Denmark from year group 2010

You answer the questions by clicking the box next to the response that you want to give.

You enter the draw to win one of 10 prizes of DKK 1,000 each, once you have answered the questions and submitted your response by clicking 'Finish'. The winners will be contacted directly soon after Friday, 1st July 2011.

At the bottom of the window you can follow the progress of the survey and move back and forth between questions. It will take approximately 15 minutes to complete the questionnaire.

Your responses will automatically be saved so if you are interrupted during completion, you can re-access the questionnaire via the link you have received.

Thank you for your time and participation!

Please indicate how strongly you disagree or agree with each of the statements:

	Disagree strongly	Disagree	Agree	Agree strongly	Do not know
Creative thinking is one of my strengths	☐	☐	☐	☐	☐
I am skilled at solving problems that can have multiple solutions	☐	☐	☐	☐	☐
I am happy to be an engineering student	☐	☐	☐	☐	☐
I have a clear picture of what kind of work I can get when I graduate as an engineer	☐	☐	☐	☐	☐
If I was to start my education today, I would not choose an engineering programme	☐	☐	☐	☐	☐
I like my study's practical approach to technology	☐	☐	☐	☐	☐
I like my study's theoretical approach to technology	☐	☐	☐	☐	☐

Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself.

	Lowest 10%	Below average	Average	Above average	Highest 10%	Do not know
Self confidence (social)	☐	☐	☐	☐	☐	☐
Leadership ability	☐	☐	☐	☐	☐	☐
Public speaking ability	☐	☐	☐	☐	☐	☐
Math ability	☐	☐	☐	☐	☐	☐

Science ability	☐	☐	☐	☐	☐	☐
Communication skills	☐	☐	☐	☐	☐	☐
Ability to apply math and science principles in solving real world problems	☐	☐	☐	☐	☐	☐
Business ability	☐	☐	☐	☐	☐	☐
Ability to perform in teams	☐	☐	☐	☐	☐	☐
Critical thinking skills	☐	☐	☐	☐	☐	☐
Wish to find new solutions	☐	☐	☐	☐	☐	☐

How important do you think each of the following skills and abilities is to becoming a successful engineer?

	Not important	Somewhat important	Very important	Crucial	Do not know
Self confidence (social)	☐	☐	☐	☐	☐
Leadership ability	☐	☐	☐	☐	☐
Public speaking ability	☐	☐	☐	☐	☐
Math ability	☐	☐	☐	☐	☐
Science ability	☐	☐	☐	☐	☐
Communication skills	☐	☐	☐	☐	☐
Ability to apply math and science principles in solving real world problems	☐	☐	☐	☐	☐
Business ability	☐	☐	☐	☐	☐
Ability to perform in teams	☐	☐	☐	☐	☐
Critical thinking skills	☐	☐	☐	☐	☐
Wish to find new solutions	☐	☐	☐	☐	☐

State maximum three keywords which - to you - characterize an engineer

____

____

____

State maximum three keywords which - to you - characterize <u>your</u> engineering education

____

____

____

Of the 20 items below, please put a check mark next to the FIVE you think are MOST IMPORTANT practicing engineering

☐ Business knowledge
☐ Communication
☐ Conducting experiments
☐ Contemporary issues
☐ Creativity

- ☐ Data analysis
- ☐ Design
- ☐ Engineering analysis
- ☐ Engineering tools
- ☐ Ethics
- ☐ Global context
- ☐ Leadership
- ☐ Life-long learning
- ☐ Management skills
- ☐ Math
- ☐ Problem solving
- ☐ Professionalism
- ☐ Science
- ☐ Societal context
- ☐ Teamwork

Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer:

	Not at all prepared	...	Somewhat prepared	...	Very well prepared
Business knowledge	☐	☐	☐	☐	☐
Communication	☐	☐	☐	☐	☐
Conducting experiments	☐	☐	☐	☐	☐
Contemporary issues	☐	☐	☐	☐	☐
Creativity	☐	☐	☐	☐	☐
Data analysis	☐	☐	☐	☐	☐
Design	☐	☐	☐	☐	☐
Engineering analysis	☐	☐	☐	☐	☐
Engineering tools	☐	☐	☐	☐	☐
Ethics	☐	☐	☐	☐	☐
Global context	☐	☐	☐	☐	☐
Leadership	☐	☐	☐	☐	☐
Life-long learning	☐	☐	☐	☐	☐
Management skills	☐	☐	☐	☐	☐
Math	☐	☐	☐	☐	☐
Problem solving	☐	☐	☐	☐	☐
Professionalism	☐	☐	☐	☐	☐
Science	☐	☐	☐	☐	☐
Societal context	☐	☐	☐	☐	☐
Teamwork	☐	☐	☐	☐	☐

How would you rate your abilities within the listed fields:

	Very good	Fairly good	Not very good	Poor	Do not know
Project management	☐	☐	☐	☐	☐

Rote learning	☐	☐	☐	☐	☐
Teamwork skills	☐	☐	☐	☐	☐
Individual written assignments	☐	☐	☐	☐	☐
Idea creation	☐	☐	☐	☐	☐
Organisational talent	☐	☐	☐	☐	☐
Conflict management	☐	☐	☐	☐	☐
Laboratory experimenting	☐	☐	☐	☐	☐
Oral communication	☐	☐	☐	☐	☐
Ability to work independently	☐	☐	☐	☐	☐
Written communication	☐	☐	☐	☐	☐

Assess your progress within the following areas since you started your engineering programme?

	Major progress	Some progress	Minor progress	No progress	Do not know
Responsible use of technology	☐	☐	☐	☐	☐
Sustainability	☐	☐	☐	☐	☐
Understanding of the role of technology in society	☐	☐	☐	☐	☐
Idea creation	☐	☐	☐	☐	☐
Individual written assignments	☐	☐	☐	☐	☐
Career planning	☐	☐	☐	☐	☐
Conflict management	☐	☐	☐	☐	☐
Laboratory experimenting	☐	☐	☐	☐	☐
Environmental impact assessment	☐	☐	☐	☐	☐
Oral communication	☐	☐	☐	☐	☐
Organisational talent	☐	☐	☐	☐	☐
Problem identification	☐	☐	☐	☐	☐
Project management	☐	☐	☐	☐	☐
Teamwork skills	☐	☐	☐	☐	☐
Self-reflexivity	☐	☐	☐	☐	☐
Ability to work independently	☐	☐	☐	☐	☐
Written communication	☐	☐	☐	☐	☐
Social responsibility	☐	☐	☐	☐	☐
Rote learning	☐	☐	☐	☐	☐
Knowledge on energy minimization	☐	☐	☐	☐	☐
Knowledge of economics	☐	☐	☐	☐	☐

Now there will be some statements that people have made about science, technology or the environment. For each statement, please tell me how much you agree or disagree.

	Totally agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Totally disagree	Do not know
Thanks to scientific and technological advances, the Earth's natural resources will be inexhaustible	☐	☐	☐	☐	☐	☐
Science and technology can sort out any problem	☐	☐	☐	☐	☐	☐

Science and technology cannot really play a role in improving the environment	☐	☐	☐	☐	☐	☐
The applications of science and technology can threaten human rights	☐	☐	☐	☐	☐	☐
New inventions will always be found to counteract any harmful effect of scientific and technological developments	☐	☐	☐	☐	☐	☐
The benefits of science are greater than any harmful effects it may have	☐	☐	☐	☐	☐	☐

And now, there will be a few questions on how you engage with science and technology. Do you…?

	Yes, regularly	Yes, occasionally	No, hardly ever	No, never	Do not know
Watch or listen to media programmes about scientific or technologic issues?	☐	☐	☐	☐	☐
Talk to friends or family about scientific or technologic issues?	☐	☐	☐	☐	☐
Attend public meetings or debates about science and technology?	☐	☐	☐	☐	☐
Sign petitions or join street demonstrations on matters of nuclear power, biotechnology or the environment?	☐	☐	☐	☐	☐
Donate money to fundraising campaigns for medical research such as research into cancer?	☐	☐	☐	☐	☐
Participate in the activities of a non-governmental organisation dealing with science and technology related issues?	☐	☐	☐	☐	☐

Prioritise how important the issues below are to you using the numbers from 1-5. Please write 1 at the issue that you find most important, 2 at the second-most important issue, etc.

To prevent pollution ___

To ensure resources for future generations ___

To generate economic growth in Denmark ___

To combat global climate changes ___

To improve living conditions of people in developing countries ___

Prioritise between the statements below on the role of engineers in society. Please write 1 at the statement that you find most important, 2 at the second-most important statement and 3 at the third most important.

Engineers should contribute to solving problems related to climate change and environmental degradation ___

Engineers should contribute to ensuring that technological development is utilised in a fair and responsible way ___

Engineers should contribute to creating an overview of complex interrelations between different scientific and technical fields ___

What is sustainability about in your opinion? Please indicate the items listed below that you find related to the concept of sustainability.

- ❑ Ethics
- ❑ Global context
- ❑ Law
- ❑ Technological context
- ❑ Natural context
- ❑ Life-long learning
- ❑ Politics
- ❑ Societal context
- ❑ Social responsibility
- ❑ Economic context

To what extent do you regard your educational institution an organisation with a focus on sustainability?

- ❑ Very much
- ❑ To some extent
- ❑ To a minor extent
- ❑ Not at all
- ❑ Do not know

What is your educational background?

- ❑ Upper secondary school or high school
- ❑ Business, commercial or technical college
- ❑ Other___________________

How many people aged 15 years or more live in your household, yourself included?

____

How many children aged 0 to 14 years old live in your household?

____

Please indicate the highest level of education completed by your mother.

- ❑ Elementary school (primary and lower secondary school)
- ❑ Upper secondary school or high school
- ❑ Business, commercial or technical college
- ❑ Vocational training (e.g. builder, carpenter, electrician or corresponding level)
- ❑ Short term further education (e.g. real estate agent, information technologist, police officer or corresponding level)
- ❑ Medium lenght higher education (e.g. BSc, BA degree, nurse, school teacher or corresponding level)
- ❑ Master's level degree (MSc, MA degree or similar)
- ❑ PhD level degree (postgraduate or graduate degree programme)

- [ ] Other__________________

Please indicate the highest level of education completed by your father.

- [ ] Elementary school (primary and lower secondary school)
- [ ] Upper secondary school or high school
- [ ] Business, commercial or technical college
- [ ] Vocational training (e.g. builder, carpenter, electrician or corresponding level)
- [ ] Short term further education (e.g. real estate agent, information technologist, police officer or corresponding level)
- [ ] Medium lenght higher education (e.g. BSc, BA degree, nurse, school teacher or corresponding level)
- [ ] Master's level degree (MSc, MA degree or similar)
- [ ] PhD level degree (postgraduate or graduate degree programme)
- [ ] Other__________________

Does/Did any of your family have a job or a university qualification in natural science, technology or engineering (for instance, physics, chemistry, biology, medicine)?

- [ ] Yes, your father
- [ ] Yes, your mother
- [ ] Yes, another member of your family
- [ ] No, no one in your family

Do any of your immediate family members hold an engineering degree?

- [ ] No
- [ ] Yes

a. What/which family member(s):

- [ ] Father or stepfather
- [ ] Mother or stepmother
- [ ] Brother or stepbrother
- [ ] Sister or stepsister
- [ ] Other

Do you hold a Danish citizenship?

- [ ] Yes
- [ ] No

a. In which geographical area are you a citizen?

- [ ] Nordic countries
- [ ] (Other) Europe
- [ ] US

- ☐ (Other) North or Central America
- ☐ South America
- ☐ Asia
- ☐ Africa
- ☐ Australia or Oceania

When you have completed the questionnaire you must press 'Finish' to submit your response and enter the draw to win DKK 1,000.
Thank you for your participation!

FOR THE ENGLISH VERSION, PLEASE CLICK THE FLAG BELOW

Ingeniørstuderende årgang 2010: Spørgeskemaundersøgelse

Du besvarer spørgsmålene ved at klikke på boxen ved det svar, du vil afgive.

Du deltager i lodtrækningen om en af de 10 præmier på 1.000 kroner, når du har besvaret spørgsmålene og trykket på "Afslut" til sidst. Vinderne udtrækkes fredag den 1. juli 2011 og får direkte besked hurtigst muligt herefter.

Nederst i vinduet kan du orientere dig om, hvor langt du er nået i spørgeskemaet og bladre frem og tilbage mellem spørgsmålene. Det tager ca. 15 minutter at besvare spørgsmålene.

Dine indtastninger bliver løbende gemt, så hvis du bliver forstyrret undervejs, kan du vende tilbage til din besvarelse ved hjælp af det link, du har fået tilsendt.

God fornøjelse!

På forhånd tak for hjælpen!

Angiv hvor enig eller uenig du er i følgende udsagn

	Meget uenig	Uenig	Enig	Meget enig	Ved ikke
Kreativ tænkning er en af mine styrker	☐	☐	☐	☐	☐
Jeg er god til at løse problemer som har mange mulige løsninger	☐	☐	☐	☐	☐
Jeg er glad for at være ingeniørstuderende	☐	☐	☐	☐	☐
Jeg har et klart billede af, hvad jeg kan komme til at arbejde med, når jeg bliver færdig som ingeniør	☐	☐	☐	☐	☐
Hvis jeg skulle starte min uddannelse i dag, ville jeg ikke vælge en ingeniøruddannelse	☐	☐	☐	☐	☐
Jeg er glad for mit studies praktiske tilgang til teknologi	☐	☐	☐	☐	☐
Jeg er glad for mit studies teoretiske tilgang til teknologi	☐	☐	☐	☐	☐

Vurder dig selv på hvert af de følgende områder i forhold til dine medstuderende på ingeniøruddannelsen. Vi er interesserede i det mest nøjagtige bud på, hvordan du ser dig selv i forhold til:

	Blandt de dårligste 10%	Under gennemsnittet	Blandt gennemsnittet	Over gennemsnittet	Blandt de bedste 10%	Ved ikke
Selvsikkerhed	☐	☐	☐	☐	☐	☐
Lederevner	☐	☐	☐	☐	☐	☐
Evne til at tale i	☐	☐	☐	☐	☐	☐

forsamlinger						
Matematiske evner	☐	☐	☐	☐	☐	☐
Videnskabelige evner	☐	☐	☐	☐	☐	☐
Kommunikative evner	☐	☐	☐	☐	☐	☐
Evne til at anvende matematik og videnskab til at løse ”real life” problemer	☐	☐	☐	☐	☐	☐
Forretningstalent	☐	☐	☐	☐	☐	☐
Evne til at arbejde i teams	☐	☐	☐	☐	☐	☐
Evne til at tænke kritisk	☐	☐	☐	☐	☐	☐
Lyst til at finde nye løsninger	☐	☐	☐	☐	☐	☐

Angiv hvor vigtige du mener hver af de følgende evner og kompetencer er for at blive en succesfuld ingeniør

	Ikke vigtigt	I nogen grad vigtigt	Meget vigtigt	Helt afgørende	Ved ikke
Selvsikkerhed	☐	☐	☐	☐	☐
Lederevner	☐	☐	☐	☐	☐
Evne til at tale i forsamlinger	☐	☐	☐	☐	☐
Matematiske evner	☐	☐	☐	☐	☐
Videnskabelige evner	☐	☐	☐	☐	☐
Kommunikative evner	☐	☐	☐	☐	☐
Evne til at anvende matematik og videnskab til at løse ”real life” problemer	☐	☐	☐	☐	☐
Forretningstalent	☐	☐	☐	☐	☐
Evne til at arbejde i teams	☐	☐	☐	☐	☐
Evne til at tænke kritisk	☐	☐	☐	☐	☐
Lyst til at finde nye løsninger	☐	☐	☐	☐	☐

Skriv maksimalt tre stikord som for dig kendetegner en ingeniør

____

____

____

Skriv maksimalt tre stikord som kendetegner <u>din</u> ingeniøruddannelse

____

____

____

Sæt kryds i nedenstående liste ved de <u>fem</u> emner, du synes er <u>mest vigtige</u> for ingeniørarbejdet.

☐ Kendskab til erhvervslivet

☐ Kommunikation

- ❑ Udførelse af eksperimenter
- ❑ Samfundsaktuelle emner
- ❑ Kreativitet
- ❑ Dataanalyse
- ❑ Design
- ❑ Ingeniørteknisk analyse
- ❑ Ingeniørfaglige redskaber
- ❑ Etik
- ❑ Globale sammenhænge
- ❑ Ledelse
- ❑ Livslang læring
- ❑ Organisatoriske færdigheder
- ❑ Matematik
- ❑ Problemløsning
- ❑ Professionalisme
- ❑ Videnskab
- ❑ Samfundsmæssige sammenhænge
- ❑ Teamwork/samarbejde

Angiv hvor godt du føler dig forberedt på at anvende hvert af de følgende emner i et stykke ingeniørarbejde?

	Slet ikke forberedt	...	Noget forberedt	...	Rigtig godt forberedt
Kendskab til erhvervslivet	❑	❑	❑	❑	❑
Kommunikation	❑	❑	❑	❑	❑
Udførelse af eksperimenter	❑	❑	❑	❑	❑
Samfundsaktuelle emner	❑	❑	❑	❑	❑
Kreativitet	❑	❑	❑	❑	❑
Dataanalyse	❑	❑	❑	❑	❑
Design	❑	❑	❑	❑	❑
Ingeniørteknisk analyse	❑	❑	❑	❑	❑
Ingeniørfaglige redskaber	❑	❑	❑	❑	❑
Etik	❑	❑	❑	❑	❑
Globale sammenhænge	❑	❑	❑	❑	❑
Ledelse	❑	❑	❑	❑	❑
Livslang læring	❑	❑	❑	❑	❑
Organisatoriske færdigheder	❑	❑	❑	❑	❑
Matematik	❑	❑	❑	❑	❑
Problemløsning	❑	❑	❑	❑	❑
Professionalisme	❑	❑	❑	❑	❑
Videnskab	❑	❑	❑	❑	❑
Samfundsmæssige sammenhænge	❑	❑	❑	❑	❑
Teamwork/samarbejde	❑	❑	❑	❑	❑

Hvordan vil du vurdere dine kompetencer på følgende områder?

	Rigtig gode	Nogenlunde	Ikke så gode	Dårlige	Ved ikke
Projektledelse	☐	☐	☐	☐	☐
Udenadslære	☐	☐	☐	☐	☐
Samarbejdsevne	☐	☐	☐	☐	☐
Individuelle, skriftlige opgaver	☐	☐	☐	☐	☐
Ideskabelse	☐	☐	☐	☐	☐
Organisationstalent	☐	☐	☐	☐	☐
Konflikthåndtering	☐	☐	☐	☐	☐
Laboratorieforsøg	☐	☐	☐	☐	☐
Selvstændigt arbejde	☐	☐	☐	☐	☐
Mundtlig formidling	☐	☐	☐	☐	☐
Skriftlig formidling	☐	☐	☐	☐	☐

Vurder hvor stor din udvikling har været på følgende områder, siden du startede på ingeniørstudiet?

	Stor udvikling	Nogen udvikling	Lille udvikling	Slet ingen udvikling	Ved ikke
Ansvarlighed i teknologianvendelse	☐	☐	☐	☐	☐
Bæredygtighed	☐	☐	☐	☐	☐
Forståelse af teknologiens samfundsmæssige rolle	☐	☐	☐	☐	☐
Ideskabelse	☐	☐	☐	☐	☐
Individuelle, skriftlige opgaver	☐	☐	☐	☐	☐
Karriereplanlægning	☐	☐	☐	☐	☐
Konflikthåndtering	☐	☐	☐	☐	☐
Laboratorieforsøg	☐	☐	☐	☐	☐
Miljøvurdering	☐	☐	☐	☐	☐
Mundtlig formidling	☐	☐	☐	☐	☐
Organisationstalent	☐	☐	☐	☐	☐
Problemidentifikation	☐	☐	☐	☐	☐
Projektledelse	☐	☐	☐	☐	☐
Samarbejdsevne	☐	☐	☐	☐	☐
Selvrefleksion	☐	☐	☐	☐	☐
Selvstændigt arbejde	☐	☐	☐	☐	☐
Skriftlig formidling	☐	☐	☐	☐	☐
Social ansvarlighed	☐	☐	☐	☐	☐
Udenadslære	☐	☐	☐	☐	☐
Viden om hvordan energiforbrug kan minimeres	☐	☐	☐	☐	☐
Viden om økonomi	☐	☐	☐	☐	☐

Her kommer nogle udsagn om videnskab og teknologi. Angiv hvor enig eller uenig du er i hvert udsagn

	Fuldstændig enig	Tilbøjelig til at være	Hverken enig eller	Tilbøjelig til at være	Fuldstændig uenig	Ved ikke

		enig	uenig	uenig		
Takket være videnskabelige og teknologiske fremskridt vil jordens naturlige ressourcer være uudtømmelige	☐	☐	☐	☐	☐	☐
Videnskab og teknologi kan løse et hvilket som helst problem	☐	☐	☐	☐	☐	☐
Videnskab og teknologi kan ikke rigtig spille nogen egentlig rolle i forbedring af miljøet	☐	☐	☐	☐	☐	☐
Anvendelserne af videnskab og teknologi kan være en trussel mod menneskerettighederne	☐	☐	☐	☐	☐	☐
Nye opfindelser vil altid blive udviklet til at modvirke alle skadelige følger af videnskabelig og teknologisk udvikling	☐	☐	☐	☐	☐	☐
Fordelene ved videnskab er større end alle skadelige virkninger den måtte have	☐	☐	☐	☐	☐	☐

Nu kommer der nogle spørgsmål om hvor engageret du er inden for videnskab og teknologi. Hvor ofte:

	Ja, regelmæssigt	Ja, indimellem	Nej, næsten aldrig	Nej, aldrig	Ved ikke
Ser eller hører du programmer om teknologi eller videnskabelige emner i medierne?	☐	☐	☐	☐	☐
Taler du om videnskabelige emner eller teknologi med venner og familie?	☐	☐	☐	☐	☐
Deltager du i offentlige møder eller debatter om videnskab og teknologi?	☐	☐	☐	☐	☐
Skriver du under på underskriftsindsamlinger eller deltager i gadedemonstrationer i forbindelse med atomkraft, bioteknologi eller miljøet?	☐	☐	☐	☐	☐
Donerer du penge til støttekampagner for medicinsk forskning som f.eks. Kræftens bekæmpelse?	☐	☐	☐	☐	☐
Deltager du i aktiviteter arrangeret af ikke-statslige organisationer, der arbejder inden for videnskab og teknologi?	☐	☐	☐	☐	☐

Vælg hvor vigtige emnerne nedenfor er for dig ved hjælp af tallene 1-5. Skriv 1 ved det mest vigtige, 2 ved det næstvigtigste, osv.

At forhindre forurening ___

At sikre ressourcer til fremtidige generationer ___

At skabe økonomisk vækst i Danmark ___

At bekæmpe de globale klimaforandringer ___

At forbedre forholdene for mennesker i ulandene ___

Prioritér mellem nedenstående udsagn om ingeniørers rolle i samfundet. Skriv 1 ved det, der for dig er mest vigtigt, 2 ved det næstvigtigste og 3 ved det tredjevigtigste.

Ingeniører skal være med til at løse problemer omkring klimaforandringer og forringelse af miljøressourcer ___

Ingeniører skal være med til at sikre, at teknologiske fremskridt bliver udnyttet ansvarligt og retfærdigt ___

Ingeniører skal være med til at skabe overblik over komplekse sammenhænge mellem forskellige videnskabelige og teknologiske fagområder ___

Hvad mener du bæredygtighed drejer sig om? Sæt kryds i nedenstående liste ved de emner, du forbinder med begrebet bæredygtighed.

- ☐ Etik
- ☐ Globale sammenhænge
- ☐ Jura
- ☐ Teknologiske sammenhænge
- ☐ Natur- og miljømæssige sammenhænge
- ☐ Livslang læring
- ☐ Politik
- ☐ Samfundsmæssige sammenhænge
- ☐ Social ansvarlighed
- ☐ Økonomiske sammenhænge

I hvor høj grad opfatter du din uddannelsesinstitution som en organisation, der har fokus på bæredygtighed?

- ☐ I høj grad
- ☐ I nogen grad
- ☐ I ringe grad
- ☐ Slet ikke
- ☐ Ved ikke

Hvad er din uddannelsesmæssige baggrund?

- ☐ Gymnasium eller hf (alment gymnasium)
- ☐ Hhx/htx (handels-/ teknisk gymnasium)
- ☐ Andet___________________

Hvor mange personer på 15 år og derover bor der i din husstand, inklusiv dig selv?

____

Hvor mange børn i alderen fra 0 til 14 år bor der i din husstand?

____

Hvilken uddannelsesmæssig baggrund har din mor? Angiv højeste, fuldførte uddannelse.

- ☐ Grundskole (folkeskole)
- ☐ Gymnasium eller hf (alment gymnasium)
- ☐ Hhx/htx (handels-/ teknisk gymnasium)
- ☐ Erhvervsfaglig uddannelse fx murer, tømrer og elektriker
- ☐ Kort, videregående uddannelse fx ejendomsmægler, datamatiker og politibetjent
- ☐ Mellemlang, videregående uddannelse fx sygeplejerske, folkeskolelærer, diplomingeniør og bachelor
- ☐ Lang, videregående uddannelse fx kandidatuddannelse og civilingeniør
- ☐ Forskeruddannelse/ph.d.-uddannelse
- ☐ Andet___________________

Hvilken uddannelsesmæssig baggrund har din far? Angiv højeste, fuldførte uddannelse.

- ☐ Grundskole (folkeskole)
- ☐ Gymnasium eller hf (alment gymnasium)
- ☐ Hhx/htx (handels-/ teknisk gymnasium)
- ☐ Erhvervsfaglig uddannelse fx murer, tømrer og elektriker
- ☐ Kort, videregående uddannelse fx ejendomsmægler, datamatiker og politibetjent
- ☐ Mellemlang, videregående uddannelse fx sygeplejerske, folkeskolelærer, diplomingeniør og bachelor
- ☐ Lang, videregående uddannelse fx kandidatuddannelse og civilingeniør
- ☐ Forskeruddannelse/ph.d.-uddannelse
- ☐ Andet___________________

Er der nogen i din familie, der har eller har haft et job eller en universitetsuddannelse inden for naturvidenskab, teknologi eller ingeniørfaget (fysik, kemi, biologi, medicin eller lignende)?

- ☐ Ja, din far
- ☐ Ja, din mor
- ☐ Ja, et andet familiemedlem
- ☐ Nej, ingen i din familie

Er der nogle af dine nærmeste slægtninge, der er ingeniører?

- ☐ Nej
- ☐ Ja

a. Hvilke(t) familiemedlem:

- ☐ Far eller stedfar
- ☐ Mor eller stedmor
- ☐ Bror eller stedbror
- ☐ Søster eller stedsøster
- ☐ Andet

Har du dansk statsborgerskab?

- ☐ Ja
- ☐ Nej

a. I hvilket område har du statsborgerskab?

- ☐ Norden
- ☐ Øvrige Europa
- ☐ USA
- ☐ Øvrige Nord- og Mellemamerika
- ☐ Sydamerika
- ☐ Asien
- ☐ Afrika
- ☐ Australien og Oceanien

Når du har besvaret spørgsmålene i spørgeskemaet, skal du huske at trykke på "Afslut", så deltager du i lodtrækningen om en af de 10 præmier på 1.000 kroner.

Tak for din besvarelse!

Overview of Variables

Not asked but registered variables (due to acces to register data and each individual's social registration number):

- Gender
- Engineering degree programme (somewhat similar to US type of major, we have 105 different engineering programmes)
- Engineering education institution (covers all 8)
- Age
- Type of education (vocational 3½ years or academic 5 years)

Overview of Questionnaire Items

Questionnaire October 2010 Questionnaire distributed to all newly enrolled engineering students in Denmark within their first month of education Response rate: 46%	**Questionnaire May 2011** Questionnaire distributed to same cohort after their first year of education Response rate: 35%	**Source**
Motivation – Item as a reason for choice of education 1.1 Technology plays an important role in solving society's problems		As APPLES2 Q9A
1.2 Engineers make more money than most other professionals		As APPLES2 Q9B
1.3 My parent(s) would disapprove if I chose a major other than engineering		As APPLES2 Q9C
1.4 Engineers have contributed greatly to fixing problems in the world		As APPLES2 Q9D
1.5 Engineers are well paid		As APPLES2 Q9E
1.6 My parent(s) want me to be an engineer		As APPLES2 Q9F
1.7 An engineering degree will guarantee me a job when I graduate		As APPLES2 Q9G
1.8 A faculty member, academic advisor, teaching assistant or other university affiliated person has encouraged and/or inspired me to study engineering		As APPLES2 Q9H
1.9 A non-university affiliated mentor has encouraged and/or inspired me to study engineering		As APPLES2 Q9I
1.10 A mentor has introduced me to people and opportunities in engineering		As APPLES2 Q9J
1.11 I feel good when I am doing engineering		As APPLES2 Q9K
1.12 I like to build stuff		As APPLES2 Q9L
1.13 I think engineering is fun		As APPLES2 Q9M
1.14 Engineering skills can be used for the good of society		As APPLES2 Q9N
1.15 I think engineering is interesting		As APPLES2 Q9O
1.16 I like to figure out how things work		As APPLES2 Q9P
1.17 Constructing new solutions fascinates me		New
Agreement with item 2.1Creative thinking is one of my strengths	**Agreement with item** A.1 Creative thinking is one of my strengths	As APPLES2 Q10A
2.2 I am skilled at solving problems that can have multiple solutions	A.2 I am skilled at solving problems that can have multiple solutions	As APPLES2 Q10B
2.3 A mentor has supported my decision to study engineering		As APPLES2 Q10C

	A.3 I am happy to be an engineering student	New
	A.4 I have a clear picture of what kind of work I can get when I graduate as an engineer	New
	A.5 If I was to start my education today, I would not choose an engineering programme	New
	A.6 I like my study's practical approach to technology	New
	A.7 I like my study's theoretical approach to technology	New
Abilities compared to average 3.1 Self confidence (social)	**Abilities compared to average** B.1 Self confidence (social)	As APPLES2 Q11A
3.2 Leadership ability	B.2 Leadership ability	As APPLES2 Q11B
3.3 Public speaking ability	B.3 Public speaking ability	As APPLES2 Q11C
3.4 Math ability	B.4 Math ability	As APPLES2 Q11D
3.5 Science ability	B.5 Science ability	As APPLES2 Q11E
3.6 Communication skills	B.6 Communication skills	As APPLES2 Q11F
3.7 Ability to apply math and science principles in solving real world problems	B.7 Ability to apply math and science principles in solving real world problems	As APPLES2 Q11G
3.8 Business ability	B.8 Business ability	As APPLES2 Q11H
3.9 Ability to perform in teams	B.9 Ability to perform in teams	As APPLES2 Q11I
3.10 Critical thinking skills	B.10 Critical thinking skills	As APPLES2 Q11J
3.11 Wish to find new solutions	B.11 Wish to find new solutions	
Importance of abilities for becoming a succesful engineer 4.1 Self confidence (social)	**Importance of abilities for becoming a succesful engineer** C.1 Self confidence (social)	As APPLES2 Q12A
4.2 Leadership ability	C.2 Leadership ability	As APPLES2 Q12B
4.3 Public speaking ability	C.3 Public speaking ability	As APPLES2 Q12C
4.4 Math ability	C.4 Math ability	As APPLES2 Q12D
4.5 Science ability	C.5 Science ability	As APPLES2 Q12E
4.6 Communication skills	C.6 Communication skills	As APPLES2 Q12F
4.7 Ability to apply math and science principles in solving real world problems	C.7 Ability to apply math and science principles in solving real world problems	As APPLES2 Q12G
4.8 Business ability	C.8 Business ability	As APPLES2 Q12H
4.9 Ability to perform in teams	C.9 Ability to perform in teams	As APPLES2 Q12I
4.10 Critical thinking skills	C.10 Critical thinking skills	
4.11 Wish to find new solutions	C.11 Wish to find new solutions	
Playground – most needed information 5.1 Availability of materials		(playground): ETD p. 11-12
5.2 Body proportions		(playground): ETD p. 11-12
5.3 Budget		(playground): ETD p. 11-12
5.4 Handicapped accessibility		(playground): ETD p. 11-12
5.5 Information about the area		(playground): ETD p. 11-12
5.6 Labor availability and cost		(playground): ETD p. 11-12
5.7 Legal liability		(playground): ETD p. 11-12
5.8 Maintenance concerns		(playground): ETD p. 11-12
5.9 Material costs		(playground): ETD p. 11-12
5.10 Material specifications		(playground): ETD p. 11-12
5.11 Neighborhood demographics		(playground): ETD p. 11-12
5.12 Neighborhood opinions		(playground): ETD p. 11-12
5.13 Safety		(playground): ETD p. 11-12
5.14 Supervision concerns		(playground): ETD p. 11-12
5.15 Technical references		(playground): ETD p. 11-12
5.16 Utilities		(playground): ETD p. 11-12
	D. Three keywords characterizing an engineer	New
	E. Three keywords characterizing your engineering education	New
Most important items practicing engineering	**Most important items practicing engineering**	(ABET, importance): ETD, p. 16

6.1 Business knowledge	F.1 Business knowledge	(ABET, importance): ETD, p. 16
6.2 Communication	F.2 Communication	(ABET, importance): ETD, p. 16
6.3 Conducting experiments	F.3 Conducting experiments	(ABET, importance): ETD, p. 16
6.4 Contemporary issues	F.4 Contemporary issues	(ABET, importance): ETD, p. 16
6.5 Creativity	F.5 Creativity	(ABET, importance): ETD, p. 16
6.6 Data analysis	F.6 Data analysis	(ABET, importance): ETD, p. 16
6.7 Design	F.7 Design	(ABET, importance): ETD, p. 16
6.8 Engineering analysis	F.8 Engineering analysis	(ABET, importance): ETD, p. 16
6.9 Engineering tools	F.9 Engineering tools	(ABET, importance): ETD, p. 16
6.10 Ethics	F.10 Ethics	(ABET, importance): ETD, p. 16
6.11 Global context	F.11 Global context	(ABET, importance): ETD, p. 16
6.12 Leadership	F.12 Leadership	(ABET, importance): ETD, p. 16
6.13 Life-long learning	F.13 Life-long learning	(ABET, importance): ETD, p. 16
6.14 Management skills	F.14 Management skills	(ABET, importance): ETD, p. 16
6.15 Math	F.15 Math	(ABET, importance): ETD, p. 16
6.16 Problem solving	F.16 Problem solving	(ABET, importance): ETD, p. 16
6.17 Professionalism	F.17 Professionalism	(ABET, importance): ETD, p. 16
6.18 Science	F.18 Science	(ABET, importance): ETD, p. 16
6.19 Societal context	F.19 Societal context	(ABET, importance): ETD, p. 16
6.20 Teamwork	F.20 Teamwork	(ABET, importance): ETD, p. 16
Preparedness to incorporate items while practicing as an engineer 7.1 Business knowledge	**Preparedness to incorporate items while practicing as an engineer** G.1 Business knowledge	(ABET, preparedness): ETD, p. 16-17
7.2 Communication	G.2 Communication	(ABET, preparedness): ETD, p. 16-17
7.3 Conducting experiments	G.3 Conducting experiments	(ABET, preparedness): ETD, p. 16-17
7.4 Contemporary issues	G.4 Contemporary issues	(ABET, preparedness): ETD, p. 16-17
7.5 Creativity	G.5 Creativity	(ABET, preparedness): ETD, p. 16-17
7.6 Data analysis	G.6 Data analysis	(ABET, preparedness): ETD, p. 16-17
7.7 Design	G.7 Design	(ABET, preparedness): ETD, p. 16-17
7.8 Engineering analysis	G.8 Engineering analysis	(ABET, preparedness): ETD, p. 16-17
7.9 Engineering tools	G.9 Engineering tools	(ABET, preparedness): ETD, p. 16-17
7.10 Ethics	G.10 Ethics	(ABET, preparedness): ETD, p. 16-17
7.11 Global context	G.11 Global context	(ABET, preparedness): ETD, p. 16-17
7.12 Leadership	G.12 Leadership	(ABET, preparedness): ETD, p. 16-17

7.13 Life-long learning	G.13 Life-long learning	(ABET, preparedness): ETD, p. 16-17
7.14 Management skills	G.14 Management skills	(ABET, preparedness): ETD, p. 16-17
7.15 Math	G.15 Math	(ABET, preparedness): ETD, p. 16-17
7.16 Problem solving	G.16 Problem solving	(ABET, preparedness): ETD, p. 16-17
7.17 Professionalism	G.17 Professionalism	(ABET, preparedness): ETD, p. 16-17
7.18 Science	G.18 Science	(ABET, preparedness): ETD, p. 16-17
7.19 Societal context	G.19 Societal context	(ABET, preparedness): ETD, p. 16-17
7.20 Teamwork	G.20 Teamwork	(ABET, preparedness): ETD, p. 16-17
(As question 19)	**Rating of own abilities** H.1 Project management	
	H.2 Rote learning	
	H.3 Teamwork skills	
	H.4 Individual written assignments	
	H.5 Idea creation	
	H.6 Organisational talent	
	H.7 Conflict management	
	H.8 Laboratory experimenting	
	H.9 Ability to work independently	
	H.10 Oral communication	
	H.11 Written communication	
	Assessment of progress since starting engineering programme I.1 Responsible use of technology	**New**
	I.2 Sustainability	
	I.3 Understanding of the role of technology in society	
	I.4 Idea creation	
	I.5 Individual written assignments	
	I.6 Career planning	
	I.7 Conflict management	
	I.8 Laboratory experimenting	
	I.9 Environmental impact assessment	
	I.10 Oral communication	
	I.11 Organisational talent	
	I.12 Problem identification	
	I.13 Project management	
	I.14 Teamwork skills	
	I.15 Self-reflexivity	
	I.16 Ability to work independently	
	I.17 Written communication	
	I.18 Social responsibility	
	I.19 Rote learning	
	I.20 Knowledge on energy minimization	
	I.21 Knowledge of economics	
(As question 12)	**Agreement with science and technology statements** J. 1Thanks to scientific and technological advances, the Earth's natural resources will be inexhaustible	
	J.2 Science and technology can sort out any problem	
	J.3 Science and technology cannot really play a role in improving the environment	
	J.4 The applications of science and	

	technology can threaten human rights	
	J.5 New inventions will always be found to counteract any harmful effect of scientific and technological developments	
	J.6 The benefits of science are greater than any harmful effects it may have	
(As question 13)	**Engagement with science and technology** K.1 Watch or listen to media programmes about scientific or technologic issues?	
	K.2 Talk to friends or family about scientific or technologic issues?	
	K.3 Attend public meetings or debates about science and technology?	
	K.4 Sign petitions or join street demonstrations on matters of nuclear power, biotechnology or the environment?	
	K.5 Donate money to fundraising campaigns for medical research such as research into cancer?	
	K.6 Participate in the activities of a non-governmental organisation dealing with science and technology related issues?	
Prioritization of item importance relative to each other 8.1 To prevent pollution	**Prioritization of item importance relative to each other** L.1 To prevent pollution	New
8.2 To ensure resources for future generations	L.2 To ensure resources for future generations	New
8.3 To generate economic growth in Denmark	L.3 To generate economic growth in Denmark	New
8.4 To combat global climate changes	L.4 To combat global climate changes	New
8.5 To improve living conditions of people in developing countries	L.5 To improve living conditions of people in developing countries	New
Prioritization of statements on the role of engineers in society relative to each other 9.1 Engineers should contribute to solving problems related to climate change and environmental degradation	**Prioritization of statements on the role of engineers in society relative to each other** M.1 Engineers should contribute to solving problems related to climate change and environmental degradation	New
9.2 Engineers should contribute to ensuring that technological development is utilised in a fair and responsible way	M.2 Engineers should contribute to ensuring that technological development is utilised in a fair and responsible way	New
9.3 Engineers should contribute to creating an overview of complex interrelations between different scientific and technical fields	M.3 Engineers should contribute to creating an overview of complex interrelations between different scientific and technical fields	New
Interest 10.1 Working environment		New
10.2 Biofuel		
10.3 Ethics		
10.4 Engineering projects in developing countries		
10.5 Research communication		
10.6 Global division of labour		
10.7 Innovation		
10.8 Intercultural communication		
10.9 Entrepreneurship		
10.10 Climate change		

10.11 Air pollution		
10.12 Human rights		
10.13 Modelling		
10.14 Technology transfer		
10.15 The interplay between different technological systems		
10.16 Theory of science		
10.17 Growth strategies		
Knowledge level 11.1 Working environment		New, inspired by Azapagic
11.2 Biofuel		
11.3 Ethics		
11.4 Engineering projects in developing countries		
11.5 Research communication		
11.6 Global division of labour		
11.7 Innovation		
11.8 Intercultural communication		
11.9 Entrepreneurship		
11.10 Climate change		
11.11 Air pollution		
11.12 Human rights		
11.13 Modelling		
11.14 Technology transfer		
11.15 The interplay between different technological systems		
11.16 Theory of science		
11.17 Growth strategies		
Agreement with science and technology statements 12. 1Thanks to scientific and technological advances, the Earth's natural resources will be inexhaustible	(As question J)	Eurobarometer
12.2 Science and technology can sort out any problem		
12.3 Science and technology cannot really play a role in improving the environment		
12.4 The applications of science and technology can threaten human rights		
12.5 New inventions will always be found to counteract any harmful effect of scientific and technological developments		
12.6 The benefits of science are greater than any harmful effects it may have		
Engagement with science and technology 13.1 Watch or listen to media programmes about scientific or technologic issues?	(As question K)	Eurobarometer
13.2 Talk to friends or family about scientific or technologic issues?		
13.3 Attend public meetings or debates about science and technology?		
13.4 Sign petitions or join street demonstrations on matters of nuclear power, biotechnology or the environment?		
13.5 Donate money to fundraising campaigns for medical research such as research into cancer?		
13.6 Participate in the activities of a		

non-governmental organisation dealing with science and technology related issues?		
Engagement with environmental questions 14.1 Watch or listen to media programmes about environmental questions?		New, inspired by Eurobarometer and Sørensen 2004
14.2 Talk to friends or family about environmental questions?		
14.3 Discuss environmental questions as part of your education?		
14.4 Attend public meetings or debates about environmental questions?		
14.5 Donate money to support of environmental questions?		
14.6 Participate in the activities of a non-governmental organisation dealing with environmental questions?		
Consumption habits 15.1 Do you choose products on the basis of ethical or environmental considerations?		New
15.2 Do you buy fair trade products?		
15.3 Do you buy organic products?		
16. Description of the concept of sustainability		New
Sustainability conception 17.1 Ethics	**Sustainability conception** N.1 Ethics	New
17.2 Global context	N.2 Global context	
17.3 Law	N.3 Law	
17.4 Technological context	N.4 Technological context	
17.5 Natural context	N.5 Natural context	
17.6 Life-long learning	N.6 Life-long learning	
17.7 Politics	N.7 Politics	
17.8 Societal context	N.8 Societal context	
17.9 Social responsibility	N.9 Social responsibility	
17.10 Economic context	N.10 Economic context	
18. Assessment of educational institution's sustainability focus	**O. Assessment of educational institution's sustainability focus**	New
Rating of own abilities 19.1 Project management	(As question H)	New
19.2 Rote learning		
19.3 Teamwork skills		
19.4 Individual written assignments		
19.5 Idea creation		
19.6 Organisational talent		
19.7 Conflict management		
19.8 Laboratory experimenting		
19.9 Ability to work independently		
19.10 Oral communication		
19.11 Written communication		
20. Experience with group-based project work		New
21. Previous education in environmental issues 21a. If yes: Indication of educational setting		New
22. Previous education in sustainability 22a. If yes: Indication of educational setting		New
Agreement in attitudes towards		New

different subjects 23.1 Natural science makes it possible to act on an objective basis		
23.2 Social science provides insight necessary for the development of technology		
23.3 Philosophy makes it possible to make a critical analysis and comparison of different subjects		
23.4 Language and literature provide access to understanding relations between humans and technology		
23.5 Mathematics provides access to a universal 'language' for all sciences		
23.6 Social science is a subject dominated by attitude where all views are of equal value		
23.7 Natural science subjects provide the instruments for understanding the world and develop technology		
23.8 It is possible to give an objective account of historic developments		
23.9 It is possible to govern technological progress based on insights in economic matters		
Socio-demographics and other background issues 24. Educational background	**Socio-demographics and other background issues (only asked if respondent did not participate in first round)** P. Educational background	New
25. Number of adults in household	Q. Number of adults in household	As Eurobarometer
26. Number of children in household	R. Number of children in household	As Eurobarometer
27. Highest level of education completed by mother	S. Highest level of education completed by mother	New
28. Highest level of education completed by mother	T. Highest level of education completed by mother	New
29. STEM background of relatives	U. STEM background of relatives	New
30. Engineers in immediate family 30a. If yes: Which	V. Engineers in immediate family Va. If yes: Which	As APPLES2 Q30
31. and 31a. Nationality	X. and Xa. Nationality	New

DANSK CENTER FOR FORSKNINGSANALYSE
DET SAMFUNDSVIDENSKABELIGE
FAKULTET
AARHUS UNIVERSITET

Information om spørgeskemaundersøgelse blandt førsteårs-ingeniørstuderende

<u>Spørgeskemaundersøgelse skal give bedre viden om ingeniørstuderendes læring</u>

Dansk Center for Forskningsanalyse

Sanne Haase

Ph.d.-studerende

Dato: 17. september 2010

Direkte tlf.: 89422378
Fax: 89422399
E-mail: sh@cfa.au.dk

Web: au.dk/sh@cfa

Afs. CVR-nr.: 31119103

Kære ansatte på DTU

I disse dage finder der en spørgeskemaundersøgelse sted blandt nystartede ingeniørstuderende i hele landet.

Undersøgelsen indgår som et element i forskningsprojektet PROCEED (A Program of Research on Opportunities and Challenges in Engineering Education in Denmark) og vil tilvejebringe data, der gør det muligt at sammenligne danske såvel som internationale ingeniørstuderendes læring. Projektet er støttet af det strategiske forskningsråd, og både AU, AAU, DTU og RUC indgår som partnere i projektet.

Undersøgelsen, der omfatter samtlige ingeniøruddannelser i Danmark, vil tilvejebringe viden om de ingeniørstuderende og deres forudsætninger for og oplevelser af det første år på ingeniørstudiet. Undersøgelsen vil derfor være værdifuld i det fremadrettede arbejde med udvikling af ingeniøruddannelserne, og resultaterne vil blive offentliggjort (under sikring af anonymitet), så de kan komme ingeniøruddannelserne til gavn.

Det vil være yderst frugtbart for undersøgelsen, hvis I i kontakten med de studerende vil bakke op omkring deres deltagelse i undersøgelsen.

For mere information om selve undersøgelsen, kontakt venligst:

Sanne Haase
Ph.d.-studerende
Center for Forskningsanalyse
Aarhus Universitet
Finlandsgade 4
8200 Århus N
Tlf. 89422378

PLEASE NOTICE: ENGLISH VERSION BELOW

Hjælp os med at gøre din uddannelse bedre og vind 10.000 kroner!

I år bliver alle landets nye ingeniørstuderende bedt om at deltage i en undersøgelse. Derfor har du fået tilsendt et link til et web-spørgeskema i din mailboks. En høj svarprocent er afgørende for, at undersøgelsen kan komme dig og din uddannelse til gavn. Så åbn din mail og afsæt ca. 15 minutter til at svare på spørgsmålene, så deltager du i lodtrækningen om 10.000 kroner.

I mailen får du mere information om undersøgelsen og om, hvordan du deltager.

Med venlig hilsen
AU-HIH

ENGLISH VERSION

Help us improve engineering programmes and win DKK 10 000!

All newly enrolled engineering students in Denmark are now invited to participate in a survey. For this purpose you have received an email with a link to a questionnaire in your student mailbox. This is why you have received an email in your student mailbox with a link to an online questionnaire. A high response rate is crucial to the validity of the survey and for further improvement of your education.

We therefore kindly ask you to spare approximately 15 minutes of your time to complete the questionnaire.
In acknowledgement of participation in the survey, all respondents will enter the draw to win DKK 10 000.

The e-mail that you have received will provide you with more detailed information on the survey and how to participate.

Kind regards,

AU-HIH

PLEASE NOTICE: ENGLISH VERSION BELOW

Hjælp os med at gøre din uddannelse bedre og vind 1.000 kroner!

Du er del af den årgang af ingeniørstuderende, som bliver fulgt tæt for at skabe et bedre billede af ingeniørstuderendes faglige udvikling i løbet af deres uddannelse. Derfor har du fået tilsendt et link til et web-spørgeskema i din mailboks. En høj svarprocent er afgørende for, at undersøgelsen kan komme dig og din uddannelse til gavn. Så tag en pause fra eksamenslæsningen, åbn din mail og afsæt ca. 15 minutter til at svare på spørgsmålene, så deltager du i lodtrækningen om en af de 10 præmier på 1.000 kroner.

I mailen får du mere information om undersøgelsen og om, hvordan du deltager.

Med venlig hilsen

AU og IHA

ENGLISH VERSION

Help us improve engineering programmes and win DKK 1 000!

Your engineering student year group is followed closely in order to provide us with more knowledge on the academic progress of engineering students during their education. For this purpose you have received an email with a link to a questionnaire in your student mailbox. This is why you have received an email in your student mailbox with a link to an online questionnaire. A high response rate is crucial to the validity of the survey and for further improvement of your education.

We therefore kindly ask you to take a break from the study for your exams, check your mailbox, and spare approximately 15 minutes of your time to complete the questionnaire.
In acknowledgement of participation in the survey, all respondents will enter the draw to win 10 prizes of DKK 1 000 each.

The e-mail that you have received will provide you with more detailed information on the survey and how to participate.

Kind regards,

AU og IHA

Fra: Survey [mailto:survey@cfa.au.dk]
Sendt: 13. september 2010 16:56
Til: Per Stig Lauridsen
Emne: Spørgeskema - Survey

PLEASE NOTICE: ENGLISH VERSION BELOW

Kære Per Stig Lauridsen,

I år bliver alle landets nye ingeniørstuderende bedt om at deltage i en undersøgelse, som skal bruges til at gøre danske ingeniøruddannelser endnu bedre. Derfor vil vi bede dig afsætte 15 minutter til at besvare et spørgeskema. Spørgeskemaet handler om dig og dine forventninger til ingeniørstudiet og til det arbejdsliv, der venter dig, når du bliver færdig som ingeniør.

Som tak for din hjælp, trækker vi lod om en check på **10.000 kroner** blandt alle besvarelser. Vinderen udtrækkes 1. november 2010 og får direkte besked hurtigst muligt herefter.

Du finder spørgeskemaet via dette personlige link: https://www.survey-xact.dk/answer?key=83X6Q3X159SP

Undersøgelsen indgår i et større forskningsprojekt, som foregår i et samarbejde mellem forskere fra hele landet, og som er støttet af en række af landets ingeniøruddannelsessteder.

Din og dine medstuderendes besvarelser vil gøre os klogere på ingeniørstuderendes forudsætninger og forhåbninger her i starten af jeres uddannelsesforløb. Det er viden, som gerne skulle kunne bidrage til, at ingeniører, der uddannes i Danmark, bliver endnu dygtigere.

Uddannelsesinstitutionerne har ikke adgang til den enkelte besvarelse. Din besvarelse vil naturligvis blive håndteret fortroligt.

For at undersøgelsen skal kunne give sikker viden om de ingeniørstuderende, er det afgørende med en høj svarprocent. Derfor vil vi bede dig besvare spørgeskemaet så hurtigt som muligt og inden den 1. oktober 2010.

Hvis du vil vide mere om selve undersøgelsen, er du velkommen til at kontakte:

Sanne Haase
Dansk Center for Forskningsanalyse
Aarhus Universitet
Tlf. 89422378

ENGLISH VERSION

Dear Per Stig Lauridsen,

All newly enrolled engineering students in Denmark will this year be invited to participate in a survey. The objective of this survey is to further improve Danish engineering degree programmes. We therefore ask you to spare approximately 15 minutes of your time to complete a questionnaire. The questionnaire is about you and your expectations to your engineering degree programme and to your future working life after graduation.

In acknowledgement of participation in the survey, all respondents will enter the draw to win **DKK 10 000**. The winner will be contacted directly soon after Monday, 1 November 2010.

You may access the online questionnaire through the following personal link: https://www.survey-xact.dk/answer?key=83X6Q3X159SP

The survey forms part of a large research project involving researchers from all over Denmark, and the project is supported by a wide range of Danish engineering education institutions.

The responses provided by you and your fellow engineering students will give us valuable information about the qualifications and expectations of newly enrolled engineering students. This information will provide a crucial basis for further improvement of Danish engineering degree programmes.

Your anonymity as a survey respondent is ensured; no educational institution will get access to individual answers. All responses are anonymous and will be kept confidential.

A high response rate is crucial to the validity of the survey. Therefore we kindly ask your assistance in completing the questionnaire as soon as possible and before Friday, 1 October 2010.

If you are interested in further information on the survey, please contact:

Sanne Haase
The Danish Centre for Studies in Research and Research Policy
Aarhus University
Tel. +45 89422378

Fra: Survey [mailto:survey@cfa.au.dk]
Sendt: 27. september 2010 12:44
Til: Per Stig Lauridsen
Emne: Reminder

PLEASE NOTICE: ENGLISH VERSION BELOW

Kære Per Stig Lauridsen,

Husk at besvare spørgeskemaet om ingeniørstuderende, så du deltager i lodtrækningen om **10.000 kroner**. For at undersøgelsen skal kunne give sikker viden om de ingeniørstuderende, er det afgørende med en høj svarprocent. Derfor vil vi bede dig besvare spørgeskemaet så hurtigt som muligt og inden fredag den 1. oktober 2010.

Du finder spørgeskemaet via dette personlige link: https://www.survey-xact.dk/answer?key=83X6Q3X159SP

I år bliver alle landets nye ingeniørstuderende bedt om at deltage i en undersøgelse, som skal bruges til at gøre danske ingeniøruddannelser endnu bedre. Derfor vil vi bede dig afsætte 15 minutter til at besvare et spørgeskema. Spørgeskemaet handler om dig og dine forventninger til ingeniørstudiet og til det arbejdsliv, der venter dig, når du bliver færdig som ingeniør.

Som tak for din hjælp, trækker vi lod om en check på 10.000 kroner blandt alle besvarelser. Vinderen udtrækkes 1. november 2010 og får direkte besked hurtigst muligt herefter.

Uddannelsesinstitutionerne har ikke adgang til den enkelte besvarelse. Din besvarelse vil naturligvis blive håndteret fortroligt.

Hvis du vil vide mere om selve undersøgelsen, er du velkommen til at kontakte:

Sanne Haase
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ENGLISH VERSION

Dear Per Stig Lauridsen,

Remember to fill in the engineering student questionnaire to enter the draw to win **DKK 10 000**. A high response rate is crucial to the validity of the survey. Therefore we kindly ask your assistance in completing the questionnaire as soon as possible and before Friday, 1 October 2010.

You may access the online questionnaire through the following personal link: https://www.survey-xact.dk/answer?key=83X6Q3X159SP

All newly enrolled engineering students in Denmark are invited to participate in a survey. The objective of this survey is to further improve Danish engineering degree programmes. We therefore ask you to spare approximately 15 minutes of your time to complete a questionnaire.

The questionnaire is about you and your expectations to your engineering degree programme and to your future working life after graduation.

In acknowledgement of participation in the survey, all respondents will enter the draw to win DKK 10 000. The winner will be contacted directly soon after Monday, 1 November 2010.

Your anonymity as a survey respondent is ensured; no educational institution will get access to individual answers. All responses are anonymous and will be kept confidential.

If you are interested in further information on the survey, please contact:

Sanne Haase
The Danish Centre for Studies in Research and Research Policy
Aarhus University
Tel. +45 89422378

Fra: Survey [mailto:survey@cfa.au.dk]
Sendt: 29. september 2010 12:56
Til: Per Stig Lauridsen
Emne: IHK har brug for dit svar

PLEASE NOTICE: ENGLISH VERSION BELOW

Kære Per Stig Lauridsen,

Ingeniørhøjskolen i København har brug for din besvarelse. Og du kan stadig nå at vinde **10.000 kroner** som tak for din hjælp.

Du finder spørgeskemaet via dette personlige link: https://www.survey-xact.dk/answer?key=83X6Q3X159SP

Vi trækker lod om en check på 10.000 kroner blandt alle besvarelser. Vinderen udtrækkes 1. november 2010 og får direkte besked hurtigst muligt herefter.

Spørgeskemaet bliver sendt ud til alle landets nyoptagne ingeniørstuderende. Undersøgelsen er en del af et dansk forskningsprojekt, som en række ingeniøruddannelsesinstitutioner indgår i. Den skal bruges til at gøre danske ingeniøruddannelser endnu bedre. Spørgeskemaet handler om dig og dine forventninger til ingeniørstudiet og til det arbejdsliv, der venter dig, når du bliver færdig som ingeniør.

Uddannelsesinstitutionerne har ikke adgang til den enkelte besvarelse. Din besvarelse vil naturligvis blive håndteret fortroligt.

Hvis du oplever at blive smidt af systemet, vil vi meget gerne have det at vide på survey@cfa.au.dk, da vi så vil bede vores eksterne leverandør af systemet om at gøre noget ved det.

Hvis du vil vide mere om selve undersøgelsen, er du velkommen til at kontakte:

Sanne Haase
Dansk Center for Forskningsanalyse
Aarhus Universitet
Tlf. 89422378

ENGLISH VERSION

Dear Per Stig Lauridsen,

Copenhagen University College in Engineering needs your answer. Please fill in the engineering student questionnaire, and you get a chance of winning **DKK 10 000** in acknowledgement of your participation.

You may access the online questionnaire through the following personal link: https://www.survey-xact.dk/answer?key=83X6Q3X159SP

All respondents will enter the draw to win DKK 10 000. The winner will be contacted directly soon after Monday, 1 November 2010.

All newly enrolled engineering students in Denmark are invited to participate in the survey that forms part of a large research project involving researchers from all over Denmark. The research project is supported by a wide range of Danish engineering education institutions.

The objective of this survey is to further improve Danish engineering degree programmes. The questionnaire is about you and your expectations to your engineering degree programme and to your future working life after graduation.

Your anonymity as a survey respondent is ensured; no educational institution will get access to individual answers. All responses are anonymous and will be kept confidential.

If you experience any technical problems, please let us know by sending an email to survey@cfa.au.dk. In that case we will ask our external system supplier to deal with the problems.

If you are interested in further information on the survey, please contact:

Sanne Haase
The Danish Centre for Studies in Research and Research Policy
Aarhus University
Tel. +45 89422378

Fra: Survey [mailto:survey@cfa.au.dk]
Sendt: 29. september 2010 12:38
Til: Per Stig Lauridsen
Emne: Information

PLEASE NOTICE: ENGLISH VERSION BELOW

Kære Per Stig Lauridsen,

Du har tidligere modtaget en mail, hvor du blev opfordrert til at deltage i en spørgeskemaundersøgelse af Danmarks nye ingeniørstuderende. Vi har registreret, at du har besvaret nogle af spørgsmålene i spørgeskemaet. Vi beklager meget, hvis det er tekniske problemer, som har forhindret dig i at gennemføre besvarelsen.

Det vil være meget gavnligt for undersøgelsen, hvis du vil hjælpe os ved at klikke dig ind igen og besvare resten af spørgeskemaet her: https://www.survey-xact.dk/answer?key=83X6Q3X159SP

Hvis du oplever at blive smidt af systemet, vil vi meget gerne have det at vide på survey@cfa.au.dk, da vi så vil bede vores eksterne leverandør af systemet om at gøre noget ved det. Samtidig vil dette give os mulighed for at lade dig indgå i lodtrækningspuljen, så du ikke mister din chance for at vinde de **10.000 kroner**.

Vinderen udtrækkes 1. november 2010 og får direkte besked hurtigst muligt herefter.

På forhånd mange tak for din hjælp!

Hvis du vil vide mere om selve undersøgelsen, er du velkommen til at kontakte:

Sanne Haase
Dansk Center for Forskningsanalyse
Aarhus Universitet
Tlf. 89422378

ENGLISH VERSION

Dear Per Stig Lauridsen,

You recently received an email inviting you to participate in an engineering student survey. We have registered that you have answered some of the questions. I deeply regret if technical trouble is the reason why you have not completed the questionnaire.

It would be very beneficial to the investigation, if you would help us by accessing the survey again and answer the remaining questions here: https://www.survey-xact.dk/answer?key=83X6Q3X159SP

If you experience any technical problems, please let us know by sending an email to survey@cfa.au.dk. In that case we will ask our external system supplier to deal with the problems. At the same time it will enable us to let you enter the draw, so you do not miss out on the chance of winning **DKK 10 000**.

The winner will be contacted directly soon after Monday, 1 November 2010.

Thanks in advance!

If you are interested in further information on the survey, please contact:

Sanne Haase
The Danish Centre for Studies in Research and Research Policy
Aarhus University
Tel. +45 89422378

Fra: Survey [mailto:survey@cfa.au.dk]
Sendt: 1. oktober 2010 14:09
Til: Per Stig Lauridsen
Emne: Svarfrist forlænget

PLEASE NOTICE: ENGLISH VERSION BELOW

Kære Per Stig Lauridsen,

Vi har forlænget svarfristen, så vi også kan få et svar fra dig om dine forventninger til ingeniøruddannelsen. Du kan stadig nå at vinde **10.000 kroner** som tak for din hjælp.

Du finder spørgeskemaet via dette personlige link: https://www.survey-xact.dk/answer?key=83X6Q3X159SP

Vi trækker lod om en check på 10.000 kroner blandt alle besvarelser. Vinderen udtrækkes 1. november 2010 og får direkte besked hurtigst muligt herefter.

Spørgeskemaet bliver sendt ud til alle landets nyoptagne ingeniørstuderende. Undersøgelsen er en del af et dansk forskningsprojekt, som en række ingeniøruddannelsesinstitutioner indgår i. Den skal bruges til at gøre danske ingeniøruddannelser endnu bedre.

Uddannelsesinstitutionerne har ikke adgang til den enkelte besvarelse. Din besvarelse vil naturligvis blive håndteret fortroligt.

Hvis du oplever at blive smidt af systemet, vil vi meget gerne have det at vide på survey@cfa.au.dk, da vi så vil bede vores eksterne leverandør af systemet om at udbedre problemet.

Hvis du vil vide mere om selve undersøgelsen, er du velkommen til at kontakte:

Sanne Haase
Dansk Center for Forskningsanalyse
Aarhus Universitet
Tlf. 89422378

ENGLISH VERSION

Dear Per Stig Lauridsen,

We have extended the survey closing date in order to give you time to fill in the engineering student questionnaire about your expectations to your engineering degree programme. You still have a chance to win **DKK 10 000** in acknowledgement of your participation.

You may access the online questionnaire through the following personal link: https://www.survey-xact.dk/answer?key=83X6Q3X159SP

All respondents will enter the draw to win DKK 10 000. The winner will be contacted directly soon after Monday, 1 November 2010.

All newly enrolled engineering students in Denmark are invited to participate in the survey that forms part of a large research project supported by a wide range of Danish engineering education institutions. The objective of this survey is to further improve Danish engineering degree programmes.

Your anonymity as a survey respondent is ensured; no educational institution will get access to individual answers. All responses are anonymous and will be kept confidential.

If you experience any technical problems, please let us know by sending an email to survey@cfa.au.dk. In that case we will ask our external system supplier to deal with the problems.

If you are interested in further information on the survey, please contact:

Sanne Haase
The Danish Centre for Studies in Research and Research Policy
Aarhus University
Tel. +45 89422378

Fra: Survey [mailto:survey@cfa.au.dk]
Sendt: 6. oktober 2010 13:43
Til: Per Stig Lauridsen
Emne: Last chance

PLEASE NOTICE: ENGLISH VERSION BELOW

Kære Per Stig Lauridsen,

Så er det ved at være sidste chance for deltage i spørgeskemaundersøgelsen om dine forventninger til ingeniørstudiet. Du kan stadig nå at vinde **10.000 kroner** som tak for din hjælp.

Du finder spørgeskemaet via dette personlige link: https://www.survey-xact.dk/answer?key=83X6Q3X159SP

Der lukkes for besvarelser på fredag den 8. oktober. Vinderen af de **10.000 kroner** udtrækkes blandt alle besvarelser den 1. november 2010 og får direkte besked hurtigst muligt herefter.

Hvis du vil vide mere om selve undersøgelsen, er du velkommen til at kontakte:

Sanne Haase
Dansk Center for Forskningsanalyse
Aarhus Universitet
Tlf. 89422378

ENGLISH VERSION

Dear Per Stig Lauridsen,

Remember to fill in the engineering student questionnaire about your expectations to your engineering degree programme. You still have a chance to win **DKK 10 000** in acknowledgement of your participation.

You may access the online questionnaire through the following personal link: https://www.survey-xact.dk/answer?key=83X6Q3X159SP

No survey responses will be accepted after Friday, 8 October. The winner of **10 000 DKK** is found by draw among all respondents and contacted directly soon after Monday, 1 November 2010.

If you are interested in further information on the survey, please contact:

Sanne Haase
The Danish Centre for Studies in Research and Research Policy
Aarhus University
Tel. +45 89422378

Fra: Survey [mailto:survey@cfa.au.dk]
Sendt: 4. maj 2011 12:16
Til: Per Stig Lauridsen
Emne: Tag en pause i eksamenslæsningen!

PLEASE NOTICE: ENGLISH VERSION BELOW

Kære Per Stig Lauridsen,

Du er del af den årgang af ingeniørstuderende, som bliver fulgt tæt for at skabe et bedre billede af ingeniørstuderendes faglige udvikling i løbet af deres uddannelse. Ved at deltage i spørgeskemaundersøgelsen bidrager du med viden, som skal bruges til at gøre danske ingeniøruddannelser endnu bedre. Så tag en pause fra eksamenslæsningen og besvar spørgeskemaet. Som tak for hjælpen deltager du så i lodtrækningen om en af 10 præmier á 1.000 kroner blandt alle besvarelser. Vinderne udtrækkes 1. juli 2011 og får direkte besked.

Du finder spørgeskemaet via dette personlige link: https://www.survey-xact.dk/answer?key=2GZKLQH9P4S2

Det tager ca. 15 min. at deltage i undersøgelsen.

Din besvarelse vil naturligvis blive håndteret fortroligt, og din uddannelsesinstitution har ikke adgang til den.

Undersøgelsen indgår i et større forskningsprojekt og er støttet af landets ingeniøruddannelsesinstitutioner.

For at undersøgelsen skal kunne give sikker viden om de ingeniørstuderende, er det afgørende med en høj svarprocent. Derfor vil vi bede dig besvare spørgeskemaet så hurtigt som muligt.

Held og lykke med dine eksamener!

Hvis du vil vide mere om selve undersøgelsen, er du velkommen til at kontakte:

Sanne Haase
Dansk Center for Forskningsanalyse
Aarhus Universitet
Tlf. 89422378

ENGLISH VERSION

Dear Per Stig Lauridsen,

You and your fellow engineering students form part of a year group which is followed closely in order to provide us with more knowledge on the academic progress of engineering students during their education. We hope that you will join the survey and thereby help us identify improvement potential of Danish engineering degree programmes. Participants will enter the draw to win one of 10 prizes of DKK 1,000 each. Winners will be drawn on 1 July 2011 and will be contacted soon thereafter.

You may access the online questionnaire through the following personal link: https://www.survey-xact.dk/answer?key=2GZKLQH9P4S2

It will take approximately 15 minutes to complete the questionnaire.

All responses are anonymous and will be kept confidential. Your educational institution will not get access to any individual answers.

The survey forms part of a major research project involving researchers from all over Denmark, and the project is supported by Danish engineering education institutions.

A high response rate is crucial to the validity of the survey. We therefore kindly ask you to take a break from the study for your exams and assist in completing the questionnaire as soon as possible.

Good luck with your exams!

If you want to know more about the survey, please contact:

Sanne Haase
Danish Centre for Studies in Research and Research Policy
Aarhus University
Tel. +45 89422378

Fra: Survey [mailto:survey@cfa.au.dk]
Sendt: 16. maj 2011 12:02
Til: Per Stig Lauridsen
Emne: Reminder

PLEASE NOTICE: ENGLISH VERSION BELOW

Kære Per Stig Lauridsen,

Husk at besvare spørgeskemaet om ingeniørstuderende, så du deltager i lodtrækningen om en af de 10 præmier på 1.000 kroner. For at undersøgelsen skal kunne give sikker viden om de ingeniørstuderende, er det afgørende med en høj svarprocent. Derfor vil vi bede dig besvare spørgeskemaet så hurtigt som muligt.

Du finder spørgeskemaet via dette personlige link: https://www.survey-xact.dk/answer?key=JJTHLD6SPQL5

Spørgeskemaet sendes ud til alle danske ingeniørstuderende på din årgang og handler om dig som ingeniørstuderende. Det tager ca. 15 min. at deltage i undersøgelsen.

Som tak for din hjælp trækker vi lod om 10 checks på 1.000 kroner blandt alle besvarelser. Vinderen udtrækkes 1. juli 2011 og får direkte besked hurtigst muligt herefter.

Held og lykke med dine eksamener!

Hvis du vil vide mere om selve undersøgelsen, er du velkommen til at kontakte:

Sanne Haase
Dansk Center for Forskningsanalyse
Aarhus Universitet
Tlf. 89422378

ENGLISH VERSION

Dear Per Stig Lauridsen,

Remember to fill in the engineering student questionnaire to enter the draw to win one of 10 prizes of DKK 1,000 each. A high response rate is crucial to the validity of the engineering student survey. Therefore we kindly ask your assistance in completing the questionnaire as soon as possible.

You may access the online questionnaire through the following personal link: https://www.survey-xact.dk/answer?key=JJTHLD6SPQL5

All Danish engineering students in your year group are invited to participate in the survey with the objective improving Danish engineering degree programmes. It will take approximately 15 minutes to complete the questionnaire.

In acknowledgement of participation in the survey, all respondents will enter the draw to win one of 10 prizes of DKK 1,000. Winners will be drawn on 1 July 2011 and will be contacted soon thereafter.

Good luck with your exams!

If you want to know more about the survey, please contact:

Sanne Haase
Danish Centre for Studies in Research and Research Policy
Aarhus University
Tel. +45 89422378

Fra: Survey [mailto:survey@cfa.au.dk]
Sendt: 27. maj 2011 11:32
Til: Per Stig Lauridsen
Emne: Tag en pause i eksamenslæsningen!

PLEASE NOTICE: ENGLISH VERSION BELOW

Kære Per Stig Lauridsen,

Husk at besvare spørgeskemaet om ingeniørstuderende, så du deltager i lodtrækningen om en af de 10 præmier på 1.000 kroner. For at undersøgelsen skal kunne give sikker viden om ingeniørstuderende, er det afgørende med en høj svarprocent. Derfor vil vi bede dig besvare spørgeskemaet så hurtigt som muligt.

Du finder spørgeskemaet via dette personlige link: https://www.survey-xact.dk/answer?key=2GZKLQH9P4S2

Spørgeskemaet sendes ud til alle danske ingeniørstuderende på din årgang og handler om dig som ingeniørstuderende. Det tager ca. 15 min. at deltage i undersøgelsen.

Som tak for din hjælp trækker vi lod om 10 checks på 1.000 kroner blandt alle besvarelser. Vinderen udtrækkes 1. juli 2011 og får direkte besked hurtigst muligt herefter.

Held og lykke med dine eksamener!

Hvis du vil vide mere om selve undersøgelsen, er du velkommen til at kontakte:

Sanne Haase
Dansk Center for Forskningsanalyse
Aarhus Universitet
Tlf. 89422378

ENGLISH VERSION

Dear Per Stig Lauridsen,

Remember to fill in the engineering student questionnaire to enter the draw to win one of 10 prizes of DKK 1,000 each. A high response rate is crucial to the validity of the engineering student survey. Therefore we kindly ask your assistance in completing the questionnaire as soon as possible.

You may access the online questionnaire through the following personal link: https://www.survey-xact.dk/answer?key=2GZKLQH9P4S2

All Danish engineering students in your year group are invited to participate in the survey with the objective of improving Danish engineering degree programmes. It will take approximately 15 minutes to complete the questionnaire.

In acknowledgement of participation in the survey, all respondents will enter the draw to win one of 10 prizes of DKK 1,000. Winners will be drawn on 1 July 2011 and will be contacted soon thereafter.

Good luck with your exams!

If you want to know more about the survey, please contact:

Sanne Haase
Danish Centre for Studies in Research and Research Policy
Aarhus University
Tel. +45 89422378

Fra: SurveyXact [mailto:surveyxact@survey-xact.dk] **På vegne af** Survey
Sendt: 7. juni 2011 14:15
Til: Per Stig Lauridsen
Emne: Husk at svare!

PLEASE NOTICE: ENGLISH VERSION BELOW

Kære Per Stig Lauridsen,

Du kan stadig nå at deltage i lodtrækningen om en af de 10 præmier på 1.000 kroner.

Du deltager i undersøgelsen om ingeniørstuderende ved at besvare spørgeskemaet via dette personlige link: https://www.survey-xact.dk/answer?key=JJTHLD6SPQL5

Spørgeskemaet sendes ud til alle danske ingeniørstuderende på din årgang og handler om dig som ingeniørstuderende. Det tager ca. 15 min. at deltage i undersøgelsen.

Som tak for din hjælp trækker vi lod om 10 checks på 1.000 kroner blandt alle besvarelser. Vinderen udtrækkes 1. juli 2011 og får direkte besked hurtigst muligt herefter.

Held og lykke med dine eksamener!

Hvis du vil vide mere om selve undersøgelsen, er du velkommen til at kontakte:

Sanne Haase
Dansk Center for Forskningsanalyse
Aarhus Universitet
Tlf. 89422378

ENGLISH VERSION

Dear Per Stig Lauridsen,

Remember to fill in the engineering student questionnaire to enter the draw to win one of 10 prizes of DKK 1,000 each.

You may access the online questionnaire through the following personal link: https://www.survey-xact.dk/answer?key=JJTHLD6SPQL5

All Danish engineering students in your year group are invited to participate in the survey with the objective of improving Danish engineering degree programmes. It will take approximately 15 minutes to complete the questionnaire.

In acknowledgement of participation in the survey, all respondents will enter the draw to win one of 10 prizes of DKK 1,000. Winners will be drawn on 1 July 2011 and will be contacted soon thereafter.

Good luck with your exams!

If you want to know more about the survey, please contact:

Sanne Haase
Danish Centre for Studies in Research and Research Policy
Aarhus University
Tel. +45 89422378

Fra: SurveyXact [mailto:surveyxact@survey-xact.dk] **På vegne af** Survey
Sendt: 16. juni 2011 11:37
Til: Per Stig Lauridsen
Emne: Sidste chance!

PLEASE NOTICE: ENGLISH VERSION BELOW

Kære Per Stig Lauridsen,

Spørgeskemaundersøgelsen af alle Danmarks ingeniørstuderende på din årgang er snart slut. Men vi vil også gerne høre om din oplevelse af at studere til ingeniør. Hvis du skynder dig, kan du lige nå at deltage i lodtrækningen om en af de 10 præmier på 1.000 kroner.

Du deltager i undersøgelsen ved at besvare spørgeskemaet via dette personlige link: https://www.survey-xact.dk/answer?key=JJTHLD6SPQL5

Det tager ca. 15 min. at deltage i undersøgelsen.

Vinderne udtrækkes 1. juli 2011 og får direkte besked hurtigst muligt herefter. Sidste frist for besvarelsen er på torsdag den 23. juni.

Held og lykke med dine eksamener!

Hvis du vil vide mere om selve undersøgelsen, er du velkommen til at kontakte:

Sanne Haase
Dansk Center for Forskningsanalyse
Aarhus Universitet
Tlf. 89422378

ENGLISH VERSION

Dear Per Stig Lauridsen,

The Engineering Student Survey addressing all Danish engineering students in your year group will soon be closed. But we still miss your answers to the questions about life as engineering student. If you hurry, you can still enter the draw to win one of 10 prizes of DKK 1,000 each.

You may access the online questionnaire through the following personal link: https://www.survey-xact.dk/answer?key=JJTHLD6SPQL5

It will take approximately 15 minutes to complete the questionnaire.

Winners will be drawn on 1 July 2011 and will be contacted soon thereafter. The survey closing date is on Thursday 23 June.

Good luck with your exams!

If you want to know more about the survey, please contact:

Sanne Haase
Danish Centre for Studies in Research and Research Policy
Aarhus University
Tel. +45 89422378

Appendix 8a: Non-Response Analysis and Weighting, 2010

Gender

		Respondents	Population
Female	N	380	864
	Percentage	22,6	23,8
Male	N	1302	1464
	Percentage	77,4	76,2
Total	N	1682	3630
	Percentage	46,3	100,0

No statistically significant difference between the gender distribution of respondents and population according to Chi Square Goodness of fit test.

Age

		Respondents	Population
17-19	N	272	608
	Percentage	16,2	16,7
20-24	N	1145	2461
	Percentage	68,1	67,8
25-30	N	181	376
	Percentage	10,8	10,4
30-34	N	57	136
	Percentage	3,4	3,7
35-	N	38	82
	Percentage	2,3	2,3
Total	N	1682	3630
	Percentage	46,3	100,0

Institution

		Respondents	Population
AU-HIH	N	80	115
	Percentage	4,8	3,2
DTU	N	439	1230
	Percentage	26,1	33,9
AAU	N	374	610
	Percentage	22,2	16,8
VIA	N	122	306
	Percentage	7,3	8,4
SDU	N	256	445
	Percentage	15,2	12,3
IHK	N	95	351
	Percentage	5,6	9,7
IHA	N	258	421
	Percentage	15,3	11,6
AU	N	58	152
	Percentage	3,4	4,2
Total	N	1682	3630
	Percentage	46,3	100,0

There is a statistically significant difference in the distribution of respondents and population according to Chi Square Goodness of fit test ($p< 0.001$).

Type of Degree Programme (vocational vs. academic)

		Respondents	Population
Vocational	N	868	1986
	Percentage	51,6%	54,7%
Academic	N	814	1644
	Percentage	48,4%	45,3%
Total	N	1682	3630
	Percentage	46,3	100,0

There is a statistically significant difference in the distribution of respondents and population according to Chi Square Goodness of fit test ($p< 0.001$).

Type of Programme (group of disciplines)

	Respondents	Population
Building/construction	11,3%	14,5%
ITC	10,6%	11,3%
Machine/Mechanical	9,5%	9,8%
Elektronics	8,3%	7,7%
Chemistry	4,8%	4,4%
Health	4,6%	4,8%
Software	4,3%	3,2%
Architecture and design	3,5%	3,2%
Bio technology	3,4%	4,3%
Global Business engineering	3,0%	2,4%
Energy	2,6%	2,1%
Building design	2,4%	2,8%
Global Management and Manufacturing	2,4%	1,7%
Business Development Engineering	2,3%	1,6%
Production/construction	2,2%	2,8%
Integrated design	2,1%	1,5%
Mechatronics	1,8%	1,2%
Physics og nano technology	1,8%	1,8%
Robot technology	1,8%	1,4%
Electronics and IT	1,8%	1,1%
Environmental technology	1,7%	1,8%
Chemistry and bio technology	1,4%	1,8%
Design and innovation	1,4%	1,8%
High voltage electrical	1,4%	,9%
Export	1,3%	1,8%
Bio proces	1,1%	,6%
Nano technology	,6%	,4%
City-, energy- and environmental planning	,5%	,4%
Other	5,9%	6,7%
Total	1682	3630

Weighting

In order to correct for the bias in institutional representation of the respondents a weighting procedure multiplies each response by a factor corresponding to the ratio between total population and responding population. The lower the response rate, the higher the weight. The weighting procedure only follows institutionally biased response rates. Statistically significant differences in respondents' and population's distribution on vocational vs. academic degree programmes is related to institutional affiliated. Therefore, additional weighting to correct for this bias is not undertaken.

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU
Weight	1,4375	2,801822	1,631016	2,508197	1,738281	3,694737	1,631783	2,62069

Appendix 8b: Non-Response Analysis and Weighting, 2011

Gender

		Respondents	Population
Female	N	335	757
	Percentage	28,3	23,8%
Male	N	847	2426
	Percentage	71,7	76,2%
Total	N	1182	3183
	Percentage	37.1	100,0

There is a statistically significant difference between the gender distribution of respondents and population according to Chi Square Goodness of fit test ($p<0.001$). However, this bias is not corrected for, since gender differences can be controlled for separately.

Age

		Respondents	Population
17-19	N	202	502
	Percentage	17,1	15,8
20-24	N	812	2218
	Percentage	68,7	69,7
25-30	N	103	282
	Percentage	8,7	8,9
30-34	N	43	115
	Percentage	3,6	3,6
35-	N	22	66
	Percentage	1,9	2,1
Total	N	1182	3183
	Percentage	37,1	100,0

Institution

		Respondents	Population
AU-HIH	N	46	112
	Percentage	3,9%	3,5%
DTU	N	339	1122
	Percentage	28,7%	35,2%
AAU	N	248	583
	Percentage	21,0%	18,3%
VIA	N	74	179
	Percentage	6,3%	5,6%
SDU	N	185	403
	Percentage	15,7%	12,7%
IHK	N	67	296
	Percentage	5,7%	9,3%
IHA	N	163	365
	Percentage	13,8%	11,5%
AU	N	60	123
	Percentage	5,1%	3,9%
Total	N	1182	3183
	Percentage	37.1	100

There is a statistically significant difference in the distribution of respondents and population according to Chi Square Goodness of fit test ($p < 0.001$).

Type of Degree Programme (vocational vs. academic)

		Respondents	Population
Vocational	N	585	1683
	Percentage	49,5	52,9%
Academic	N	597	1500
	Percentage	50,5	47,1%
Total	N	1182	3183
	Percentage	37.1	100

There is a statistically significant difference in the distribution of respondents and population according to Chi Square Goodness of fit test ($p < 0.05$).

Type of Programme (group of disciplines)

	Respondents	Population
Building/construction	12,5%	14,6%
ITC	9,2%	9,3%
Machine/Mechanical	8,7%	9,8%
Electronics	6,4%	7,8%
Chemistry	5,1%	4,1%
Health	4,7%	4,9%
Software	2,8%	3,2%
Architecture and design	3,1%	3,2%
Bio technology	5,7%	4,6%
Global Business engineering	3,4%	2,5%
Energy	2,8%	2,4%
Building design	3,0%	2,8%
Global Management and Manufacturing	2,1%	1,9%
Business Development Engineering	1,9%	1,9%
Production/construction	2,6%	2,9%
Integrated design	2,2%	1,6%
Mechatronics	1,6%	1,2%
Physics og nano technology	2,1%	1,9%
Robot technology	1,5%	1,4%
Electronics and IT	1,9%	1,4%
Environmental technology	1,9%	1,7%
Chemistry and bio technology	1,9%	1,8%
Design and innovation	2,0%	2,0%
High voltage electrical	,9%	,9%
Export	,8%	1,9%
Bio proces	,8%	,7%
Nano technology	,5%	,5%
City-, energy- and environmental planning	,6%	,4%
Other	7,3%	6,7%
Total	1182	3183

Weighting

In order to correct for the bias in institutional representation of the respondents a weighting procedure multiplies each response by a factor corresponding to the ratio between total population and responding population. The lower the response rate, the higher the weight. The weighting procedure only follows institutionally biased response rates. Statistically significant differences in respondents' and population's distribution on vocational vs. academic degree programmes is related to institutional affiliated. Therefore, additional weighting to correct for this bias is not undertaken. Gender bias in response rates has not been corrected for, since gender can easily be controlled for.

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU
Weight	2,434783	3,309735	2,350806	2,418919	2,178378	4,41791	2,239264	2,05

Engineering Student Survey, October 2010
Frequencies per institution

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Population in total
Population size (N)	115	1236	613	310	446	357	423	152	3630
Gender distribution in population; Female/Male; Per cent	12,2 87,8	27,3 72,7	27,2 72,8	20,6 79,4	17,9 82,1	22,4 77,6	15,4 84,6	43,4 56,6	23,9 76,1
Average age of population; years	22,8	21,5	21,8	22,4	22,9	23,2	22,3	22,2	22,1
Average response rate; per cent	70	36	61	39	57	27	61	38	46
Distribution on engineering education type; vocational (diplomingeniør)/ academic (Civilingeniør)	100 0	36,3 63,7	11,4 88,6	100 0	62,1 37,9	100 0	100 0	0 100	54,8 45,2

Question 1 We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you; Technology plays an important role in solving society's problems; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not a reason for my choice of education	6,3	5,3	9,1	5,8	5,9	6,3	5,4	5,2	6,2
Minimal reason for my choice of education	8,9	17,8	14,5	14,0	15,7	16,8	16,7	24,1	16,4
Moderate reason for my choice of education	54,4	40,4	39,2	36,4	40,4	42,1	44,7	36,2	40,8
Major reason for my choice of education	27,8	36,3	36,6	43,0	35,3	34,7	32,7	34,5	35,9
Do not know	2,5	,2	,5	,8	2,7	,0	,4	,0	,7
Respondents (N)	79	438	372	121	255	95	257	58	3617

Question 1 We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you; Engineers make more money than most other professionals; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not a reason for my choice of education	8,9	16,4	14,9	3,3	13,7	17,9	10,9	19,0	14,1
Minimal reason for my choice of education	32,9	30,1	32,7	36,7	27,7	22,1	31,1	34,5	30,4
Moderate reason for my choice of education	40,5	42,5	39,5	36,7	41,4	44,2	47,5	37,9	41,8
Major reason for my choice of education	15,2	9,4	11,9	21,7	15,2	15,8	10,1	8,6	12,4
Do not know	2,5	1,6	1,1	1,7	2,0	,0	,4	,0	1,2
Respondents (N)	79	438	370	120	256	95	257	58	3613

Question 1 We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you; My parent(s) would disapprove if I chose a major other than engineering; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not a reason for my choice of education	87,3	89,4	85,9	80,0	87,5	82,1	87,2	91,2	86,9
Minimal reason for my choice of education	6,3	7,8	9,2	12,5	7,8	10,5	6,6	7,0	8,5
Moderate reason for my choice of education	,0	2,1	2,2	4,2	3,5	4,2	2,3	1,8	2,6
Major reason for my choice of education	2,5	,0	1,9	1,7	,0	2,1	1,2	,0	,9
Do not know	3,8	,7	,8	1,7	1,2	1,1	2,7	,0	1,2
Respondents (N)	79	436	370	120	256	95	257	57	3604

Question 1 We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you; Engineers have contributed greatly to fixing problems in the world; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not a reason for my choice of education	10,1	6,4	9,2	5,8	8,2	7,4	4,3	8,6	7,1
Minimal reason for my choice of education	19,0	16,2	14,4	13,3	17,6	19,1	16,0	29,3	16,7
Moderate reason for my choice of education	39,2	39,0	40,2	41,7	38,4	39,4	48,6	29,3	40,1
Major reason for my choice of education	27,8	37,2	35,1	39,2	33,7	30,9	30,4	32,8	34,7
Do not know	3,8	1,1	1,1	,0	2,0	3,2	,8	,0	1,3
Respondents (N)	79	438	368	120	255	94	257	58	3604

Question 1 We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you; Engineers are well paid; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not a reason for my choice of education	3,8	13,3	11,4	3,3	10,3	8,5	7,4	19,0	10,6
Minimal reason for my choice of education	29,1	25,5	28,4	22,3	28,5	31,9	25,3	32,8	27,1
Moderate reason for my choice of education	46,8	45,0	44,9	48,8	41,5	40,4	50,2	39,7	44,8
Major reason for my choice of education	17,7	15,4	14,6	24,8	17,4	18,1	15,6	8,6	16,4
Do not know	2,5	,9	,8	,8	2,4	1,1	1,6	,0	1,2
Respondents (N)	79	436	370	121	253	94	257	58	3601

Question 1 We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you; My parent(s) want me to be an engineer; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not a reason for my choice of education	85,5	78,2	79,0	68,9	78,9	72,6	78,9	82,5	77,6
Minimal reason for my choice of education	9,2	14,9	14,4	15,1	10,9	14,7	14,3	15,8	14,1
Moderate reason for my choice of education	3,9	3,9	3,5	12,6	7,0	5,3	3,6	1,8	5,0
Major reason for my choice of education	,0	1,4	1,4	3,4	1,2	2,1	1,2	,0	1,5
Do not know	1,3	1,6	1,6	,0	2,0	5,3	2,0	,0	1,8
Respondents (N)	76	436	367	119	256	95	251	57	3583

Question 1 We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you; An engineering degree will guarantee me a job when I graduate; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not a reason for my choice of education	6,4	6,4	9,4	7,4	9,1	7,4	8,9	12,1	8,0
Minimal reason for my choice of education	29,5	22,2	18,6	17,2	16,5	27,4	17,5	19,0	20,5
Moderate reason for my choice of education	44,9	44,7	45,6	35,2	45,3	38,9	50,2	50,0	44,4
Major reason for my choice of education	19,2	25,5	23,5	37,7	26,4	21,1	21,0	19,0	24,9
Do not know	,0	1,1	3,0	2,5	2,8	5,3	2,3	,0	2,2
Respondents (N)	78	436	371	122	254	95	257	58	3609

Question 1 We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you; A faculty member, academic advisor, teaching assistant or other university affiliated person has encouraged and/or inspired me to study engineering; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not a reason for my choice of education	64,1	72,1	65,2	53,7	68,2	72,6	66,7	74,1	68,2
Minimal reason for my choice of education	21,8	15,8	17,3	26,4	21,2	13,7	17,6	15,5	17,8
Moderate reason for my choice of education	5,1	7,3	13,5	13,2	8,2	9,5	9,8	6,9	9,4
Major reason for my choice of education	6,4	3,0	3,0	5,0	2,0	4,2	3,1	3,4	3,3
Do not know	2,6	1,8	1,1	1,7	,4	,0	2,7	,0	1,4
Respondents (N)	78	437	371	121	255	95	255	58	3607

Question 1 We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you; A non-university affiliated mentor has encouraged and/or inspired me to study engineering; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not a reason for my choice of education	52,6	48,3	48,5	47,9	48,0	46,3	47,5	67,2	48,9
Minimal reason for my choice of education	30,8	18,3	21,0	20,7	21,9	23,2	16,7	20,7	20,2
Moderate reason for my choice of education	7,7	24,0	20,8	18,2	20,7	18,9	21,4	6,9	20,6
Major reason for my choice of education	6,4	7,8	7,8	12,4	9,0	10,5	11,7	5,2	8,9
Do not know	2,6	1,6	1,9	,8	,4	1,1	2,7	,0	1,5
Respondents (N)	78	437	371	121	256	95	257	58	3612

Question 1 We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you; A mentor has introduced me to people and opportunities in engineering; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not a reason for my choice of education	53,8	52,9	51,9	44,6	50,8	49,5	51,2	72,4	52,1
Minimal reason for my choice of education	26,9	18,5	20,5	22,3	23,2	16,8	21,1	12,1	19,9
Moderate reason for my choice of education	10,3	21,5	20,3	20,7	16,9	21,1	18,4	13,8	19,6
Major reason for my choice of education	6,4	4,1	5,4	10,7	8,3	10,5	6,3	1,7	6,2
Do not know	2,6	3,0	1,9	1,7	,8	2,1	3,1	,0	2,2
Respondents (N)	78	437	370	121	254	95	256	58	3606

Question 1 We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you; I feel good when I am doing engineering; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not a reason for my choice of education	,0	4,6	4,1	3,3	2,0	3,2	2,7	17,2	4,1
Minimal reason for my choice of education	7,8	12,6	14,1	11,6	11,4	14,7	11,3	27,6	13,1
Moderate reason for my choice of education	50,6	36,4	39,2	37,2	42,7	33,7	43,8	32,8	38,6
Major reason for my choice of education	40,3	42,8	38,1	46,3	41,6	45,3	38,7	20,7	40,9
Do not know	1,3	3,7	4,6	1,7	2,4	3,2	3,5	1,7	3,3
Respondents (N)	77	437	370	121	255	95	256	58	3606

Question 1 We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you; I like to build stuff; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not a reason for my choice of education	1,3	11,2	6,5	5,0	4,7	6,3	3,9	32,8	8,4
Minimal reason for my choice of education	16,7	19,5	11,1	9,9	11,7	16,8	12,9	19,0	15,2
Moderate reason for my choice of education	42,3	27,9	35,4	27,3	35,5	29,5	36,9	31,0	31,8
Major reason for my choice of education	39,7	38,7	44,9	57,0	46,1	46,3	44,7	17,2	42,7
Do not know	,0	2,7	2,2	,8	2,0	1,1	1,6	,0	1,9
Respondents (N)	78	437	370	121	256	95	255	58	3608

Question 1 We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you; I think engineering is fun; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not a reason for my choice of education	1,3	1,1	2,4	4,1	1,6	4,2	1,6	10,3	2,4
Minimal reason for my choice of education	9,1	7,3	9,2	4,1	5,9	6,3	9,7	17,2	7,8
Moderate reason for my choice of education	42,9	35,8	38,0	43,0	40,9	41,1	38,5	39,7	38,6
Major reason for my choice of education	45,5	52,7	47,7	46,3	48,8	46,3	47,9	31,0	48,5
Do not know	1,3	3,0	2,7	2,5	2,8	2,1	2,3	1,7	2,6
Respondents (N)	77	438	371	121	254	95	257	58	3610

Question 1 We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you; Engineering skills can be used for the good of society; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not a reason for my choice of education	6,4	4,1	7,9	3,3	7,1	4,2	3,5	8,6	5,2
Minimal reason for my choice of education	9,0	16,5	13,3	11,6	15,3	12,6	14,4	19,0	14,7
Moderate reason for my choice of education	57,7	42,7	39,0	39,7	45,1	41,1	45,5	43,1	42,8
Major reason for my choice of education	26,9	35,1	38,8	43,8	30,6	38,9	35,4	27,6	35,7
Do not know	,0	1,6	1,1	1,7	2,0	3,2	1,2	1,7	1,6
Respondents (N)	78	436	369	121	255	95	257	58	3605

Question 1 We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you; I think engineering is interesting; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not a reason for my choice of education	,0	,5	1,3	,8	1,2	4,3	1,2	3,5	1,3
Minimal reason for my choice of education	2,6	2,7	3,2	1,7	2,3	4,3	3,9	10,5	3,3
Moderate reason for my choice of education	35,9	28,8	32,1	28,3	27,3	25,5	29,6	42,1	29,7
Major reason for my choice of education	60,3	66,1	62,0	66,7	66,4	63,8	62,3	43,9	63,7
Do not know	1,3	1,8	1,3	2,5	2,7	2,1	3,1	,0	2,0
Respondents (N)	78	437	371	120	256	94	257	57	3604

Question 1 We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you; I like to figure out how things work; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not a reason for my choice of education	,0	1,1	2,2	1,7	1,2	3,2	1,2	6,9	1,8
Minimal reason for my choice of education	7,7	6,2	5,4	4,2	7,4	3,2	5,4	13,8	6,0
Moderate reason for my choice of education	32,1	26,1	29,0	24,4	30,9	34,7	34,2	25,9	29,0
Major reason for my choice of education	60,3	64,8	61,6	68,1	58,2	57,9	56,8	53,4	61,5
Do not know	,0	1,8	1,9	1,7	2,3	1,1	2,3	,0	1,7
Respondents (N)	78	437	372	119	256	95	257	58	3609

Question 1 We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you; Constructing new solutions fascinates me; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not a reason for my choice of education	,0	,9	2,2	3,3	,8	3,2	1,2	6,9	1,8
Minimal reason for my choice of education	7,7	7,3	4,3	5,8	8,2	8,5	9,8	15,5	7,5
Moderate reason for my choice of education	34,6	29,6	27,5	25,8	29,7	28,7	36,1	32,8	29,9
Major reason for my choice of education	57,7	60,4	63,6	61,7	59,0	57,4	50,6	44,8	58,7
Do not know	,0	1,8	2,4	3,3	2,3	2,1	2,4	,0	2,1
Respondents (N)	78	439	371	120	256	94	255	58	3609

Question 2 Please indicate how strongly you disagree or agree with each of the statements; Creative thinking is one of my strengths; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Disagree strongly	,0	,9	,5	,8	,8	1,1	1,6	,0	,9
Disagree	6,5	8,7	6,7	7,4	7,8	9,6	10,9	13,8	8,6
Agree	46,8	51,1	52,3	49,6	56,5	56,4	55,1	53,4	52,8
Agree strongly	45,5	36,1	36,7	38,0	32,5	28,7	28,9	27,6	34,3
Do not know	1,3	3,2	3,8	4,1	2,4	4,3	3,5	5,2	3,4
Respondents (N)	77	438	371	121	255	94	256	58	3607

Question 2 Please indicate how strongly you disagree or agree with each of the statements; I am skilled at solving problems that can have multiple solutions; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Disagree strongly	1,3	,9	,3	,0	,0	1,1	,8	,0	,6
Disagree	1,3	4,1	2,4	7,4	6,3	2,1	8,2	1,8	4,5
Agree	50,6	64,9	58,2	51,2	60,2	57,4	56,0	54,4	59,4
Agree strongly	44,2	26,1	34,5	36,4	28,7	34,0	32,7	35,1	31,2
Do not know	2,6	3,9	4,6	5,0	4,7	5,3	2,3	8,8	4,3
Respondents (N)	77	436	371	121	254	94	257	57	3598

Question 2 Please indicate how strongly you disagree or agree with each of the statements; A mentor has supported my decision to study engineering; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Disagree strongly	10,3	6,2	10,0	17,6	7,8	6,4	7,0	6,9	8,2
Disagree	14,1	7,1	11,9	24,4	9,4	13,8	12,5	5,2	11,0
Agree	44,9	36,4	36,9	29,4	40,0	19,1	32,7	29,3	34,2
Agree strongly	21,8	42,8	36,1	24,4	35,3	48,9	40,1	44,8	38,9
Do not know	9,0	7,6	5,1	4,2	7,5	11,7	7,8	13,8	7,6
Respondents (N)	78	437	371	119	255	94	257	58	3602

Question 3 Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Self confidence (social); per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	2,6	3,5	1,1	3,4	,8	1,1	1,6	3,5	2,3
Below average	13,2	10,2	10,5	7,6	9,9	2,2	7,1	8,8	8,9
Average	32,9	39,8	39,0	40,7	45,8	49,5	44,9	47,4	42,1
Above average	28,9	33,5	38,7	30,5	30,4	24,2	32,3	29,8	32,4
Highest 10%	21,1	12,3	9,7	17,8	11,9	23,1	13,4	10,5	13,6
Do not know	1,3	,7	1,1	,0	1,2	,0	,8	,0	,7
Respondents (N)	76	430	362	118	253	91	254	57	3540

Question 3 Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Leadership ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	,0	1,4	,6	2,5	,8	,0	2,8	3,5	1,3
Below average	6,6	11,9	6,9	12,7	12,3	4,4	13,0	8,8	10,3
Average	39,5	34,0	38,2	23,7	30,2	37,4	34,3	35,1	33,9
Above average	34,2	38,1	35,7	39,8	38,5	37,4	33,5	36,8	37,1
Highest 10%	19,7	12,8	17,2	20,3	15,9	20,9	15,7	14,0	15,9
Do not know	,0	1,9	1,4	,8	2,4	,0	,8	1,8	1,4
Respondents (N)	76	430	361	118	252	91	254	57	3537

Question 3 Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Public speaking ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	1,4	5,8	5,8	2,6	5,2	3,3	5,5	10,5	5,3
Below average	24,3	20,2	21,1	16,2	20,6	14,4	20,5	10,5	19,3
Average	37,8	33,0	33,0	32,5	34,5	34,4	39,0	40,4	34,4
Above average	23,0	27,0	28,3	35,0	27,0	35,6	24,8	26,3	28,3
Highest 10%	13,5	13,3	10,8	13,7	11,1	12,2	9,4	12,3	12,0
Do not know	,0	,7	1,1	,0	1,6	,0	,8	,0	,7
Respondents (N)	74	430	361	117	252	90	254	57	3528

Question 3 Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Math ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	5,3	,7	,6	1,7	2,0	,0	,4	1,8	1,0
Below average	15,8	12,1	10,2	3,4	11,5	7,7	9,0	8,8	10,2
Average	42,1	42,6	46,8	40,7	46,0	46,2	40,0	40,4	43,5
Above average	25,0	32,6	29,4	33,1	28,6	26,4	36,9	35,1	31,4
Highest 10%	11,8	11,9	11,9	20,3	11,1	19,8	13,3	14,0	13,5
Do not know	,0	,2	1,1	,8	,8	,0	,4	,0	,5
Respondents (N)	76	430	361	118	252	91	255	57	3539

Question 3 Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Science ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	,0	,0	,3	,0	,0	1,1	,0	,0	,2
Below average	5,3	5,8	6,4	4,3	4,4	8,8	3,5	1,8	5,4
Average	60,5	43,3	47,2	44,4	52,8	48,4	44,3	24,6	45,5
Above average	26,3	40,5	36,2	35,0	36,4	30,8	39,6	59,6	38,2
Highest 10%	7,9	9,8	8,6	14,5	5,2	11,0	12,2	14,0	9,9
Do not know	,0	,7	1,4	1,7	1,2	,0	,4	,0	,8
Respondents (N)	76	430	362	117	250	91	255	57	3534

Question 3 Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Communication skills; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	,0	,9	,0	,9	1,2	1,1	,4	,0	,7
Below average	9,3	9,8	10,8	6,8	8,3	7,9	11,8	8,9	9,6
Average	37,3	37,9	43,4	32,5	42,1	39,3	41,3	39,3	39,5
Above average	36,0	36,5	34,5	40,2	36,5	36,0	37,4	42,9	36,8
Highest 10%	17,3	14,1	10,2	18,8	11,5	15,7	7,1	8,9	12,7
Do not know	,0	,7	1,1	,9	,4	,0	2,0	,0	,8
Respondents (N)	75	427	362	117	252	89	254	56	3516

Question 3 Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Ability to apply math and science principles in solving real world problems; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	,0	,9	,3	,8	1,2	1,1	,4	1,8	,8
Below average	13,2	5,4	8,3	6,8	7,6	6,6	3,5	5,3	6,4
Average	44,7	46,2	46,1	35,6	45,8	47,3	47,5	45,6	45,4
Above average	36,8	37,8	33,4	40,7	35,5	28,6	36,9	31,6	35,7
Highest 10%	3,9	7,2	7,5	14,4	7,2	12,1	10,6	14,0	8,9
Do not know	1,3	2,6	4,4	1,7	2,8	4,4	1,2	1,8	2,8
Respondents (N)	76	429	362	118	251	91	255	57	3536

Question 3 Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Business ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	,0	4,9	2,2	3,4	1,2	2,2	2,7	7,0	3,3
Below average	11,8	22,4	22,7	11,1	17,9	18,7	22,7	19,3	20,2
Average	40,8	38,2	38,1	42,7	43,3	33,0	43,9	35,1	39,3
Above average	34,2	22,6	25,1	27,4	24,2	30,8	22,4	19,3	24,6
Highest 10%	13,2	5,1	6,6	12,0	7,9	11,0	3,9	10,5	7,2
Do not know	,0	6,8	5,2	3,4	5,6	4,4	4,3	8,8	5,4
Respondents (N)	76	429	362	117	252	91	255	57	3535

Question 3 Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Ability to perform in teams; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	,0	,7	,8	1,7	,8	1,1	,8	1,8	,9
Below average	4,0	7,7	6,1	4,2	6,3	7,7	7,9	5,3	6,8
Average	24,0	43,7	40,6	28,8	30,2	30,8	32,3	40,4	37,0
Above average	45,3	39,5	40,3	50,8	48,8	42,9	44,5	40,4	42,9
Highest 10%	26,7	8,1	11,3	13,6	12,7	16,5	13,8	12,3	11,9
Do not know	,0	,2	,8	,8	1,2	1,1	,8	,0	,6
Respondents (N)	75	430	362	118	252	91	254	57	3537

Question 3 Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Critical thinking skills; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	,0	,5	,3	,0	,0	,0	,0	,0	,2
Below average	2,6	3,0	2,8	2,5	4,4	2,2	2,4	5,3	3,0
Average	31,6	26,7	32,2	28,0	29,8	27,5	30,7	19,3	28,5
Above average	44,7	49,1	42,0	41,5	47,2	50,5	48,0	52,6	47,1
Highest 10%	21,1	19,1	21,6	27,1	18,3	18,7	17,3	21,1	20,0
Do not know	,0	1,6	1,1	,8	,4	1,1	1,6	1,8	1,2
Respondents (N)	76	430	357	118	252	91	254	57	3530

Question 3 Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Wish to find new solutions; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	,0	,2	,3	,0	,0	,0	,0	,0	,1
Below average	1,3	2,3	1,4	,8	1,2	3,3	3,9	1,8	2,1
Average	28,0	32,9	26,0	19,5	29,0	22,0	36,5	33,9	29,4
Above average	41,3	42,7	47,8	40,7	41,3	51,6	45,9	42,9	44,4
Highest 10%	28,0	21,4	23,5	38,1	27,4	23,1	13,3	21,4	23,3
Do not know	1,3	,5	1,1	,8	1,2	,0	,4	,0	,6
Respondents (N)	75	429	362	118	252	91	255	56	3533

Question 4 How important do you think each of the following skills and abilities is to becoming a successful engineer? Self confidence (social); per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	2,7	1,4	,8	1,7	1,6	1,1	,4	,0	1,2
Somewhat important	28,0	34,8	27,5	26,3	29,5	33,0	31,2	43,9	31,8
Very important	52,0	50,1	56,3	50,8	56,2	53,8	54,0	45,6	52,6
Crucial	16,0	12,0	13,7	19,5	12,0	12,1	13,6	10,5	13,2
Do not know	1,3	1,6	1,7	1,7	,8	,0	,8	,0	1,2
Respondents (N)	75	425	357	118	251	91	250	57	3507

Question 4 How important do you think each of the following skills and abilities is to becoming a successful engineer? Leadership ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	8,0	6,6	2,2	3,4	4,0	3,3	2,4	3,5	4,4
Somewhat important	25,3	41,1	29,8	32,2	28,0	31,9	39,4	31,6	34,9
Very important	45,3	41,1	49,0	40,7	53,2	46,2	42,6	42,1	44,7
Crucial	20,0	9,7	17,3	22,9	12,4	18,7	14,5	22,8	14,7
Do not know	1,3	1,4	1,7	,8	2,4	,0	1,2	,0	1,3
Respondents (N)	75	423	359	118	250	91	249	57	3501

Question 4 How important do you think each of the following skills and abilities is to becoming a successful engineer? Public speaking ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	5,3	6,9	5,0	7,7	3,6	4,4	7,6	5,3	5,9
Somewhat important	46,7	48,0	34,9	37,6	39,4	40,7	43,2	38,6	42,2
Very important	34,7	35,5	43,9	37,6	44,6	46,2	36,8	40,4	39,6
Crucial	13,3	8,0	14,2	15,4	12,0	8,8	11,6	14,0	11,1
Do not know	,0	1,7	2,0	1,7	,4	,0	,8	1,8	1,2
Respondents (N)	75	423	358	117	251	91	250	57	3500

Question 4 How important do you think each of the following skills and abilities is to becoming a successful engineer? Math ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	,0	,5	,0	,0	,4	,0	,4	,0	,3
Somewhat important	24,0	14,6	16,7	14,4	16,7	16,7	8,8	12,3	14,9
Very important	52,0	50,0	51,0	42,4	56,2	48,9	55,0	54,4	51,0
Crucial	24,0	34,4	31,5	42,4	26,7	34,4	35,3	33,3	33,4
Do not know	,0	,5	,8	,8	,0	,0	,4	,0	,4
Respondents (N)	75	424	359	118	251	90	249	57	3502

Question 4 How important do you think each of the following skills and abilities is to becoming a successful engineer? Science ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	,0	,0	,0	,9	,4	,0	,0	,0	,1
Somewhat important	20,0	9,0	13,4	10,3	14,8	10,0	9,2	7,0	10,9
Very important	58,7	52,8	53,5	52,1	59,6	60,0	56,4	50,9	54,9
Crucial	20,0	37,7	32,3	35,0	24,8	30,0	34,0	42,1	33,5
Do not know	1,3	,5	,8	1,7	,4	,0	,4	,0	,6
Respondents (N)	75	424	359	117	250	90	250	57	3499

Question 4 How important do you think each of the following skills and abilities is to becoming a successful engineer? Communication skills; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	2,7	,7	,6	,0	,8	,0	,0	,0	,5
Somewhat important	16,0	20,5	21,4	20,5	20,9	23,3	13,7	19,3	20,0
Very important	60,0	53,3	50,1	56,4	55,8	61,1	63,9	47,4	55,3
Crucial	21,3	25,0	26,2	21,4	22,5	15,6	21,3	33,3	23,5
Do not know	,0	,5	1,7	1,7	,0	,0	1,2	,0	,7
Respondents (N)	75	424	359	117	249	90	249	57	3496

Question 4 How important do you think each of the following skills and abilities is to becoming a successful engineer? Ability to apply math and science principles in solving real world problems; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	,0	,5	,3	,9	,4	,0	,4	,0	,4
Somewhat important	14,7	4,3	5,6	8,5	9,2	7,7	7,7	5,3	6,5
Very important	45,3	28,8	41,4	30,8	36,3	38,5	31,0	21,1	33,4
Crucial	40,0	65,7	51,0	59,8	53,8	53,8	60,1	73,7	59,0
Do not know	,0	,7	1,7	,0	,4	,0	,8	,0	,7
Respondents (N)	75	423	355	117	251	91	248	57	3492

Question 4 How important do you think each of the following skills and abilities is to becoming a successful engineer? Business ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	9,3	16,3	10,9	8,5	10,8	5,6	12,4	7,0	12,0
Somewhat important	37,3	56,1	48,5	50,0	49,8	41,1	61,8	57,9	52,3
Very important	40,0	20,5	30,6	33,1	33,1	42,2	20,1	28,1	27,8
Crucial	12,0	4,0	6,7	6,8	6,0	7,8	4,4	7,0	5,7
Do not know	1,3	3,1	3,3	1,7	,4	3,3	1,2	,0	2,3
Respondents (N)	75	424	359	118	251	90	249	57	3502

Question 4 How important do you think each of the following skills and abilities is to becoming a successful engineer? Ability to perform in teams; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	,0	,7	,3	,0	1,6	,0	,4	,0	,5
Somewhat important	6,8	8,5	6,4	11,9	4,8	7,7	3,2	1,8	6,9
Very important	48,6	45,9	39,6	50,0	47,6	53,8	38,4	42,1	45,2
Crucial	44,6	44,7	53,2	38,1	46,0	38,5	57,6	56,1	47,1
Do not know	,0	,2	,6	,0	,0	,0	,4	,0	,2
Respondents (N)	74	425	359	118	250	91	250	57	3502

Question 4 How important do you think each of the following skills and abilities is to becoming a successful engineer? Critical thinking skills; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	,0	,2	,0	,0	,4	,0	,8	,0	,2
Somewhat important	8,0	7,1	6,7	7,6	10,8	4,4	8,8	7,1	7,5
Very important	66,7	50,9	48,5	50,0	53,8	47,3	51,6	41,1	50,6
Crucial	24,0	40,5	43,7	42,4	35,1	48,4	38,0	51,8	41,0
Do not know	1,3	1,2	1,1	,0	,0	,0	,8	,0	,7
Respondents (N)	75	422	359	118	251	91	250	56	3499

Question 4 How important do you think each of the following skills and abilities is to becoming a successful engineer? Wish to find new solutions; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	,0	,2	,3	,0	,4	,0	,0	,0	,2
Somewhat important	5,3	6,6	3,9	6,0	7,6	5,5	5,2	3,5	5,8
Very important	42,7	24,7	29,9	44,4	33,2	37,4	41,0	26,3	32,0
Crucial	52,0	68,0	65,4	47,9	58,8	57,1	53,4	68,4	61,5
Do not know	,0	,5	,6	1,7	,0	,0	,4	1,8	,5
Respondents (N)	75	425	358	117	250	91	249	57	3502

Question 5 You have been asked to design a playground. You have a limited amount of time and resources to gather information for your design. From the following list, please put a check mark next to the FIVE kinds of information you would MOST LIKELY NEED as you work on your design; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Availability of materials	45,3	37,3	39,6	44,1	38,4	44,0	41,5	33,9	39,6
Body proportions	29,3	19,6	18,3	12,7	26,4	18,7	24,6	17,9	20,3
Budget	82,7	75,5	75,0	67,8	72,8	76,9	71,4	80,4	74,5
Handicapped accessibility	6,7	5,4	7,9	11,9	7,6	5,5	7,3	12,5	7,2
Information about the area	40,0	40,6	39,0	51,7	42,4	39,6	37,5	35,7	40,8
Labor availability and cost	18,7	29,0	27,2	22,9	23,6	20,9	32,3	26,8	26,7
Legal liability	46,7	49,3	48,6	44,1	56,8	49,5	48,4	53,6	49,7
Maintenance concerns	20,0	30,4	32,0	22,0	27,2	28,6	31,0	23,2	28,8
Material costs	41,3	40,3	41,6	44,1	36	42,9	31,9	42,9	39,7
Material specifications	34,7	29,0	25,3	31,4	35,2	34,1	27,4	28,6	29,8
Neighborhood demographics	5,3	12,3	9,6	11,9	13,2	8,8	8,1	14,3	10,9
Neighborhood opinions	22,7	17,9	20,5	13,6	13,2	15,4	21,0	14,3	17,5
Safety	80,0	83,7	84,6	70,3	76,8	76,9	82,3	83,9	80,9
Supervision concerns	5,3	4,7	6,7	7,6	4,4	5,5	6,0	5,4	5,5
Technical references	17,3	22,9	21,9	32,2	23,6	27,5	27,0	25,0	24,4
Utilities	4,0	2,1	2,2	11,9	2,4	5,5	2,4	1,8	3,4
Respondents (N)	75	424	356	118	250	91	248	56	3516

Percentages sum to 500% since each respondent gives five answers.

Question 6 Of the 20 items below, please put a check mark next to the FIVE you think are MOST IMPORTANT practicing engineering; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Business knowledge	21,3	12,1	15,8	10,3	15,7	15,4	15,8	21,4	14,5
Communication	45,3	29,6	33,2	32,8	35,5	42,9	37,7	25,0	33,9
Conducting experiments	8,0	11,3	14,1	7,8	6,5	11,0	9,3	16,1	10,8
Contemporary issues	1,3	11,8	15,2	1,7	5,2	4,4	7,7	12,5	9,3
Creativity	64,0	60,8	51,8	53,4	61,3	45,1	44,5	51,8	55,4
Data analysis	10,7	14,4	12,1	27,6	12,5	15,4	11,3	14,3	11,7
Design	12,0	9,2	14,1	26,7	13,7	19,8	9,7	3,6	13,1
Engineering analysis	32,0	33,6	28,5	44,0	31,0	36,3	37,7	32,1	34,1
Engineering tools	24,0	31,7	25,9	31,9	38,7	38,5	32,8	33,9	32,4
Ethics	2,7	9,7	5,1	3,4	6,5	7,7	4,9	10,7	7,1
Global context	13,3	11,6	12,7	7,8	11,3	12,1	8,9	10,7	11,2
Leadership	30,7	11,8	22,0	13,8	23,4	26,4	21,9	16,1	18,6
Life-long learning	10,7	23,9	18,9	22,4	17,7	15,4	32,0	26,8	22,1
Management skills	8,0	5,4	6,8	3,4	7,3	11,0	8,1	10,7	6,9
Math	18,7	24,8	27,0	33,6	22,6	24,2	24,7	8,9	24,9
Problem solving	76,0	83,2	75,5	69,8	79,8	79,1	73,3	76,8	78,8
Professionalism	22,7	18,7	20,6	31,0	16,9	13,2	21,9	14,3	19,7
Science	24,0	30,5	23,9	26,7	21,4	22,0	22,3	30,4	26,1
Societal context	6,7	16,1	15,2	3,4	8,5	6,6	9,7	21,4	12,3
Teamwork	68,0	49,9	61,7	48,3	64,5	53,8	66,0	62,5	57,2
Respondents (N)	75	423	355	116	248	91	247	56	3481

Percentages sum to 500% since each respondent gives five answers.

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Business knowledge; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	6,8	26,0	19,8	17,9	17,8	18,9	19,7	30,9	21,4
-	13,7	34,3	26,5	21,4	22,7	17,8	27,3	30,9	27,3
Somewhat prepared	39,7	24,5	34,0	40,2	37,2	33,3	31,1	30,9	31,2
-	21,9	10,0	10,8	12,5	15,3	18,9	11,8	5,5	12,3
Very well prepared	17,8	5,1	9,0	8,0	7,0	11,1	10,1	1,8	7,7
Respondents (N)	73	408	344	112	242	90	238	55	3376

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Communication; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	,0	3,9	2,6	3,6	1,7	2,2	5,1	7,3	3,4
-	8,2	19,7	14,2	9,8	11,3	13,3	15,2	23,6	15,6
Somewhat prepared	39,7	42,3	50,9	46,4	47,5	52,2	47,7	47,3	46,4
-	32,9	27,8	22,4	21,4	30,0	17,8	26,6	16,4	25,2
Very well prepared	19,2	6,4	9,9	18,8	9,6	14,4	5,5	5,5	9,4
Respondents (N)	73	407	344	112	240	90	237	55	3368

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Conducting experiments; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	9,7	7,6	9,6	7,2	5,8	11,1	7,6	3,7	7,9
-	19,4	19,6	22,2	19,8	22,7	24,4	23,2	14,8	21,1
Somewhat prepared	44,4	42,4	41,8	41,4	44,6	45,6	40,9	35,2	42,4
-	22,2	23,5	19,9	24,3	22,7	12,2	22,4	33,3	22,0
Very well prepared	4,2	6,9	6,4	7,2	4,1	6,7	5,9	13,0	6,5
Respondents (N)	72	408	342	111	242	90	237	54	3364

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Contemporary issues; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	2,7	8,4	9,4	7,1	11,2	3,3	8,8	10,9	8,3
-	26,0	27,6	23,4	16,1	21,2	21,1	29,8	30,9	24,8
Somewhat prepared	47,9	39,4	42,1	58,9	43,2	51,1	44,1	29,1	43,5
-	13,7	19,7	19,3	12,5	21,2	18,9	14,7	25,5	18,6
Very well prepared	9,6	4,9	5,8	5,4	3,3	5,6	2,5	3,6	4,8
Respondents (N)	73	406	342	112	241	90	238	55	3365

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Creativity; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	,0	4,4	2,1	3,6	2,5	6,7	2,5	5,5	3,6
-	4,1	11,6	11,2	6,3	10,8	6,7	14,8	23,6	11,2
Somewhat prepared	32,9	36,7	37,5	34,2	35,3	44,9	44,3	29,1	37,7
-	39,7	33,7	33,9	31,5	34,4	28,1	27,0	38,2	32,7
Very well prepared	23,3	13,5	15,3	24,3	17,0	13,5	11,4	3,6	14,8
Respondents (N)	73	406	339	111	241	89	237	55	3352

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Data analysis; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	5,5	11,5	14,0	5,4	7,4	12,4	8,5	10,9	10,4
-	24,7	29,4	26,3	17,9	24,4	28,1	24,3	20,0	26,0
Somewhat prepared	38,4	34,6	39,2	39,3	43,0	33,7	43,4	41,8	38,1
-	26,0	20,6	15,2	28,6	20,2	20,2	19,1	23,6	20,4
Very well prepared	5,5	3,9	5,3	8,9	5,0	5,6	4,7	3,6	5,0
Respondents (N)	73	408	342	112	242	89	235	55	3364

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Design; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	5,5	17,8	14,9	10,7	10,7	12,4	14,7	18,5	14,6
-	16,4	27,6	27,1	15,2	23,1	23,6	28,2	40,7	25,8
Somewhat prepared	50,7	33,3	36,4	38,4	34,7	43,8	38,2	27,8	36,3
-	19,2	17,1	15,5	24,1	21,1	15,7	12,6	11,1	17,1
Very well prepared	8,2	4,2	6,1	11,6	10,3	4,5	6,3	1,9	6,2
Respondents (N)	73	409	343	112	242	89	238	54	3371

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Engineering analysis; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	8,5	12,8	22,5	9,8	14,0	15,6	11,0	14,5	14,3
-	28,2	36,9	32,7	21,4	26,9	28,9	27,5	20,0	30,8
Somewhat prepared	46,5	31,9	31,9	40,2	39,7	36,7	42,8	38,2	36,0
-	11,3	15,7	7,9	19,6	14,9	11,1	14,8	20,0	14,1
Very well prepared	5,6	2,7	5,0	8,9	4,5	7,8	3,8	7,3	4,7
Respondents (N)	71	407	342	112	242	90	236	55	3364

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Engineering tools; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	8,3	11,2	20,2	6,4	10,3	10,0	8,5	10,9	11,7
-	26,4	33,7	30,1	28,2	26,0	24,4	24,6	16,4	28,8
Somewhat prepared	48,6	35,5	34,8	34,5	44,2	44,4	43,2	36,4	38,6
-	12,5	16,4	10,2	20,9	14,5	14,4	19,1	30,9	16,1
Very well prepared	4,2	3,2	4,7	10,0	5,0	6,7	4,7	5,5	4,9
Respondents (N)	72	409	342	110	242	90	236	55	3364

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Ethics; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	5,5	15,0	11,4	5,4	7,1	13,5	13,6	18,2	12,1
-	16,4	22,8	25,1	22,3	26,7	18,0	25,4	25,5	23,4
Somewhat prepared	38,4	30,9	38,8	41,1	37,1	34,8	38,6	25,5	35,1
-	27,4	23,0	16,9	19,6	21,3	24,7	14,8	25,5	21,0
Very well prepared	12,3	8,3	7,9	11,6	7,9	9,0	7,6	5,5	8,5
Respondents (N)	73	408	343	112	240	89	236	55	3364

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Global context; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	5,5	14,7	12,0	7,2	12,0	8,9	15,7	18,2	12,7
-	19,2	26,5	28,9	23,4	22,8	25,6	30,5	32,7	26,6
Somewhat prepared	45,2	36,5	37,6	45,0	43,2	36,7	39,4	21,8	38,2
-	20,5	18,4	15,2	17,1	17,4	22,2	11,9	21,8	17,5
Very well prepared	9,6	3,9	6,4	7,2	4,6	6,7	2,5	5,5	5,0
Respondents (N)	73	408	343	111	241	90	236	55	3363

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Leadership; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	1,4	17,2	12,0	9,0	7,9	12,4	14,8	20,0	13,4
-	11,0	25,5	25,1	16,2	19,6	15,7	22,9	32,7	22,5
Somewhat prepared	37,0	36,3	32,5	28,8	37,1	34,8	38,1	20,0	34,5
-	30,1	15,9	19,3	33,3	26,7	25,8	19,5	18,2	21,2
Very well prepared	20,5	5,1	11,1	12,6	8,8	11,2	4,7	9,1	8,4
Respondents (N)	73	408	342	111	240	89	236	55	3360

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Life-long learning; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	8,2	18,1	14,7	12,5	12,4	14,6	14,0	23,6	15,5
-	23,3	18,4	20,8	11,6	24,4	18,0	19,9	29,1	19,7
Somewhat prepared	31,5	29,2	33,4	33,9	33,9	33,7	29,2	21,8	31,1
-	27,4	21,6	21,4	22,3	18,2	25,8	24,2	18,2	21,9
Very well prepared	9,6	12,7	9,7	19,6	11,2	7,9	12,7	7,3	11,8
Respondents (N)	73	408	341	112	242	89	236	55	3364

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Management skills; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	5,6	11,8	10,3	9,0	5,0	10,1	9,8	9,1	9,8
-	15,3	27,8	21,2	21,6	23,7	14,6	22,6	40,0	23,9
Somewhat prepared	47,2	33,9	42,5	48,6	41,5	41,6	47,0	27,3	39,9
-	26,4	20,9	19,8	17,1	23,7	27,0	15,0	18,2	20,7
Very well prepared	5,6	5,7	6,2	3,6	6,2	6,7	5,6	5,5	5,7
Respondents (N)	72	407	339	111	241	89	234	55	3349

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Math; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	4,1	2,4	3,8	1,8	2,5	2,2	2,1	5,5	2,7
-	15,1	15,4	14,1	9,8	16,1	12,2	11,1	14,5	14,0
Somewhat prepared	38,4	38,6	43,1	36,6	41,3	47,8	41,3	29,1	40,3
-	30,1	29,6	26,1	27,7	28,9	26,7	29,8	38,2	28,9
Very well prepared	12,3	13,9	12,9	24,1	11,2	11,1	15,7	12,7	14,1
Respondents (N)	73	409	341	112	242	90	235	55	3369

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Problem solving; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	,0	2,9	3,8	,9	,8	4,4	2,5	3,6	2,7
-	6,8	10,5	9,4	6,3	7,4	11,1	8,1	18,2	9,6
Somewhat prepared	26,0	35,7	38,3	31,3	37,6	41,1	40,7	16,4	36,0
-	49,3	37,9	31,9	39,3	39,7	30,0	34,7	52,7	37,1
Very well prepared	17,8	13,0	16,7	22,3	14,5	13,3	14,0	9,1	14,7
Respondents (N)	73	409	342	112	242	90	236	55	3372

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Professionalism; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	4,2	9,1	9,1	4,5	4,1	7,9	7,7	7,3	7,6
-	12,5	17,9	14,9	10,7	14,9	22,5	14,9	21,8	16,5
Somewhat prepared	37,5	30,6	34,2	39,3	36,0	31,5	37,9	30,9	33,7
-	31,9	30,9	27,5	25,0	34,7	24,7	27,2	32,7	29,4
Very well prepared	13,9	11,5	14,3	20,5	10,3	13,5	12,3	7,3	12,8
Respondents (N)	72	408	342	112	242	89	235	55	3362

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Science; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	5,5	4,7	7,3	2,7	2,5	10,0	3,8	1,9	5,0
-	8,2	16,7	18,2	9,9	17,2	13,3	14,5	9,4	15,3
Somewhat prepared	43,8	39,2	42,8	44,1	46,0	44,4	47,2	30,2	42,3
-	32,9	31,1	25,8	29,7	28,0	22,2	27,2	47,2	29,1
Very well prepared	9,6	8,3	5,9	13,5	6,3	10,0	7,2	11,3	8,3
Respondents (N)	73	408	341	111	239	90	235	53	3353

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Societal context; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	6,8	10,3	8,3	2,7	5,4	7,8	10,1	9,1	8,3
-	16,4	29,2	25,7	17,3	24,9	22,2	22,8	47,3	26,0
Somewhat prepared	46,6	35,8	41,9	52,7	44,4	44,4	44,7	20,0	40,8
-	21,9	19,1	17,7	18,2	19,5	16,7	19,8	21,8	18,9
Very well prepared	8,2	5,6	6,5	9,1	5,8	8,9	2,5	1,8	6,0
Respondents (N)	73	408	339	110	241	90	237	55	3359

Question 7 Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Teamwork; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	,0	2,7	2,3	2,7	,4	1,1	2,1	3,6	2,1
-	4,1	8,1	8,7	6,3	6,3	10,1	6,8	18,2	8,2
Somewhat prepared	13,7	33,6	26,2	30,4	26,3	28,1	32,1	16,4	29,1
-	54,8	36,3	38,2	34,8	37,5	29,2	40,5	41,8	37,2
Very well prepared	27,4	19,4	24,5	25,9	29,6	31,5	18,6	20,0	23,4
Respondents (N)	73	408	343	112	240	89	237	55	3365

Question 8 Prioritise how important the issues below are to you using the numbers from 1-5. Please write 1 at the issue that you find most important, 2 at the second-most important issue, etc; per cent

Respondents assessing issue as **most important**	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
To prevent pollution	9,6	14,6	15,0	18,8	13,7	17,8	11,4	20,0	14,9
To ensure resources for future generations	24,7	38,7	30,1	33,0	36,5	22,2	36,9	52,7	34,8
To generate economic growth in Denmark	35,6	17,1	24,5	16,1	21,6	21,1	19,5	16,4	20,0
To combat global climate changes	17,8	14,4	16,2	15,2	12,4	15,6	19,9	3,6	14,9
To improve living conditions of people in developing countries	12,3	15,1	14,2	17,0	15,8	23,3	11,9	7,3	15,2
Respondents (N)	73	403	339	112	241	90	236	55	3349

Question 8 Prioritise how important the issues below are to you using the numbers from 1-5. Please write 1 at the issue that you find most important, 2 at the second-most important issue, etc; per cent

Respondents assessing issue as **least important**	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
To prevent pollution	13,7	10,2	11,8	14,3	14,5	15,6	9,7	5,5	11,7
To ensure resources for future generations	6,8	4,2	7,1	7,1	7,1	7,8	7,6	1,8	6,0
To generate economic growth in Denmark	32,9	37,5	27,4	33,0	25,7	31,1	30,9	34,5	32,3
To combat global climate changes	16,4	15,4	15,3	18,8	16,2	16,7	15,3	25,5	16,3
To improve living conditions of people in developing countries	30,1	32,5	38,3	26,8	36,5	28,9	36,0	32,7	33,5
Respondents (N)	73	403	339	112	241	90	236	55	3349

Question 8 Prioritise how important the issues below are to you using the numbers from 1-5. Please write 1 at the issue that you find most important, 2 at the second-most important issue, etc; per cent

Mean (Average score when most important is coded as 1, second-most important as 2, etc.)	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
To prevent pollution	3,15	2,95	2,96	2,87	2,95	2,97	3,05	2,80	2,96
To ensure resources for future generations	2,44	2,20	2,40	2,37	2,31	2,56	2,34	1,95	2,31
To generate economic growth in Denmark	2,97	3,44	3,01	3,42	3,08	3,20	3,19	3,38	3,25
To combat global climate changes	3,01	3,05	3,08	3,09	3,15	3,08	2,94	3,40	3,08
To improve living conditions of people in developing countries	3,42	3,35	3,56	3,26	3,52	3,20	3,50	3,47	3,41
Respondents (N)	73	403	339	112	241	90	236	55	3349

Question 9 Prioritise between the statements below on the role of engineers in society. Please write 1 at the statement that you find most important, 2 at the second-most important statement and 3 at the third most important; per cent

Respondents assessing issue as **most important**	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Engineers should contribute to solving problems related to climate change and environmental degradation	24,7	30,9	28,9	33,9	28,1	32,6	27,2	16,4	29,4
Engineers should contribute to ensuring that technological development is utilised in a fair and responsible way	41,1	38,7	37,5	39,3	41,7	33,7	38,3	30,9	38,1
Engineers should contribute to creating an overview of complex interrelations between different scientific and technical fields	34,2	30,4	33,6	26,8	30,2	33,7	34,5	52,7	32,5
Respondents (N)	73	401	339	112	242	89	235	55	3339

Question 9 Prioritise between the statements below on the role of engineers in society. Please write 1 at the statement that you find most important, 2 at the second-most important statement and 3 at the third most important; per cent

Respondents assessing issue as **least important**	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Engineers should contribute to solving problems related to climate change and environmental degradation	39,7	37,9	40,4	37,5	41,7	40,4	37,9	49,1	39,6
Engineers should contribute to ensuring that technological development is utilised in a fair and responsible way	32,9	28,7	30,4	21,4	27,7	31,5	27,7	32,7	28,7
Engineers should contribute to creating an overview of complex interrelations between different scientific and technical fields	27,4	33,4	29,2	41,1	30,6	28,1	34,5	18,2	31,8
Respondents (N)	73	401	339	112	242	89	235	55	3339

Question 10 Please rate your interest in the fields listed below; Working environment; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very interested	27,1	22,7	34,3	39,3	27,6	33,7	26,9	30,2	28,7
Somewhat interested	54,3	56,2	50,9	52,7	56,9	49,4	56,8	49,1	54,1
Not interested	17,1	19,1	11,5	6,3	13,0	16,9	15,0	20,8	15,3
Do not know	1,4	2,0	3,3	1,8	2,5	,0	1,3	,0	1,9
Respondents (N)	70	397	338	112	239	89	234	53	3310

Question 10 Please rate your interest in the fields listed below; Biofuel; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very interested	17,1	21,1	20,4	24,3	25,2	15,9	24,5	54,7	22,9
Somewhat interested	54,3	50,5	53,3	49,5	51,3	52,3	51,9	32,1	50,7
Not interested	24,3	27,6	24,3	19,8	21,8	30,7	22,7	13,2	24,7
Do not know	4,3	,8	2,1	6,3	1,7	1,1	,9	,0	1,7
Respondents (N)	70	398	338	111	238	88	233	53	3303

Question 10 Please rate your interest in the fields listed below; Ethics; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very interested	10,0	24,1	19,0	17,1	21,1	19,1	21,1	29,6	21,2
Somewhat interested	62,9	49,1	49,0	47,7	54,4	60,7	50,4	42,6	51,1
Not interested	21,4	24,8	28,2	28,8	19,8	19,1	24,6	25,9	24,4
Do not know	5,7	2,0	3,9	6,3	4,6	1,1	3,9	1,9	3,2
Respondents (N)	70	399	337	111	237	89	232	54	3308

Question 10 Please rate your interest in the fields listed below; Engineering projects in developing countries; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very interested	24,6	33,1	33,4	42,0	31,0	46,6	35,0	43,4	35,4
Somewhat interested	49,3	48,2	45,9	43,8	52,3	43,2	43,6	47,2	46,9
Not interested	23,2	16,9	18,6	10,7	15,5	10,2	17,9	7,5	15,8
Do not know	2,9	1,8	2,1	3,6	1,3	,0	3,4	1,9	2,0
Respondents (N)	69	396	338	112	239	88	234	53	3302

Question 10 Please rate your interest in the fields listed below; Research communication; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very interested	10,0	22,2	21,0	17,0	19,2	21,3	27,4	35,2	21,9
Somewhat interested	62,9	55,4	52,1	67,9	60,3	57,3	50,4	46,3	56,0
Not interested	25,7	19,9	21,3	10,7	17,6	19,1	18,8	16,7	18,9
Do not know	1,4	2,5	5,6	4,5	2,9	2,2	3,4	1,9	3,3
Respondents (N)	70	397	338	112	239	89	234	54	3313

Question 10 Please rate your interest in the fields listed below; Global division of labour; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very interested	31,4	23,6	24,0	23,4	25,3	28,1	21,5	24,1	24,3
Somewhat interested	52,9	52,5	47,3	51,4	48,1	49,4	54,1	51,9	50,9
Not interested	11,4	18,8	23,1	18,0	21,1	21,3	18,0	20,4	19,8
Do not know	4,3	5,0	5,6	7,2	5,5	1,1	6,4	3,7	5,1
Respondents (N)	70	398	338	111	237	89	233	54	3308

Question 10 Please rate your interest in the fields listed below; Innovation; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very interested	75,7	60,9	52,8	67,9	62,6	59,6	56,8	51,9	59,8
Somewhat interested	22,9	32,1	38,1	24,1	31,1	34,8	37,6	38,9	33,2
Not interested	1,4	4,8	5,6	4,5	4,2	5,6	3,0	5,6	4,6
Do not know	,0	2,3	3,5	3,6	2,1	,0	2,6	3,7	2,4
Respondents (N)	70	399	339	112	238	89	234	54	3318

Question 10 Please rate your interest in the fields listed below; Intercultural communication; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very interested	37,1	25,8	26,3	33,9	30,3	34,8	18,8	27,8	27,6
Somewhat interested	45,7	47,4	46,0	44,6	47,9	44,9	56,0	42,6	47,5
Not interested	11,4	21,8	23,0	17,9	18,5	15,7	19,7	25,9	20,3
Do not know	5,7	5,0	4,7	3,6	3,4	4,5	5,6	3,7	4,6
Respondents (N)	70	399	339	112	238	89	234	54	3318

Question 10 Please rate your interest in the fields listed below; Entrepreneurship; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very interested	64,3	34,1	45,6	25,2	45,4	38,6	43,6	44,4	39,6
Somewhat interested	32,9	50,1	37,0	52,3	44,1	43,2	43,6	38,9	44,9
Not interested	2,9	14,0	14,5	15,3	8,4	15,9	12,0	14,8	13,2
Do not know	,0	1,8	3,0	7,2	2,1	2,3	,9	1,9	2,4
Respondents (N)	70	399	338	111	238	88	234	54	3310

Question 10 Please rate your interest in the fields listed below; Climate change; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very interested	24,3	36,3	38,9	33,9	32,8	34,1	41,9	42,6	36,4
Somewhat interested	54,3	48,6	40,7	42,9	50,0	48,9	44,4	48,1	46,7
Not interested	18,6	14,0	18,6	21,4	16,4	15,9	12,4	9,3	15,6
Do not know	2,9	1,0	1,8	1,8	,8	1,1	1,3	,0	1,2
Respondents (N)	70	399	339	112	238	88	234	54	3315

Question 10 Please rate your interest in the fields listed below; Air pollution; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very interested	23,2	30,8	31,4	33,9	27,8	29,2	30,3	38,9	30,7
Somewhat interested	56,5	52,6	48,8	44,6	54,4	53,9	54,7	51,9	52,0
Not interested	17,4	16,0	18,3	17,9	16,5	16,9	12,4	9,3	16,0
Do not know	2,9	,5	1,5	3,6	1,3	,0	2,6	,0	1,3
Respondents (N)	69	399	338	112	237	89	234	54	3313

Question 10 Please rate your interest in the fields listed below; Human rights; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very interested	17,1	28,6	25,4	29,7	26,5	37,5	26,5	38,9	28,6
Somewhat interested	60,0	48,4	49,0	45,9	54,6	39,8	50,0	42,6	48,5
Not interested	18,6	21,3	23,3	21,6	17,2	22,7	22,2	18,5	21,2
Do not know	4,3	1,8	2,4	2,7	1,7	,0	1,3	,0	1,7
Respondents (N)	70	399	339	111	238	88	234	54	3312

Question 10 Please rate your interest in the fields listed below; Modelling; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very interested	22,9	27,6	27,4	29,5	33,5	26,1	25,3	20,4	27,6
Somewhat interested	50,0	50,1	48,4	43,8	51,5	58,0	51,5	42,6	50,1
Not interested	15,7	16,8	17,4	21,4	9,6	11,4	16,7	29,6	16,4
Do not know	11,4	5,5	6,8	5,4	5,4	4,5	6,4	7,4	6,0
Respondents (N)	70	399	339	112	239	88	233	54	3315

Question 10 Please rate your interest in the fields listed below; Technology transfer; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very interested	41,4	35,4	38,1	42,3	45,4	35,2	39,1	29,6	38,0
Somewhat interested	48,6	46,3	44,6	39,6	45,0	58,0	51,5	48,1	47,2
Not interested	5,7	9,9	11,6	12,6	5,5	4,5	5,2	13,0	8,8
Do not know	4,3	8,4	5,7	5,4	4,2	2,3	4,3	9,3	6,0
Respondents (N)	70	395	336	111	238	88	233	54	3294

Question 10 Please rate your interest in the fields listed below; The interplay between different technological systems; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very interested	48,6	48,1	43,5	40,2	47,3	44,3	51,1	44,2	46,4
Somewhat interested	38,6	39,8	41,7	42,0	41,0	45,5	42,5	28,8	40,8
Not interested	10,0	8,6	8,9	12,5	8,8	6,8	3,9	21,2	8,8
Do not know	2,9	3,5	6,0	5,4	2,9	3,4	2,6	5,8	4,0
Respondents (N)	70	397	336	112	239	88	233	52	3299

Question 10 Please rate your interest in the fields listed below; Theory of science; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very interested	27,1	29,5	35,0	32,1	35,6	29,9	32,1	18,9	31,2
Somewhat interested	57,1	48,4	47,8	50,0	46,9	57,5	53,0	47,2	49,9
Not interested	14,3	17,9	12,8	14,3	15,5	11,5	12,8	34,0	15,8
Do not know	1,4	4,3	4,5	3,6	2,1	1,1	2,1	,0	3,2
Respondents (N)	70	397	337	112	239	87	234	53	3301

Question 10 Please rate your interest in the fields listed below; Growth strategies; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very interested	44,3	20,4	24,7	20,5	27,6	35,2	19,8	22,6	24,2
Somewhat interested	47,1	44,7	53,0	52,7	50,2	44,3	50,4	43,4	48,1
Not interested	7,1	29,6	16,4	23,2	18,8	19,3	27,2	30,2	23,6
Do not know	1,4	5,3	6,0	3,6	3,3	1,1	2,6	3,8	4,1
Respondents (N)	70	398	336	112	239	88	232	53	3303

Question 11 How do you rate your knowledge on the following topics; Working environment; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not heard of	1,5	4,1	3,9	6,4	,8	,0	1,7	11,3	3,4
Heard of but could not explain	16,2	29,9	23,4	34,5	21,2	25,3	28,4	24,5	26,9
Have some knowledge	77,9	59,4	64,3	50,0	70,3	66,7	60,3	56,6	62,0
Know a lot	4,4	6,6	8,4	9,1	7,6	8,0	9,5	7,5	7,7
Respondents (N)	68	394	333	110	236	87	232	53	3270

Question 11 How do you rate your knowledge on the following topics; Biofuel; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not heard of	,0	2,0	3,6	3,6	4,2	3,4	2,6	3,8	2,9
Heard of but could not explain	52,9	33,5	41,7	36,4	33,1	41,4	38,8	20,8	36,5
Have some knowledge	38,2	58,1	50,3	53,6	58,5	51,7	52,2	56,6	54,5
Know a lot	8,8	6,3	4,5	6,4	4,2	3,4	6,5	18,9	6,1
Respondents (N)	68	394	336	110	236	87	232	53	3275

Question 11 How do you rate your knowledge on the following topics; Ethics; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not heard of	4,5	2,8	4,2	8,4	3,4	3,4	4,3	5,7	4,0
Heard of but could not explain	31,3	24,7	34,6	40,2	30,5	31,0	41,3	22,6	31,0
Have some knowledge	52,2	62,8	55,5	43,9	57,2	62,1	47,8	67,9	57,4
Know a lot	11,9	9,7	5,7	7,5	8,9	3,4	6,5	3,8	7,6
Respondents (N)	67	393	335	107	236	87	230	53	3258

Question 11 How do you rate your knowledge on the following topics; Engineering projects in developing countries; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not heard of	10,3	13,0	14,4	6,4	12,3	9,2	8,2	17,3	11,8
Heard of but could not explain	55,9	55,6	57,5	48,2	60,0	54,0	58,6	55,8	56,1
Have some knowledge	32,4	29,3	27,2	38,2	25,5	34,5	31,9	26,9	30,1
Know a lot	1,5	2,0	,9	7,3	2,1	2,3	1,3	,0	2,1
Respondents (N)	68	392	334	110	235	87	232	52	3262

Question 11 How do you rate your knowledge on the following topics; Research communication; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not heard of	19,1	18,3	21,7	16,4	18,3	20,7	18,5	18,9	19,0
Heard of but could not explain	58,8	58,6	54,2	58,2	63,4	55,2	59,9	47,2	57,8
Have some knowledge	22,1	21,3	22,3	20,0	16,6	21,8	20,3	32,1	21,2
Know a lot	,0	1,8	1,8	5,5	1,7	2,3	1,3	1,9	2,0
Respondents (N)	68	394	336	110	235	87	232	53	3273

Question 11 How do you rate your knowledge on the following topics; Global division of labour; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not heard of	16,4	27,6	26,0	22,7	24,4	24,4	25,1	34,0	25,8
Heard of but could not explain	44,8	53,8	51,3	56,4	50,0	45,3	53,2	49,1	51,8
Have some knowledge	35,8	17,1	21,2	17,3	22,6	25,6	20,3	17,0	20,2
Know a lot	3,0	1,5	1,5	3,6	3,0	4,7	1,3		2,1
Respondents (N)	67	392	335	110	234	86	231	53	3257

Question 11 How do you rate your knowledge on the following topics; Innovation; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not heard of	1,5	6,4	7,2	9,1	3,4	2,3	6,5	11,3	6,0
Heard of but could not explain	13,2	34,2	34,6	29,1	29,8	32,2	36,2	35,8	32,8
Have some knowledge	63,2	50,3	50,1	49,1	51,9	51,7	50,9	47,2	50,8
Know a lot	22,1	9,2	8,1	12,7	14,9	13,8	6,5	5,7	10,4
Respondents (N)	68	392	335	110	235	87	232	53	3266

Question 11 How do you rate your knowledge on the following topics; Intercultural communication; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not heard of	13,2	26,0	24,9	8,3	19,6	17,2	25,4	34,0	22,5
Heard of but could not explain	39,7	49,9	47,0	50,5	48,5	40,2	53,0	45,3	48,2
Have some knowledge	39,7	21,1	25,1	33,0	28,1	31,0	19,8	17,0	24,9
Know a lot	7,4	3,1	3,0	8,3	3,8	11,5	1,7	3,8	4,4
Respondents (N)	68	393	334	109	235	87	232	53	3264

Question 11 How do you rate your knowledge on the following topics; Entrepreneurship; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not heard of	1,5	7,1	7,4	17,3	6,4	4,7	4,3	5,7	7,1
Heard of but could not explain	16,2	36,1	34,5	41,8	34,0	32,6	42,2	37,7	35,9
Have some knowledge	58,8	49,4	47,0	30,9	46,8	55,8	47,4	54,7	48,0
Know a lot	23,5	7,4	11,0	10,0	12,8	7,0	6,0	1,9	8,9
Respondents (N)	68	393	336	110	235	86	232	53	3267

Question 11 How do you rate your knowledge on the following topics; Climate change; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not heard of	1,5	1,3	2,1	1,8	,8	1,1	1,7	5,7	1,6
Heard of but could not explain	19,1	10,4	16,2	18,2	18,2	10,3	15,1	15,1	14,0
Have some knowledge	64,7	60,3	62,8	59,1	59,3	71,3	61,6	49,1	61,4
Know a lot	14,7	28,0	18,9	20,9	21,6	17,2	21,6	30,2	23,0
Respondents (N)	68	393	333	110	236	87	232	53	3263

Question 11 How do you rate your knowledge on the following topics; Air pollution; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not heard of	1,5	2,3	3,0	1,8	1,3	1,1	,9	5,7	2,1
Heard of but could not explain	38,2	24,2	28,3	25,5	30,5	20,7	31,6	17,0	26,4
Have some knowledge	48,5	61,3	58,0	52,7	58,1	67,8	59,3	67,9	59,9
Know a lot	11,8	12,2	10,7	20,0	10,2	10,3	8,2	9,4	11,6
Respondents (N)	68	393	336	110	236	87	231	53	3270

Question 11 How do you rate your knowledge on the following topics; Human rights; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not heard of	1,5	1,5	2,4	5,5	3,4	,0	1,7	9,4	2,4
Heard of but could not explain	22,1	21,3	28,1	30,0	31,4	22,1	34,1	18,9	25,9
Have some knowledge	61,8	64,7	60,8	49,1	54,7	64,0	53,9	62,3	60,0
Know a lot	14,7	12,4	8,7	15,5	10,6	14,0	10,3	9,4	11,7
Respondents (N)	68	394	334	110	236	86	232	53	3268

Question 11 How do you rate your knowledge on the following topics; Modelling; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not heard of	20,6	20,1	21,7	14,7	14,0	20,7	24,3	22,6	19,8
Heard of but could not explain	51,5	48,2	45,5	45,9	49,4	51,7	47,8	43,4	47,9
Have some knowledge	25,0	27,7	29,5	33,0	32,8	24,1	23,9	34,0	28,5
Know a lot	2,9	4,1	3,3	6,4	3,8	3,4	3,9	,0	3,8
Respondents (N)	68	394	336	109	235	87	230	53	3267

Question 11 How do you rate your knowledge on the following topics; Technology transfer; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not heard of	16,2	25,6	22,2	14,5	15,0	16,3	18,6	35,8	21,2
Heard of but could not explain	44,1	51,5	51,7	46,4	56,2	52,3	54,5	39,6	51,4
Have some knowledge	35,3	19,8	22,2	29,1	25,8	24,4	24,2	22,6	23,3
Know a lot	4,4	3,0	3,9	10,0	3,0	7,0	2,6	1,9	4,1
Respondents (N)	68	394	333	110	233	86	231	53	3259

Question 11 How do you rate your knowledge on the following topics; The interplay between different technological systems; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not heard of	11,8	18,8	20,9	16,5	13,6	14,0	15,1	30,2	17,7
Heard of but could not explain	51,5	49,4	47,5	46,8	52,3	48,8	50,9	47,2	49,3
Have some knowledge	29,4	26,7	27,2	31,2	30,6	30,2	28,9	17,0	27,9
Know a lot	7,4	5,1	4,5	5,5	3,4	7,0	5,2	5,7	5,1
Respondents (N)	68	393	335	109	235	86	232	53	3262

Question 11 How do you rate your knowledge on the following topics; Theory of science; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not heard of	7,4	6,4	11,3	11,1	7,7	8,1	8,3	11,5	8,4
Heard of but could not explain	35,3	44,8	45,5	50,0	45,5	51,2	43,0	48,1	45,7
Have some knowledge	47,1	40,5	36,3	30,6	42,1	29,1	41,7	38,5	38,3
Know a lot	10,3	8,4	6,8	8,3	4,7	11,6	7,0	1,9	7,6
Respondents (N)	68	393	336	108	233	86	230	52	3252

Question 11 How do you rate your knowledge on the following topics; Growth strategies; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not heard of	4,4	23,7	17,6	14,5	15,8	13,8	19,4	30,8	19,2
Heard of but could not explain	45,6	53,1	57,3	60,0	54,7	50,6	54,3	46,2	54,0
Have some knowledge	44,1	20,2	22,7	24,5	25,6	29,9	23,3	23,1	23,8
Know a lot	5,9	3,1	2,4	,9	3,8	5,7	3,0	,0	3,1
Respondents (N)	68	392	335	110	234	87	232	52	3261

Question 12 Now there will be some statements that people have made about science, technology or the environment. For each statement, please tell me how much you agree or disagree; Thanks to scientific and technological advances, the Earth's natural resources will be inexhaustible; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Totally agree	10,6	7,5	8,8	10,2	5,6	9,4	8,8	7,8	8,1
Tend to agree	21,2	28,8	23,6	26,9	31,5	32,9	27,4	25,5	28,0
Neither agree nor disagree	22,7	13,1	17,0	20,4	12,5	9,4	17,3	11,8	14,6
Tend to disagree	30,3	23,4	27,3	24,1	23,7	24,7	22,6	29,4	24,6
Totally disagree	15,2	24,7	20,0	16,7	25,0	20,0	22,6	25,5	22,3
Do not know	,0	2,6	3,3	1,9	1,7	3,5	1,3	,0	2,3
Respondents (N)	66	389	330	108	232	85	226	51	3214

Question 12 Now there will be some statements that people have made about science, technology or the environment. For each statement, please tell me how much you agree or disagree; Science and technology can sort out any problem; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Totally agree	7,6	12,9	12,5	11,1	7,8	9,4	8,4	9,8	10,9
Tend to agree	37,9	29,9	33,8	36,1	35,8	29,4	36,3	33,3	32,9
Neither agree nor disagree	33,3	16,0	14,9	27,8	18,5	22,4	17,3	15,7	18,4
Tend to disagree	9,1	20,1	20,7	13,9	19,4	21,2	20,8	23,5	19,6
Totally disagree	12,1	20,4	15,5	10,2	17,2	16,5	16,4	17,6	17,1
Do not know	,0	,8	2,4	,9	1,3	1,2	,9	,0	1,1
Respondents (N)	66	388	328	108	232	85	226	51	3208

Question 12 Now there will be some statements that people have made about science, technology or the environment. For each statement, please tell me how much you agree or disagree; Science and technology cannot really play a role in improving the environment; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Totally agree	4,5	1,0	1,8	1,9	2,1	4,8	2,2	2,0	2,0
Tend to agree	1,5	2,6	4,9	11,1	4,3	8,4	4,0	4,0	4,6
Neither agree nor disagree	9,1	3,1	11,6	11,1	5,6	7,2	4,9	4,0	6,3
Tend to disagree	21,2	14,7	18,2	25,0	27,0	18,1	22,1	18,0	19,2
Totally disagree	63,6	77,6	61,1	50,0	60,1	59,0	65,5	72,0	66,5
Do not know	,0	1,0	2,4	,9	,9	2,4	1,3	,0	1,3
Respondents (N)	66	389	329	108	233	83	226	50	3204

Question 12 Now there will be some statements that people have made about science, technology or the environment. For each statement, please tell me how much you agree or disagree; The applications of science and technology can threaten human rights; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Totally agree	,0	7,0	6,1	7,4	4,7	9,4	4,9	3,9	6,2
Tend to agree	19,7	24,7	19,7	21,3	20,3	18,8	21,8	27,5	22,1
Neither agree nor disagree	25,8	22,4	25,2	27,8	22,8	29,4	22,7	23,5	24,2
Tend to disagree	25,8	19,6	19,1	20,4	27,6	20,0	18,2	25,5	20,9
Totally disagree	27,3	21,9	23,3	19,4	20,3	16,5	24,9	17,6	21,5
Do not know	1,5	4,4	6,7	3,7	4,3	5,9	7,6	2,0	5,0
Respondents (N)	66	388	330	108	232	85	225	51	3209

Question 12 Now there will be some statements that people have made about science, technology or the environment. For each statement, please tell me how much you agree or disagree; New inventions will always be found to counteract any harmful effect of scientific and technological developments; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Totally agree	9,1	5,7	5,5	16,7	3,0	5,9	6,6	3,9	6,4
Tend to agree	27,3	21,1	27,4	21,3	16,5	22,4	23,3	31,4	22,6
Neither agree nor disagree	21,2	23,9	24,6	25,9	38,3	30,6	27,8	15,7	26,7
Tend to disagree	25,8	26,2	22,8	25,0	20,9	18,8	23,3	27,5	23,9
Totally disagree	6,1	13,9	9,4	6,5	10,4	12,9	10,1	13,7	11,3
Do not know	10,6	9,3	10,3	4,6	10,9	9,4	8,8	7,8	9,2
Respondents (N)	66	389	329	108	230	85	227	51	3210

Question 12 Now there will be some statements that people have made about science, technology or the environment. For each statement, please tell me how much you agree or disagree; The benefits of science are greater than any harmful effects it may have; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Totally agree	39,4	25,6	19,4	23,1	19,8	25,9	22,0	21,6	23,5
Tend to agree	28,8	28,7	33,0	25,9	29,7	34,1	33,5	37,3	30,8
Neither agree nor disagree	24,2	25,9	24,2	25,0	32,8	17,6	23,3	23,5	25,2
Tend to disagree	4,5	10,8	12,1	16,7	9,9	12,9	11,0	5,9	11,2
Totally disagree	3,0	4,6	5,8	6,5	3,9	5,9	7,0	5,9	5,3
Do not know	,0	4,4	5,5	2,8	3,9	3,5	3,1	5,9	4,1
Respondents (N)	66	390	330	108	232	85	227	51	3218

Question 13 And now, there will be a few questions on how you *engage* with science and technology. Do you watch or listen to media programmes about scientific or technologic issues? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	42,4	43,7	43,2	37,3	42,2	34,5	37,3	42,4	41,0
Yes, occasionally	47,0	45,2	46,6	53,9	46,2	52,4	55,6	47,0	48,4
No, hardly ever	10,6	9,0	7,1	6,9	10,7	7,1	5,8	10,6	8,2
No, never	,0	1,6	1,2	,0	,9	4,8	,4	,0	1,5
Do not know	,0	,5	1,9	2,0	,0	1,2	,9	,0	,9
Respondents (N)	66	378	324	102	225	84	225	50	3138

Question 13 And now, there will be a few questions on how you *engage* with science and technology. Do you talk to friends or family about scientific or technologic issues? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	24,2	49,2	35,8	23,5	38,2	35,7	37,8	24,2	39,9
Yes, occasionally	56,1	40,5	49,7	55,9	51,6	44,0	47,6	56,1	46,3
No, hardly ever	19,7	7,1	10,8	17,6	9,8	16,7	12,0	19,7	11,0
No, never	,0	2,6	2,2	1,0	,4	2,4	1,8	,0	1,9
Do not know	,0	,5	1,5	2,0	,0	1,2	,9	,0	,8
Respondents (N)	66	378	324	102	225	84	225	50	3138

Question 13 And now, there will be a few questions on how you *engage* with science and technology. Do you attend public meetings or debates about science and technology? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	3,0	2,1	2,2	,0	1,8	,0	1,8	3,0	1,8
Yes, occasionally	13,6	10,3	10,5	23,5	13,8	13,1	9,4	13,6	12,2
No, hardly ever	53,0	42,5	43,7	50,0	45,3	35,7	47,8	53,0	44,7
No, never	30,3	43,8	41,8	24,5	38,2	50,0	39,7	30,3	40,0
Do not know	,0	1,3	1,9	2,0	,9	1,2	1,3	,0	1,3
Respondents (N)	66	379	323	102	225	84	224	50	3137

Question 13 And now, there will be a few questions on how you *engage* with science and technology. Do you sign petitions or join street demonstrations on matters of nuclear power, biotechnology or the environment? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	,0	,5	2,5	2,9	3,1	2,4	,4	,0	1,5
Yes, occasionally	4,5	9,8	8,0	15,7	8,4	6,0	8,4	4,5	9,1
No, hardly ever	28,8	20,4	17,6	36,3	18,7	22,6	19,1	28,8	21,5
No, never	63,6	67,2	68,2	41,2	68,0	66,7	69,3	63,6	65,4
Do not know	3,0	2,1	3,7	3,9	1,8	2,4	2,7	3,0	2,5
Respondents (N)	66	378	324	102	225	84	225	50	3138

Question 13 And now, there will be a few questions on how you *engage* with science and technology. Do you donate money to fundraising campaigns for medical research such as research into cancer? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	1,5	4,7	5,6	1,0	7,1	13,1	5,3	1,5	6,0
Yes, occasionally	30,3	26,1	30,0	29,4	25,3	23,8	28,9	30,3	27,3
No, hardly ever	30,3	27,7	25,4	28,4	25,8	26,2	27,6	30,3	27,1
No, never	37,9	40,1	36,5	37,3	40,4	34,5	36,0	37,9	37,8
Do not know	,0	1,3	2,5	3,9	1,3	2,4	2,2	,0	1,8
Respondents (N)	66	379	323	102	225	84	225	49	3136

Question 13 And now, there will be a few questions on how you *engage* with science and technology. Do you participate in the activities of a non-governmental organisation dealing with science and technology related issues? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	1,6	2,9	2,8	1,0	3,1	,0	,4	1,6	2,2
Yes, occasionally	10,9	13,8	10,9	15,8	14,2	9,5	13,3	10,9	12,8
No, hardly ever	43,8	24,9	25,9	38,6	24,4	26,2	26,7	43,8	27,7
No, never	40,6	52,8	55,1	39,6	52,0	58,3	54,7	40,6	52,0
Do not know	3,1	5,6	5,3	5,0	6,2	6,0	4,9	3,1	5,4
Respondents (N)	64	377	321	101	225	84	225	50	3125

Question 14 Now, there will be a few questions on how you engage with *environmental questions*. Do you watch or listen to media programmes about environmental questions? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	28,8	25,6	22,3	24,5	25,8	28,6	23,1	28,0	25,2
Yes, occasionally	56,1	54,4	61,0	51,0	56,0	44,0	56,0	46,0	54,3
No, hardly ever	15,2	14,2	12,4	20,6	14,7	22,6	16,0	22,0	15,9
No, never	,0	5,3	2,8	2,9	2,7	3,6	3,6	4,0	3,8
Do not know	,0	,5	1,5	1,0	,9	1,2	1,3	,0	,9
Respondents (N)	66	379	323	102	225	84	225	50	3139

Question 14 Now, there will be a few questions on how you engage with *environmental questions*. Do you talk to friends or family about environmental questions? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	12,1	27,0	19,9	15,7	20,4	20,2	16,4	18,0	21,3
Yes, occasionally	57,6	49,5	52,8	54,9	53,8	52,4	55,6	62,0	52,8
No, hardly ever	25,8	19,0	21,4	22,5	21,3	20,2	21,8	14,0	20,4
No, never	4,5	4,0	4,3	5,9	3,6	6,0	4,9	6,0	4,5
Do not know	,0	,5	1,6	1,0	,9	1,2	1,3	,0	,9
Respondents (N)	66	378	322	102	225	84	225	50	3135

Question 14 Now, there will be a few questions on how you engage with *environmental questions*. Do you discuss environmental questions as part of your education? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	7,6	9,8	12,4	8,8	12,1	11,9	4,0	4,1	9,7
Yes, occasionally	45,5	34,2	43,2	43,1	36,3	39,3	34,8	42,9	38,0
No, hardly ever	39,4	33,7	31,4	37,3	35,0	33,3	40,2	40,8	34,9
No, never	6,1	19,6	9,9	8,8	11,7	14,3	17,4	12,2	14,6
Do not know	1,5	2,7	3,1	2,0	4,9	1,2	3,6	,0	2,8
Respondents (N)	66	377	322	102	223	84	224	49	3124

Question 14 Now, there will be a few questions on how you engage with *environmental questions*. Do you attend public meetings or debates about environmental questions? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	1,5	,8	,3	3,0	,4	2,4	,4	,0	1,0
Yes, occasionally	3,0	6,9	7,8	13,0	5,3	6,0	5,8	4,0	6,9
No, hardly ever	34,8	23,8	24,2	46,0	28,0	31,0	28,0	34,0	28,1
No, never	59,1	67,2	65,5	36,0	64,4	59,5	64,4	62,0	62,5
Do not know	1,5	1,3	2,2	2,0	1,8	1,2	1,3	,0	1,5
Respondents (N)	66	378	322	100	225	84	225	50	3130

Question 14 Now, there will be a few questions on how you engage with *environmental questions*. Do you donate money to support of environmental questions? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	,0	1,9	1,9	2,0	2,2	2,4	,9	4,0	1,9
Yes, occasionally	10,8	10,3	10,9	15,8	9,3	9,6	11,2	12,0	10,9
No, hardly ever	33,8	25,5	21,7	31,7	20,4	25,3	25,0	18,0	24,6
No, never	55,4	60,5	62,1	46,5	64,4	61,4	61,2	66,0	60,4
Do not know	,0	1,9	3,4	4,0	3,6	1,2	1,8	,0	2,3
Respondents (N)	65	377	322	101	225	83	224	50	3123

Question 14 Now, there will be a few questions on how you engage with *environmental questions*. Do you participate in the activities of a non-governmental organisation dealing with environmental questions? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	,0	,8	,6	1,0	,9	1,2	,5	2,0	,8
Yes, occasionally	4,5	8,0	7,2	10,8	6,7	4,8	5,0	4,0	7,0
No, hardly ever	30,3	20,3	16,2	33,3	17,8	19,0	19,4	26,0	20,7
No, never	65,2	68,7	69,8	51,0	68,4	72,6	72,5	64,0	67,9
Do not know	,0	2,1	6,2	3,9	6,2	2,4	2,7	4,0	3,6
Respondents (N)	66	374	321	102	225	84	222	50	3117

Question 15 Below are some questions focusing on your *consumption habits*; Do you choose products on the basis of ethical or environmental considerations? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly, even if the price is somewhat higher	16,9	19,0	13,0	11,9	14,7	13,3	13,3	8,0	15,1
Yes, if the price is the same or marginally higher	52,3	49,6	43,5	49,5	47,6	45,8	47,1	48,0	47,7
No, hardly ever	15,4	16,6	26,2	19,8	23,6	15,7	22,7	26,0	20,3
No, never	12,3	11,6	11,1	15,8	8,0	21,7	14,2	16,0	12,9
Do not know	3,1	3,2	6,2	3,0	6,2	3,6	2,7	2,0	4,0
Respondents (N)	65	379	324	101	225	83	225	50	3133

Question 15 Below are some questions focusing on your *consumption habits*; Do you buy fair trade products? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly, even if the price is somewhat higher	7,6	11,1	10,2	12,7	9,3	11,9	9,3	10,0	10,6
Yes, if the price is the same or marginally higher	47,0	44,3	35,2	49,0	41,8	39,3	38,7	40,0	41,6
No, hardly ever	19,7	24,3	27,8	12,7	24,4	25,0	28,9	20,0	24,2
No, never	15,2	10,3	10,8	12,7	12,0	14,3	13,3	22,0	12,2
Do not know	10,6	10,0	16,0	12,7	12,4	9,5	9,8	8,0	11,4
Respondents (N)	66	379	324	102	225	84	225	50	3141

Question 15 Below are some questions focusing on your *consumption habits*; Do you buy organic products? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly, even if the price is somewhat higher	21,2	23,0	13,0	16,7	18,2	20,2	13,4	8,0	18,1
Yes, if the price is the same or marginally higher	51,5	47,2	44,4	49,0	45,3	47,6	49,1	48,0	47,1
No, hardly ever	18,2	17,9	28,7	16,7	24,0	17,9	23,2	28,0	21,4
No, never	7,6	8,7	9,3	14,7	10,2	10,7	13,4	16,0	10,5
Do not know	1,5	3,2	4,6	2,9	2,2	3,6	,9	,0	2,9
Respondents (N)	66	379	324	102	225	84	224	50	3139

Question 17 What is sustainability about in your opinion? Please indicate the items listed below that you find related to the concept of sustainability

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Ethics	50,0	53,0	43,8	33,0	51,6	34,9	48,2	52,2	47,2
Global context	60,9	69,2	67,1	59,1	65,6	71,1	60,5	71,7	66,6
Law	14,1	11,1	11,8	18,2	10,0	10,8	9,1	6,5	11,2
Technological context	53,1	57,0	55,0	59,1	48,9	53,0	55,0	43,5	54,5
Natural context	85,9	91,4	82,4	68,2	85,1	75,9	85,0	93,5	84,9
Life-long learning	28,1	20,8	20,4	34,1	21,3	20,5	21,8	23,9	22,2
Politics	31,3	33,2	34,8	19,3	25,8	21,7	28,2	21,7	29,3
Societal context	45,3	58,9	54,3	30,7	54,3	44,6	50,9	47,8	52,2
Social responsibility	50,0	58,9	53,7	48,9	53,8	54,2	55,5	69,6	55,9
Economic context	68,8	59,7	61,3	44,3	56,6	54,2	64,1	71,7	59,2
Respondents (N)	64	370	313	88	221	83	220	46	3049
Average number of answers	4.88	5.13	4.85	4.15	4.73	4.41	4.78	5.02	4.83

Question 18 To what extent do you regard your educational institution an organisation with a focus on sustainability? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very much	27,7	43,4	32,8	28,3	22,9	37,3	31,1	26,1	34,7
To some extent	52,3	38,1	44,3	48,9	50,0	39,8	46,8	43,5	43,3
To a minor extent	15,4	4,0	8,0	10,9	8,7	8,4	5,9	15,2	7,2
Not at all	,0	,5	1,0	3,3	3,7	1,2	1,8	2,2	1,5
Do not know	4,6	13,9	14,0	8,7	14,7	13,3	14,4	13,0	13,3
Respondents (N)	65	373	314	92	218	83	222	46	3050

Question 19 How would you rate your abilities within the listed fields; Project management; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	35,4	17,8	24,2	21,5	28,3	36,6	21,2	19,6	23,4
Fairly good	56,9	55,7	60,2	48,4	55,3	43,9	54,1	45,7	54,1
Not very good	6,2	19,5	11,5	19,4	9,6	11,0	18,5	23,9	15,7
Poor	1,5	3,0	1,0	6,5	2,3	1,2	4,1	4,3	2,8
Do not know	,0	4,1	3,2	4,3	4,6	7,3	2,3	6,5	4,1
Respondents (N)	65	370	314	93	219	82	222	46	3042

Question 19 How would you rate your abilities within the listed fields; Rote learning; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	16,9	16,8	12,1	6,5	9,3	14,6	12,3	8,7	13,2
Fairly good	43,1	46,2	56,5	51,1	50,9	56,1	47,3	52,2	50,2
Not very good	33,8	27,6	23,3	33,7	32,4	25,6	31,8	30,4	28,5
Poor	4,6	8,1	4,5	2,2	5,1	1,2	6,8	8,7	5,7
Do not know	1,5	1,4	3,5	6,5	2,3	2,4	1,8	,0	2,3
Respondents (N)	65	370	313	92	216	82	220	46	3029

Question 19 How would you rate your abilities within the listed fields; Teamwork skills; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	56,9	45,9	46,8	35,9	54,3	46,9	46,4	39,1	46,6
Fairly good	43,1	47,6	47,8	54,3	39,3	43,2	48,6	56,5	47,0
Not very good	,0	5,1	2,9	8,7	5,9	3,7	4,1	2,2	4,6
Poor	,0	,8	1,3	1,1	,0	2,5	,0	2,2	,9
Do not know	,0	,5	1,3	,0	,5	3,7	,9	,0	,9
Respondents (N)	65	370	312	92	227	81	222	46	3033

Question 19 How would you rate your abilities within the listed fields; Individual written assignments; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	27,7	35,0	33,0	30,4	26,0	40,2	30,3	32,6	32,8
Fairly good	56,9	55,6	49,0	53,3	59,8	47,6	57,9	56,5	54,4
Not very good	15,4	7,6	13,5	14,1	12,3	9,8	9,0	8,7	10,3
Poor	,0	1,4	3,2	2,2	,9	1,2	1,4	2,2	1,6
Do not know	,0	,5	1,3	,0	,9	1,2	1,4	,0	,8
Respondents (N)	65	369	312	92	219	82	221	46	3032

Question 19 How would you rate your abilities within the listed fields; Idea creation; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	41,5	29,6	32,5	39,1	35,6	31,7	24,4	17,4	31,1
Fairly good	53,8	54,7	56,4	42,4	47,9	53,7	57,0	54,3	53,3
Not very good	4,6	13,7	8,6	16,3	15,1	13,4	14,9	26,1	13,6
Poor	,0	,0	,6	1,1	1,4	,0	1,8	,0	,6
Do not know	,0	1,9	1,9	1,1	,0	1,2	1,8	2,2	1,5
Respondents (N)	65	371	314	92	219	82	221	46	3041

Question 19 How would you rate your abilities within the listed fields; Organisational talent; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	15,4	21,1	22,0	20,4	25,2	26,8	15,9	28,3	21,8
Fairly good	66,2	53,8	52,9	52,7	46,3	51,2	55,9	54,3	53,0
Not very good	15,4	18,6	16,6	17,2	21,1	15,9	21,8	10,9	18,2
Poor	3,1	1,9	2,9	3,2	1,8	1,2	2,3	2,2	2,2
Do not know	,0	4,6	5,7	6,5	5,5	4,9	4,1	4,3	4,9
Respondents (N)	65	370	314	93	218	82	220	46	3037

Question 19 How would you rate your abilities within the listed fields; Conflict management; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	33,8	28,1	23,2	19,4	29,4	26,8	25,8	30,4	26,6
Fairly good	36,9	50,0	55,4	54,8	53,2	51,2	50,7	37,0	51,0
Not very good	24,6	17,0	16,2	18,3	15,1	14,6	17,6	32,6	17,4
Poor	4,6	3,0	2,2	5,4	1,4	1,2	2,3	,0	2,5
Do not know	,0	1,9	2,9	2,2	,9	6,1	3,6	,0	2,4
Respondents (N)	65	370	314	93	218	82	221	46	3039

Question 19 How would you rate your abilities within the listed fields; Laboratory experimenting; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	13,8	17,5	13,7	12,9	14,7	22,2	19,8	39,1	17,7
Fairly good	44,6	53,6	55,6	48,4	60,1	51,9	55,9	45,7	53,9
Not very good	27,7	20,8	20,8	30,1	18,8	14,8	19,8	13,0	20,4
Poor	12,3	3,0	3,2	4,3	1,8	6,2	,5	2,2	3,2
Do not know	1,5	5,1	6,7	4,3	4,6	4,9	4,1	,0	4,8
Respondents (N)	65	371	313	93	218	81	222	46	3038

Question 19 How would you rate your abilities within the listed fields; **Oral communication; per cent**

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	35,4	42,9	38,5	41,3	35,6	37,8	36,2	43,5	39,6
Fairly good	50,8	49,9	51,0	43,5	55,7	47,6	49,8	50,0	50,1
Not very good	13,8	6,7	8,0	13,0	8,2	12,2	12,2	6,5	9,0
Poor	,0	,0	1,0	2,2	,5	,0	,5	,0	,4
Do not know	,0	,5	1,6	,0	,0	2,4	1,4	,0	,9
Respondents (N)	65	371	312	92	219	82	221	46	3056

Question 19 How would you rate your abilities within the listed fields; **Ability to work independently; per cent**

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	48,4	34,7	35,4	44,1	31,5	36,6	23,0	26,1	34,0
Fairly good	40,6	45,3	47,8	44,1	52,5	48,8	52,7	52,2	47,9
Not very good	9,4	17,1	12,7	4,3	14,2	11,0	22,1	19,6	14,8
Poor	1,6	2,4	2,5	7,5	1,8	2,4	,5	2,2	2,5
Do not know	,0	,5	1,6	,0	,0	1,2	1,8	,0	,8
Respondents (N)	64	369	314	93	219	82	222	46	3056

Question 19 How would you rate your abilities within the listed fields; Written communication; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	24,6	37,3	32,7	32,3	29,7	36,6	25,8	35,6	33,3
Fairly good	60,0	53,5	50,3	50,5	58,4	53,7	57,0	46,7	53,7
Not very good	12,3	8,4	12,8	14,0	11,4	6,1	14,0	17,8	10,9
Poor	1,5	,3	2,6	3,2	,5	2,4	1,4	,0	1,3
Do not know	1,5	,5	1,6	,0	,0	1,2	1,8	,0	,8
Respondents (N)	65	370	312	93	219	82	221	45	3034

Question 20 To what extent have you had experience with group-based project work? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very much	41,5	40,4	40,4	35,5	45,4	40,2	41,9	28,3	40,4
To some extent	55,4	48,5	43,9	49,5	45,4	50,0	48,2	45,7	47,6
To a minor extent	3,1	9,4	14,4	11,8	7,8	9,8	9,0	26,1	10,7
Not at all	,0	,8	1,3	3,2	,5	,0	,5	,0	,8
Do not know	,0	,8	,0	,0	,9	,0	,5	,0	,4
Respondents (N)	65	371	312	93	218	82	222	46	3040

Question 21 Have you previously received education in environmental issues? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes	60,0	65,2	67,5	61,3	61,9	51,2	62,6	52,2	62,5
No	32,3	29,9	24,8	34,4	33,0	42,7	30,6	39,1	31,6
Do not know	7,7	4,9	7,6	4,3	5,0	6,1	6,8	8,7	5,9
Respondents (N)	65	371	314	93	218	82	222	46	3043

Question 22 Have you previously received education in sustainability? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes	50,8	48,0	44,1	33,3	52,1	37,8	40,1	34,8	44,3
No	40,0	43,9	47,6	57,0	43,3	59,8	51,4	58,7	48,4
Do not know	9,2	8,1	8,3	9,7	4,6	2,4	8,6	6,5	7,3
Respondents (N)	65	369	313	93	217	82	222	46	3034

Question 23 Please indicate whether you agree or disagree in the following attitudes towards different subjects? Natural science makes it possible to act on an objective basis; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Agree	64,1	68,8	64,0	61,1	61,5	67,9	70,9	65,2	66,4
Neither agree nor disagree	35,9	27,4	32,8	36,7	36,7	30,9	25,9	32,6	30,8
Disagree	0	3,8	3,2	2,2	1,8	1,2	3,2	2,2	2,8
Respondents (N)	64	369	311	90	218	81	220	46	3017

Question 23 Please indicate whether you agree or disagree in the following attitudes towards different subjects? Social science provides insight necessary for the development of technology; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Agree	46,9	53,3	60,6	48,9	53,7	59,8	52,3	45,7	54,3
Neither agree nor disagree	43,8	36,7	32,6	38,0	38,5	29,3	39,5	50,0	36,7
Disagree	9,4	10,1	6,8	13,0	7,8	11,0	8,2	4,3	9,1
Respondents (N)	64	368	310	92	218	82	220	46	3021

Question 23 Please indicate whether you agree or disagree in the following attitudes towards different subjects? Philosophy makes it possible to make a critical analysis and comparison of different subjects; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Agree	29,7	31,8	34,7	32,6	31,3	22,5	32,0	23,9	31,0
Neither agree nor disagree	62,5	53,5	54,3	50,0	57,1	58,8	53,4	54,3	54,7
Disagree	7,8	14,7	10,9	17,4	11,5	18,8	14,6	21,7	14,3
Respondents (N)	64	368	311	92	217	80	219	46	3012

Question 23 Please indicate whether you agree or disagree in the following attitudes towards different subjects? Language and literature provide access to understanding relations between humans and technology; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Agree	39,7	39,1	43,9	48,4	39,0	42,7	42,3	43,5	41,5
Neither agree nor disagree	52,4	42,1	40,3	40,7	46,8	12,7	45,9	32,6	42,7
Disagree	7,9	18,8	15,8	11,0	14,2	3,4	11,8	23,9	15,7
Respondents (N)	63	368	310	91	218	82	220	46	3017

Question 23 Please indicate whether you agree or disagree in the following attitudes towards different subjects? Mathematics provides access to a universal 'language' for all sciences; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Agree	92,2	88,1	83,8	80,4	86,3	81,7	87,7	91,3	86,1
Neither agree nor disagree	6,3	10,0	13,3	15,2	11,4	15,9	10,5	8,7	11,6
Disagree	1,6	1,9	2,9	4,3	2,3	2,4	1,8	,0	2,3
Respondents (N)	64	369	309	92	219	82	220	46	3024

Question 23 Please indicate whether you agree or disagree in the following attitudes towards different subjects? Social science is a subject dominated by attitude where all views are of equal value; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Agree	42,2	32,9	44,4	31,5	39,3	40,7	40,6	43,5	37,9
Neither agree nor disagree	50,0	43,5	43,1	57,6	48,4	44,4	41,1	41,3	45,0
Disagree	7,8	23,6	12,5	10,9	12,3	14,8	18,3	15,2	17,0
Respondents (N)	64	368	311	92	219	81	219	46	3019

Question 23 Please indicate whether you agree or disagree in the following attitudes towards different subjects? Natural science subjects provide the instruments for understanding the world and develop technology; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Agree	73,4	86,6	82,3	69,6	79,5	65,9	81,2	89,1	80,7
Neither agree nor disagree	23,4	12,3	16,1	23,9	19,6	34,1	15,6	10,9	17,6
Disagree	3,1	1,1	1,6	6,5	,9	,0	3,2	,0	1,7
Respondents (N)	64	367	310	92	219	82	218	46	3017

Question 23 Please indicate whether you agree or disagree in the following attitudes towards different subjects? It is possible to give an objective account of historic developments; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Agree	28,1	22,5	30,2	25,0	33,0	31,7	29,4	15,2	26,9
Neither agree nor disagree	54,7	38,6	44,7	57,6	51,8	46,3	44,0	45,7	45,0
Disagree	17,2	38,9	25,1	17,4	15,1	22,0	26,6	39,1	28,1
Respondents (N)	64	365	311	92	218	82	218	46	3011

Question 23 Please indicate whether you agree or disagree in the following attitudes towards different subjects? It is possible to govern technological progress based on insights in economic matters; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Agree	31,3	26,4	32,9	30,4	31,5	37,0	24,1	21,7	29,2
Neither agree nor disagree	59,4	55,4	55,2	50,0	54,3	50,6	62,3	67,4	55,8
Disagree	9,4	18,2	11,9	19,6	14,2	12,3	13,6	10,9	15,1
Respondents (N)	64	368	310	92	219	81	220	46	3019

Question 24 What is your educational background? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Primary or lower secondary school	,0	,0	,0	,0	,0	,0	,0	,0	,0
Upper secondary school or high school	49,2	65,1	64,0	68,1	50,9	54,9	55,3	82,6	59,5
Business, commercial or technical college	44,4	26,4	32,8	23,1	34,7	28,0	32,9	10,9	29,8
Other	6,3	8,4	3,2	8,8	14,4	17,1	11,9	6,5	10,7
Respondents (N)	63	367	307	91	216	82	219	46	3004

Question 27 Please indicate the highest level of education completed by your mother; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Elementary school (primary and lower secondary school)	7,8	7,9	12,7	7,6	14,0	21,0	11,5	4,3	11,0
Upper secondary school or high school	9,4	9,5	11,1	13,0	12,1	9,9	10,1	4,3	10,3
Business, commercial or technical college	7,8	2,5	8,5	12,0	4,7	9,9	5,0	2,2	5,7
Vocational training (e.g. builder, carpenter, electrician or corresponding level)	14,1	9,0	12,7	5,4	11,7	8,6	14,2	17,4	10,7
Short term further education (e.g. real estate agent, information technologist, police officer or corresponding level)	10,9	9,3	9,8	9,8	13,1	7,4	12,8	10,9	10,2
Medium lenght higher education (e.g. BSc, BA degree, nurse, school teacher or corresponding level)	31,3	36,0	31,9	23,9	31,3	27,2	29,8	41,3	32,2
Masters level degree (MSc, MA degree or similar)	12,5	17,7	9,8	18,5	8,4	7,4	7,8	6,5	12,5
PhD level degree (postgraduate or graduate degree programme)	1,6	1,9	,7	3,3	,5	,0	1,4	,0	1,3
Other	4,7	6,3	2,9	6,5	4,2	8,6	7,3	13,0	6,1
Respondents (N)	64	367	307	92	214	81	218	46	2099

Question 28 Please indicate the highest level of education completed by your father; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Elementary school (primary and lower secondary school)	15,9	7,6	12,9	8,7	12,5	17,1	10,5	6,7	10,7
Upper secondary school or high school	9,5	4,9	4,2	5,4	3,7	13,4	4,1	2,2	5,5
Business, commercial or technical college	3,2	1,9	2,6	8,7	3,2	2,4	2,3	2,2	2,9
Vocational training (e.g. builder, carpenter, electrician or corresponding level)	27,0	19,3	34,0	19,6	30,1	20,7	35,9	28,9	25,9
Short term further education (e.g. real estate agent, information technologist, police officer or corresponding level)	4,8	5,7	8,7	15,2	7,4	6,1	11,4	6,7	7,9
Medium lenght higher education (e.g. BSc, BA degree, nurse, school teacher or corresponding level)	15,9	21,8	16,5	18,5	15,3	20,7	19,1	24,4	19,3
Masters level degree (MSc, MA degree or similar)	19,0	29,4	15,9	15,2	20,4	11,0	13,2	15,6	20,3
PhD level degree (postgraduate or graduate degree programme)	3,2	4,4	1,0	5,4	1,9	2,4	,5	,0	2,7
Other	1,6	4,9	4,2	3,3	5,6	6,1	3,2	13,3	4,9
Respondents (N)	63	367	309	92	216	82	220	45	3009

Question 29 Does/Did any of your family have a job or a university qualification in natural science, technology or engineering (for instance, physics, chemistry, biology, medicine)? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, your father	22,7	30,9	18,7	28,1	21,4	20,5	16,7	19,1	24,0
Yes, your mother	7,6	15,1	7,6	15,6	5,0	9,6	7,2	10,6	10,7
Yes, another member of your family	31,8	39,2	35,9	26,0	35,0	31,3	38,0	42,6	36,1
Total, yes	51,5	64,2	52,1	50,0	50,5	50,6	53,4	59,6	43,9
No, no one in your family	48,5	35,8	47,9	50,0	49,5	49,4	46,6	40,4	56,1
Respondents (N)	66	372	315	96	220	83	222	47	3084

Sum of yes-answers is higher than ”Total, yes” indicates due to possibility of more than one positive answer when more family members with job or education within the field specified.

Question 30 Do any of your immediate family members hold an engineering degree? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
No	60,9	58,4	66,0	62,4	62,6	61,0	73,2	69,6	63,0
Yes	39,1	41,6	34,0	37,6	37,4	39,0	26,8	30,4	37,0
Father or stepfather	17,2	20,7	11,0	15,1	13,8	14,6	6,8	15,2	15,2
Mother or stepmother	1,6	3,0	1,9	6,5	0,0	3,7	0,5	2,2	2,4
Brother or stepbrother	3,1	4,1	4,5	5,4	6,9	3,7	3,6	8,7	4,7
Sister or stepsister	4,7	2,4	1,9	3,2	1,4	2,4	2,3	0,0	2,2
Other	20,3	21,5	18,4	21,5	20,2	23,2	16,8	13,0	20,1
Respondents (N)	64	368	310*	93	218**	82	220	46	3042**

Sum of yes-answers is higher than total ”Yes” indicates due to possibility of more than one positive answer when more family members hold an engineering degree.
* In the case of AAU N is 312 for the main yes/no answer.
** In the case of SDU N is 219 for the main yes/no answer.
*** In the weighted total N is 3047 for the main yes/no answer.

Question 31 Do you hold a Danish citizenship? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes	89,1	96,8	90,4	42,6	86,3	84,1	96,4	93,5	88,5
No	10,9	3,2	9,6	57,4	13,7	15,9	3,6	6,5	11,5
Respondents (N)	66	370	312	94	219	82	220	46	3055

Question 31b In which geographical area are you a citizen? Per cent
(only asked to those answering ”No” to previous question)

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Nordic countries	14,3	58,3	23,3	5,6	23,3	7,7	62,5	66,7	19,8
(Other) Europe	71,4	33,3	50,0	85,2	66,7	53,8	37,5	,0	64,1
US	,0	,0	,0	,0	,0	,0	,0	,0	,0
(Other) North or Central America	,0	,0	3,3	,0	,0	,0	,0	,0	,5
South America	,0	,0	3,3	,0	,0	,0	,0	,0	,5
Asia	,0	8,3	10,0	3,7	10,0	38,5	,0	,0	10,5
Africa	14,3	,0	6,7	5,6	,0	,0	,0	33,3	4,2
Australia or Oceania	,0	,0	3,3	,0	,0	,0	,0	,0	,5
Respondents (N)	7	12	30	54	30	7	8	3	352

Engineering Student Survey, May 2011
Frequencies per institution

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Population in total
Population size (N)	112	1122	583	179	403	296	365	123	3183
Gender distribution in population; Female/Male; Per cent	12,5 87,5	27,0 73,0	25,4 74,6	19,3 80,7	18,4 81,6	22,8 77,2	16,2 83,8	45,5 54,5	23,7 76,3
Average age of population; years in 2010	22,7	21,4	21,9	22,2	22,9	22,9	22,1	22,0	22,0
Average response rate; per cent	41,1%	30,2%	42,2%	40,9%	45,9%	22,1%	44,7%	48,8%	37,0%
Distribution on engineering education type; vocational (diplomingeniør)/ academic (Civilingeniør)	100 0	36,2 63,8	12,4 87,6	100 0	63,3 36,7	100 0	100 0	0 100	53,0 47,0

Question A: Please indicate how strongly you disagree or agree with each of the statements; Creative thinking is one of my strengths; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Disagree strongly	,0	1,5	,8	1,4	1,1	,0	,6	1,7	1,0
Disagree	8,7	9,2	10,7	5,4	10,4	7,8	11,1	23,3	10,0
Agree	32,6	47,6	57,8	51,4	46,4	50,0	50,0	60,0	50,0
Agree strongly	58,7	39,6	28,7	37,8	38,8	39,1	37,0	10,0	36,6
Do not know	,0	2,1	2,0	4,1	3,3	3,1	1,2	5,0	2,4
Respondents (N)	46	338	244	74	183	64	162	60	3150

Question A: Please indicate how strongly you disagree or agree with each of the statements; I am skilled at solving problems that can have multiple solutions; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Disagree strongly	,0	,6	,4	,0	,5	1,5	,0	,0	,5
Disagree	4,3	7,4	4,1	5,5	4,4	3,1	6,8	10,0	5,8
Agree	56,5	55,2	61,5	56,2	59,6	53,8	58,6	68,3	57,8
Agree strongly	39,1	33,8	30,7	34,2	33,3	41,5	32,1	15,0	33,2
Do not know	,0	3,0	3,3	4,1	2,2	,0	2,5	6,7	2,7
Respondents (N)	46	337	244	73	183	65	162	60	3149

Question A: Please indicate how strongly you disagree or agree with each of the statements; I am happy to be an engineering student; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Disagree strongly	,0	1,8	,8	1,4	1,1	,0	,0	,0	1,0
Disagree	,0	3,6	2,9	2,7	2,2	3,1	2,5	1,7	2,8
Agree	39,1	27,8	33,2	33,8	32,4	29,7	29,6	59,3	31,7
Agree strongly	58,7	63,3	60,7	60,8	59,3	64,1	64,8	32,2	61,1
Do not know	2,2	3,6	2,5	1,4	4,9	3,1	3,1	6,8	3,4
Respondents (N)	46	338	244	74	182	64	162	59	3146

Question A: Please indicate how strongly you disagree or agree with each of the statements; I have a clear picture of what kind of work I can get when I graduate as an engineer; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Disagree strongly	4,3	8,4	6,6	1,4	4,4	3,1	3,1	16,7	6,2
Disagree	28,3	31,0	29,3	21,6	29,5	32,3	34,8	51,7	31,3
Agree	47,8	40,3	41,3	48,6	44,3	33,8	42,9	21,7	40,7
Agree strongly	13,0	16,4	18,2	24,3	17,5	29,2	14,3	10,0	17,9
Do not know	6,5	3,9	4,5	4,1	4,4	1,5	5,0	,0	3,9
Respondents (N)	46	335	242	74	183	65	161	60	3138

Question A: Please indicate how strongly you disagree or agree with each of the statements; If I was to start my education today, I would not choose an engineering programme; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Disagree strongly	48,9	50,9	53,5	54,1	50,3	48,4	52,5	35,0	50,7
Disagree	40,0	30,5	26,7	33,8	25,7	28,1	27,2	46,7	29,8
Agree	8,9	5,9	8,6	4,1	9,3	3,1	10,5	10,0	7,3
Agree strongly	2,2	5,6	4,9	2,7	4,4	15,6	6,2	1,7	5,9
Do not know	,0	7,1	6,2	5,4	10,4	4,7	3,7	6,7	6,4
Respondents (N)	45	338	243	74	183	64	162	60	3146

Question A: Please indicate how strongly you disagree or agree with each of the statements; I like my study's pratical approach to technology; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Disagree strongly	,0	2,4	1,6	1,4	3,3	1,6	,6	8,3	2,2
Disagree	4,3	10,1	10,3	1,4	11,5	11,1	6,2	18,3	9,6
Agree	47,8	46,1	45,3	50,0	45,9	46,0	49,7	50,0	46,8
Agree strongly	41,3	34,5	37,0	39,2	32,2	34,9	41,6	11,7	35,2
Do not know	6,5	6,8	5,8	8,1	7,1	6,3	1,9	11,7	6,3
Respondents (N)	46	336	243	74	183	63	161	60	3135

Question A: Please indicate how strongly you disagree or agree with each of the statements; I like my study's theoretical approach to technology; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Disagree strongly	,0	1,8	1,6	2,8	2,2	3,1	,0	,0	1,6
Disagree	4,3	9,2	15,6	5,6	12,6	9,4	9,9	10,0	10,6
Agree	73,9	54,5	57,8	69,4	59,9	67,2	57,1	61,7	59,0
Agree strongly	17,4	28,0	19,3	13,9	20,3	17,2	31,1	25,0	23,5
Do not know	4,3	6,5	5,7	8,3	4,9	3,1	1,9	3,3	5,2
Respondents (N)	46	336	244	72	182	64	161	60	3135

Question B: Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Self confidence (social); per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	,0	4,5	2,5	,0	,6	,0	1,9	1,7	2,4
Below average	15,2	11,5	7,9	2,8	14,5	7,8	10,8	6,8	10,3
Average	26,1	36,0	45,2	51,4	35,8	46,9	44,6	45,8	40,5
Above average	30,4	31,1	33,2	31,9	30,7	28,1	31,2	32,2	31,3
Highest 10%	28,3	16,6	10,4	13,9	16,8	15,6	10,8	13,6	14,9
Do not know	,0	,3	,8	,0	1,7	1,6	,6	,0	,7
Respondents (N)	46	331	241	72	179	64	157	59	3093

Question B: Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Leadership ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	,0	3,0	1,2	,0	1,7	,0	,6	,0	1,6
Below average	6,5	8,5	7,5	17,1	9,5	6,3	12,8	6,8	9,0
Average	34,8	31,1	34,0	31,4	26,8	37,5	30,8	40,7	32,2
Above average	30,4	36,6	38,6	27,1	38,5	32,8	34,0	33,9	35,7
Highest 10%	28,3	19,3	17,4	24,3	20,7	23,4	21,2	16,9	20,2
Do not know	,0	1,5	1,2	,0	2,8	,0	,6	1,7	1,3
Respondents (N)	46	331	241	70	179	64	156	59	3086

Question B: Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Public speaking ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	2,2	3,6	4,6	1,4	2,2	1,6	3,8	3,4	3,3
Below average	17,8	20,1	21,2	18,1	16,2	14,1	21,8	27,1	19,5
Average	35,6	32,2	34,4	36,1	37,4	35,9	35,3	33,9	34,4
Above average	24,4	26,4	28,2	27,8	27,4	37,5	25,6	23,7	27,7
Highest 10%	20,0	16,7	10,8	16,7	15,1	10,9	12,8	11,9	14,4
Do not know	,0	,9	,8	,0	1,7	,0	,6	,0	,8
Respondents (N)	45	329	241	72	179	64	156	59	3082

Question B: Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Math ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	4,3	3,0	2,1	1,4	2,2	1,6	,6	6,8	2,5
Below average	8,7	14,8	13,7	6,9	14,0	14,1	12,8	8,5	13,3
Average	47,8	37,6	40,7	34,7	44,1	31,3	41,0	50,8	39,5
Above average	21,7	25,5	31,1	20,8	27,9	40,6	30,8	16,9	28,1
Highest 10%	17,4	18,2	11,6	36,1	10,6	12,5	14,7	16,9	16,0
Do not know	,0	,9	,8	,0	1,1	,0	,0	,0	,6
Respondents (N)	46	330	241	72	179	64	156	59	3088

Question B: Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Science ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	,0	1,5	,4	,0	,6	,0	,0	1,7	,7
Below average	6,5	3,3	5,8	4,2	7,3	3,1	2,5	1,7	4,3
Average	45,7	43,8	49,6	44,4	47,5	46,9	47,1	49,2	46,3
Above average	32,6	37,2	35,8	36,1	35,2	42,2	40,1	32,2	37,0
Highest 10%	15,2	12,1	7,1	15,3	7,3	7,8	10,2	13,6	10,3
Do not know	,0	2,1	1,3	,0	2,2	,0	,0	1,7	1,3
Respondents (N)	46	331	240	72	179	64	157	59	3091

Question B: Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Communication skills; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	,0	,9	1,3	,0	,6	,0	,0	,0	,6
Below average	10,9	10,4	8,8	6,9	7,9	7,8	7,6	5,1	8,8
Average	34,8	36,0	42,1	45,8	36,2	42,2	40,8	54,2	39,5
Above average	30,4	38,7	37,9	33,3	42,4	32,8	38,9	30,5	37,6
Highest 10%	23,9	13,4	8,8	13,9	11,9	17,2	12,7	8,5	12,8
Do not know	,0	,6	1,3	,0	1,1	,0	,0	1,7	,7
Respondents (N)	46	328	240	72	177	64	157	59	3077

Question B: Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Ability to apply math and science principles in solving real world problems; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	2,2	,9	1,7	2,8	,0	,0	1,3	,0	1,0
Below average	8,7	10,9	10,5	5,6	8,9	10,9	3,8	3,4	9,1
Average	54,3	47,7	42,3	36,6	49,7	43,8	45,9	56,9	46,4
Above average	28,3	28,4	33,9	40,8	31,3	31,3	38,2	25,9	31,7
Highest 10%	6,5	8,5	7,5	12,7	8,4	7,8	9,6	6,9	8,4
Do not know	,0	3,6	4,2	1,4	1,7	6,3	1,3	6,9	3,3
Respondents (N)	46	331	239	71	179	64	157	58	3084

Question B: Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Business ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	,0	3,9	3,8	1,4	1,1	,0	2,5	,0	2,6
Below average	10,9	24,8	22,1	18,1	16,9	15,6	22,3	27,1	21,4
Average	47,8	38,4	39,6	43,1	46,6	37,5	36,3	33,9	39,7
Above average	26,1	19,6	20,8	22,2	23,0	29,7	28,0	16,9	22,4
Highest 10%	10,9	7,3	5,8	13,9	7,3	14,1	4,5	5,1	7,7
Do not know	4,3	6,0	7,9	1,4	5,1	3,1	6,4	16,9	6,1
Respondents (N)	46	331	240	72	178	64	157	59	3089

Question B: Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Ability to perform in teams; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	,0	,3	1,2	,0	1,1	,0	1,3	,0	,6
Below average	4,4	7,3	3,7	5,6	5,6	1,6	3,9	5,1	5,2
Average	31,1	37,3	35,3	29,6	31,3	34,9	38,1	40,7	35,5
Above average	44,4	44,2	47,7	50,7	48,0	44,4	45,8	45,8	46,0
Highest 10%	17,8	10,6	10,4	14,1	12,8	19,0	11,0	6,8	12,0
Do not know	2,2	,3	1,7	,0	1,1	,0	,0	1,7	,7
Respondents (N)	45	330	241	71	179	63	155	59	3076

Question B: Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Critical thinking skills; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	,0	,6	,4	,0	,6	,0	,0	,0	,4
Below average	4,3	3,0	3,3	4,2	3,9	,0	1,3	8,5	3,0
Average	30,4	25,7	31,7	25,0	25,1	35,9	26,1	33,9	28,1
Above average	41,3	47,7	43,8	47,2	43,6	43,8	52,9	45,8	46,4
Highest 10%	23,9	22,4	18,3	20,8	25,7	20,3	18,5	11,9	21,0
Do not know	,0	,6	2,5	2,8	1,1	,0	1,3	,0	1,1
Respondents (N)	46	331	240	72	179	64	157	59	3091

Question B: Rate yourself on each of the following traits as compared to your classmates. We want the most accurate estimate of how you see yourself; Wish to find new solutions; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Lowest 10%	,0	,0	,4	,0	,0	,0	,0	,0	,1
Below average	2,2	3,9	2,1	,0	3,9	3,1	2,5	3,4	3,1
Average	23,9	28,7	32,4	29,2	29,6	31,3	32,5	44,1	30,6
Above average	45,7	45,9	45,2	31,9	39,7	43,8	45,2	40,7	43,7
Highest 10%	28,3	19,0	17,8	36,1	24,6	21,9	18,5	10,2	20,7
Do not know	,0	2,4	2,1	2,8	2,2	,0	1,3	1,7	1,9
Respondents (N)	46	331	241	72	179	64	157	59	3093

Question C: How important do you think each of the following skills and abilities is to becoming a successful engineer? Self confidence (social); per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	,0	2,5	1,7	1,5	,0	1,7	1,3	1,8	1,6
Somewhat important	40,0	32,3	29,5	23,5	23,3	25,0	29,7	38,6	29,7
Very important	44,4	54,5	54,3	57,4	61,9	56,7	56,1	54,4	55,6
Crucial	15,6	8,9	12,4	17,6	12,5	16,7	12,9	5,3	11,7
Do not know	,0	1,8	2,1	,0	2,3	,0	,0	,0	1,3
Respondents (N)	45	325	234	68	176	60	155	57	3012

Question C: How important do you think each of the following skills and abilities is to becoming a successful engineer? Leadership ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	8,9	5,2	3,9	9,1	4,5	1,7	,6	,0	4,2
Somewhat important	20,0	44,3	31,3	31,8	32,2	40,0	35,5	35,1	37,1
Very important	51,1	40,0	50,6	40,9	48,0	33,3	47,1	47,4	43,9
Crucial	20,0	8,6	12,9	18,2	13,6	25,0	16,8	17,5	13,7
Do not know	,0	1,8	1,3	,0	1,7	,0	,0	,0	1,1
Respondents (N)	45	325	233	66	177	60	155	57	3007

Question C: How important do you think each of the following skills and abilities is to becoming a successful engineer? Public speaking ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	6,7	7,4	8,1	8,8	3,4	1,7	6,5	,0	6,2
Somewhat important	37,8	45,8	32,9	44,1	38,2	46,7	34,0	38,6	40,6
Very important	46,7	37,5	42,7	33,8	41,6	36,7	50,3	52,6	41,1
Crucial	8,9	8,3	14,1	13,2	15,2	15,0	8,5	7,0	11,1
Do not know	,0	,9	2,1	,0	1,7	,0	,7	1,8	1,1
Respondents (N)	45	325	234	68	178	60	153	57	3012

Question C: How important do you think each of the following skills and abilities is to becoming a successful engineer? Math ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	,0	1,2	,9	,0	,6	,0	,0	,0	,7
Somewhat important	24,4	22,2	19,7	23,9	24,2	18,3	20,6	19,3	21,5
Very important	51,1	48,3	49,6	37,3	52,8	58,3	50,3	61,4	50,2
Crucial	24,4	28,0	28,6	38,8	21,3	23,3	29,0	19,3	27,1
Do not know	,0	,3	1,3	,0	1,1	,0	,0	,0	,5
Respondents (N)	45	325	234	67	178	60	155	57	3014

Question C: How important do you think each of the following skills and abilities is to becoming a successful engineer? Science ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	2,2	,9	,9	,0	,6	,0	1,3	,0	,8
Somewhat important	28,9	11,3	15,4	22,4	23,6	18,3	16,9	15,8	16,3
Very important	42,2	51,5	58,5	40,3	55,1	55,0	54,5	68,4	53,6
Crucial	26,7	35,3	23,9	37,3	19,1	26,7	27,3	15,8	28,5
Do not know	,0	,9	1,3	,0	1,7	,0	,0	,0	,8
Respondents (N)	45	326	234	67	178	60	154	57	3015

Question C: How important do you think each of the following skills and abilities is to becoming a successful engineer? Communication skills; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	,0	,3	,9	,0	,0	,0	,0	,0	,3
Somewhat important	18,2	19,1	18,5	25,0	17,4	18,3	15,5	12,3	18,3
Very important	61,4	57,1	52,8	57,4	61,8	56,7	57,4	59,6	57,2
Crucial	20,5	22,5	26,6	17,6	20,2	25,0	27,1	28,1	23,6
Do not know	,0	,9	1,3	,0	,6	,0	,0	,0	,6
Respondents (N)	44	324	233	68	178	60	155	57	3008

Question C: How important do you think each of the following skills and abilities is to becoming a successful engineer? Ability to apply math and science principles in solving real world problems; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	2,3	,6	,9	,0	,6	,0	,0	,0	,5
Somewhat important	2,3	9,0	5,2	13,4	10,7	5,0	9,1	5,3	8,0
Very important	50,0	32,4	41,4	31,3	43,3	35,0	34,4	35,1	36,6
Crucial	45,5	57,4	51,3	55,2	44,4	60,0	56,5	59,6	54,3
Do not know	,0	,6	1,3	,0	1,1	,0	,0	,0	,6
Respondents (N)	44	324	232	67	178	60	154	57	3001

Question C: How important do you think each of the following skills and abilities is to becoming a successful engineer? Business ability; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	15,6	21,2	16,3	9,0	11,9	10,2	11,0	10,5	15,7
Somewhat important	44,4	53,1	42,9	49,3	49,7	47,5	56,5	50,9	50,1
Very important	31,1	20,6	30,0	29,9	29,4	30,5	26,6	29,8	26,2
Crucial	8,9	3,7	6,4	10,4	6,8	11,9	4,5	3,5	5,9
Do not know	,0	1,5	4,3	1,5	2,3	,0	1,3	5,3	2,1
Respondents (N)	45	326	233	67	177	59	154	57	3006

Question C: How important do you think each of the following skills and abilities is to becoming a successful engineer? Ability to perform in teams; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	,0	,9	1,7	1,5	,6	,0	,0	,0	,8
Somewhat important	8,9	7,1	6,8	10,3	9,1	10,0	2,6	3,5	7,1
Very important	35,6	48,0	38,9	44,1	40,3	45,0	43,5	52,6	44,1
Crucial	55,6	43,4	51,3	44,1	49,4	45,0	53,9	43,9	47,4
Do not know	,0	,6	1,3	,0	,6	,0	,0	,0	,5
Respondents (N)	45	325	234	68	176	60	154	57	3010

Question C: How important do you think each of the following skills and abilities is to becoming a successful engineer? Critical thinking skills; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	2,2	,6	,9	,0	,0	,0	,0	,0	,5
Somewhat important	17,8	8,3	6,9	3,0	11,9	8,3	5,8	10,5	8,4
Very important	55,6	52,8	51,3	59,7	52,8	50,0	56,8	57,9	53,4
Crucial	24,4	37,0	39,2	35,8	33,5	41,7	36,8	31,6	36,6
Do not know	,0	1,2	1,7	1,5	1,7	,0	,6	,0	1,1
Respondents (N)	45	324	232	67	176	60	155	57	3002

Question C: How important do you think each of the following skills and abilities is to becoming a successful engineer? Wish to find new solutions; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not important	,0	,6	,9	,0	,0	1,7	,0	,0	,5
Somewhat important	6,7	4,6	6,4	10,3	7,9	3,3	7,8	7,1	6,1
Very important	44,4	33,8	42,7	41,2	36,7	48,3	41,2	39,3	38,9
Crucial	48,9	59,7	48,3	47,1	53,1	46,7	51,0	51,8	53,2
Do not know	,0	1,2	1,7	1,5	2,3	,0	,0	1,8	1,2
Respondents (N)	45	325	234	68	177	60	153	56	3008

Question F: Of the 20 items below, please put a check mark next to the FIVE you think are MOST IMPORTANT practicing engineering; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Business knowledge	29,5	15,0	19,8	13,4	18,2	22,0	20,8	15,8	18,0
Communication	38,6	22,5	32,0	31,3	44,3	37,3	35,6	42,1	31,6
Conducting experiments	18,2	15,6	18,0	16,4	13,1	6,8	12,1	12,3	14,5
Contemporary issues	6,8	6,9	8,6	4,5	3,4	5,1	5,4	10,5	6,4
Creativity	65,9	60,0	39,6	49,3	58,5	49,2	43,0	29,8	51,7
Data analysis	4,5	15,3	16,2	22,4	11,4	10,2	8,7	15,8	13,8
Design	2,3	10,9	12,2	16,4	14,8	16,9	14,8	8,8	12,5
Engineering analysis	25,0	29,1	36,0	52,2	27,3	28,8	42,3	40,4	33,1
Engineering tools	31,8	32,5	28,8	28,4	38,6	39,0	42,3	31,6	34,0
Ethics	4,5	8,1	3,6	4,5	2,8	1,7	2,0	12,3	5,2
Global context	11,4	10,0	11,3	9,0	12,5	16,9	6,7	10,5	10,8
Leadership	31,8	10,0	19,8	16,4	25,6	30,5	24,2	22,8	18,8
Life-long learning	18,2	29,7	22,1	25,4	24,4	25,4	28,9	19,3	26,1
Management skills	2,3	4,1	9,5	6,0	9,1	5,1	6,0	3,5	6,0
Math	13,6	25,3	24,8	31,3	18,2	32,2	24,8	14,0	24,3
Problem solving	68,2	84,7	82,0	64,2	75,6	72,9	77,2	80,7	79,2
Professionalism	22,7	17,5	15,3	23,9	15,3	16,9	22,1	12,3	17,7
Science	25,0	33,8	21,2	26,9	16,5	18,6	16,8	38,6	25,5
Societal context	6,8	10,3	15,3	3,0	4,5	5,1	4,7	14,0	9,0
Teamwork	72,7	58,8	64,0	55,2	65,9	59,3	61,7	64,9	61,6
Respondents (N)	44	320	222	67	176	59	149	57	2945

Percentages sum to 500% since each respondent gives five answers.

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Business knowledge; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	2,3	28,9	23,0	15,6	19,1	14,0	17,7	43,4	22,8
-	20,5	27,2	29,1	25,0	20,8	19,3	34,0	28,3	26,4
Somewhat prepared	25,0	29,5	34,7	31,3	36,4	40,4	36,9	20,8	32,7
-	29,5	8,9	9,4	20,3	16,2	17,5	6,4	3,8	11,6
Very well prepared	22,7	5,6	3,8	7,8	7,5	8,8	5,0	3,8	6,4
Respondents (N)	44	305	213	64	173	57	141	53	2825

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Communication; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	2,3	4,3	1,9	1,6	2,9	,0	2,1	7,5	2,9
-	4,5	14,8	14,6	3,1	12,8	10,7	12,1	35,8	13,6
Somewhat prepared	38,6	46,9	47,4	45,3	40,1	44,6	52,5	45,3	46,0
-	27,3	23,6	31,0	32,8	30,2	33,9	26,2	9,4	27,1
Very well prepared	27,3	10,5	5,2	17,2	14,0	10,7	7,1	1,9	10,3
Respondents (N)	44	305	213	64	172	56	141	53	2819

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Conducting experiments; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	2,3	9,5	10,4	3,1	8,1	14,0	5,7	1,9	8,5
-	23,3	21,3	22,3	20,3	20,2	21,1	17,0	9,4	20,4
Somewhat prepared	46,5	38,0	41,2	39,1	49,7	40,4	46,1	34,0	41,5
-	20,9	23,3	20,4	34,4	17,9	19,3	27,7	26,4	22,8
Very well prepared	7,0	7,9	5,7	3,1	4,0	5,3	3,5	28,3	6,8
Respondents (N)	43	305	211	64	173	57	141	53	2818

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Contemporary issues; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	2,3	11,8	6,1	6,3	12,8	15,8	12,1	18,9	10,9
-	13,6	33,1	23,9	18,8	25,6	15,8	37,9	37,7	28,1
Somewhat prepared	47,7	34,8	43,7	53,1	37,8	47,4	34,3	34,0	39,3
-	31,8	15,7	22,1	17,2	19,8	14,0	15,0	7,5	17,5
Very well prepared	4,5	4,6	4,2	4,7	4,1	7,0	,7	1,9	4,1
Respondents (N)	44	305	213	64	172	57	140	53	2821

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Creativity; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	,0	3,6	3,8	3,1	1,2	1,8	1,4	3,8	2,8
-	,0	12,8	14,2	6,3	9,3	7,0	13,6	35,8	12,2
Somewhat prepared	20,9	36,8	40,8	34,4	32,6	36,8	38,6	37,7	36,5
-	41,9	30,3	26,5	34,4	31,4	40,4	37,9	18,9	31,7
Very well prepared	37,2	16,4	14,7	21,9	25,6	14,0	8,6	3,8	16,8
Respondents (N)	43	304	211	64	172	57	140	53	2810

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Data analysis; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	,0	6,6	10,8	1,6	5,8	7,0	3,6	3,8	6,3
-	13,6	20,7	27,2	7,8	17,4	15,8	15,0	15,1	19,1
Somewhat prepared	59,1	36,1	36,2	40,6	40,1	42,1	51,4	43,4	40,3
-	25,0	28,5	22,1	39,1	29,7	26,3	28,6	28,3	27,8
Very well prepared	2,3	8,2	3,8	10,9	7,0	8,8	1,4	9,4	6,5
Respondents (N)	44	305	213	64	172	57	140	53	2821

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Design; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	,0	18,0	16,5	1,6	5,8	14,0	6,4	28,3	13,3
-	9,1	29,5	25,0	10,9	18,5	14,0	26,4	35,8	24,0
Somewhat prepared	52,3	31,1	30,7	46,9	36,4	33,3	35,7	20,8	33,7
-	31,8	13,4	19,8	25,0	30,1	33,3	25,7	11,3	21,2
Very well prepared	6,8	7,9	8,0	15,6	9,2	5,3	5,7	3,8	7,8
Respondents (N)	44	305	212	64	173	57	140	53	2821

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Engineering analysis; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	6,8	6,9	9,9	1,6	5,8	5,4	1,4	15,1	6,6
-	11,4	18,7	23,6	12,5	12,2	16,1	13,6	20,8	17,4
Somewhat prepared	45,5	45,6	40,6	37,5	47,1	39,3	45,7	37,7	43,6
-	31,8	21,6	20,8	31,3	32,6	30,4	32,1	17,0	25,6
Very well prepared	4,5	7,2	5,2	17,2	2,3	8,9	7,1	9,4	6,9
Respondents (N)	44	305	212	64	172	56	140	53	2814

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Engineering tools; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	6,8	6,3	5,7	1,6	2,9	1,8	1,4	5,7	4,5
-	15,9	17,1	22,7	7,8	8,8	10,5	10,9	20,8	15,3
Somewhat prepared	36,4	40,8	47,4	37,5	47,6	47,4	44,2	41,5	43,5
-	36,4	28,9	21,3	39,1	35,9	29,8	34,8	18,9	29,7
Very well prepared	4,5	6,9	2,8	14,1	4,7	10,5	8,7	13,2	7,0
Respondents (N)	44	304	211	64	170	57	138	53	2804

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Ethics; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	4,5	24,3	17,9	9,4	13,9	10,5	25,9	32,1	19,4
-	27,3	26,9	31,1	15,6	30,1	21,1	32,4	24,5	27,5
Somewhat prepared	36,4	26,9	32,1	40,6	30,1	47,4	21,6	26,4	30,6
-	25,0	15,1	11,8	15,6	20,2	17,5	14,4	13,2	15,7
Very well prepared	6,8	6,9	7,1	18,8	5,8	3,5	5,8	3,8	6,9
Respondents (N)	44	305	212	64	173	57	139	53	2818

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Global context; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	4,5	20,7	16,5	7,9	14,5	12,5	19,6	22,6	17,0
-	6,8	30,2	33,5	19,0	27,3	23,2	33,3	34,0	28,8
Somewhat prepared	43,2	33,4	34,4	46,0	31,4	42,9	37,0	32,1	35,6
-	38,6	12,1	13,2	20,6	19,2	17,9	8,0	9,4	14,7
Very well prepared	6,8	3,6	2,4	6,3	7,6	3,6	2,2	1,9	4,0
Respondents (N)	44	305	212	63	172	56	138	53	2807

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Leadership; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	,0	20,7	8,0	4,7	7,6	7,0	9,4	32,1	13,0
-	6,8	31,1	22,2	10,9	14,0	22,8	30,9	35,8	24,6
Somewhat prepared	34,1	28,9	36,8	45,3	37,2	38,6	39,6	20,8	34,2
-	36,4	12,5	28,8	28,1	29,7	19,3	16,5	5,7	20,2
Very well prepared	22,7	6,9	4,2	10,9	11,6	12,3	3,6	5,7	7,9
Respondents (N)	44	305	212	64	172	57	139	53	2816

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Life-long learning; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	,0	16,1	16,7	6,3	10,5	7,0	10,7	32,1	13,5
-	16,3	20,1	21,4	9,4	22,1	14,0	24,3	18,9	19,7
Somewhat prepared	34,9	30,6	27,6	29,7	29,7	45,6	39,3	22,6	32,1
-	44,2	17,8	25,2	39,1	26,7	21,1	17,9	24,5	23,0
Very well prepared	4,7	15,5	9,0	15,6	11,0	12,3	7,9	1,9	11,7
Respondents (N)	43	304	210	64	172	57	140	53	2808

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Management skills; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	2,3	12,1	5,7	4,7	4,7	5,7	5,0	24,5	8,4
-	18,2	20,3	20,4	18,8	17,8	11,3	17,9	30,2	19,2
Somewhat prepared	36,4	44,3	40,8	43,8	39,1	56,6	55,0	32,1	44,4
-	34,1	15,7	28,0	20,3	29,0	18,9	17,1	11,3	20,9
Very well prepared	9,1	7,5	5,2	12,5	9,5	7,5	5,0	1,9	7,2
Respondents (N)	44	305	211	64	169	53	140	53	2792

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Math; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	2,3	1,3	2,8	,0	2,3	3,6	2,1	1,9	2,0
-	20,5	9,9	11,7	,0	12,7	7,1	9,3	9,4	10,1
Somewhat prepared	36,4	34,2	41,3	40,6	45,7	35,7	38,6	34,0	38,1
-	29,5	32,2	35,2	32,8	35,3	42,9	37,9	37,7	34,9
Very well prepared	11,4	22,4	8,9	26,6	4,0	10,7	12,1	17,0	15,0
Respondents (N)	44	304	213	64	173	56	140	53	2815

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Problem solving; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	,0	1,3	,0	,0	,6	,0	,7	1,9	,7
-	2,3	5,9	6,2	1,6	1,7	7,1	7,2	9,6	5,4
Somewhat prepared	22,7	34,8	30,8	34,4	34,3	28,6	34,5	34,6	32,9
-	61,4	38,0	47,4	35,9	45,9	42,9	41,7	40,4	42,4
Very well prepared	13,6	20,0	15,6	28,1	17,4	21,4	15,8	13,5	18,5
Respondents (N)	44	305	211	64	172	56	139	52	2807

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Professionalism; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	,0	6,9	3,3	1,6	1,7	1,8	5,7	17,0	4,8
-	9,1	14,1	16,7	7,9	12,7	21,4	15,7	15,1	14,7
Somewhat prepared	29,5	41,1	38,1	33,3	38,7	46,4	42,9	41,5	40,1
-	40,9	26,6	31,9	44,4	33,5	19,6	28,6	24,5	29,5
Very well prepared	20,5	11,2	10,0	12,7	13,3	10,7	7,1	1,9	10,8
Respondents (N)	44	304	210	63	173	56	140	53	2806

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Science; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	,0	2,7	2,3	,0	2,3	3,6	,7	1,9	2,2
-	13,6	12,3	16,0	6,3	18,6	12,5	10,9	9,4	13,3
Somewhat prepared	52,3	45,0	53,1	46,0	42,4	46,4	58,4	22,6	47,2
-	27,3	29,7	23,0	38,1	30,8	30,4	28,5	41,5	29,4
Very well prepared	6,8	10,3	5,6	9,5	5,8	7,1	1,5	24,5	8,0
Respondents (N)	44	300	213	63	172	56	137	53	2791

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Societal context; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	2,3	13,2	4,8	6,3	9,3	7,1	6,5	22,6	9,5
-	15,9	24,4	28,6	12,5	26,7	21,4	35,5	30,2	25,7
Somewhat prepared	47,7	40,3	41,4	51,6	37,2	35,7	42,8	41,5	40,9
-	25,0	16,8	21,9	28,1	22,1	30,4	13,8	5,7	19,8
Very well prepared	9,1	5,3	3,3	1,6	4,7	5,4	1,4	,0	4,2
Respondents (N)	44	303	210	64	172	56	138	53	2798

Question G: Please rate how well prepared you are to incorporate each of the following items while practicing as an engineer; Teamwork; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Not at all prepared	,0	,7	,9	,0	,0	,0	,7	1,9	,6
-	,0	5,6	4,7	4,7	2,3	5,4	4,3	13,2	4,9
Somewhat prepared	13,6	24,9	21,7	31,3	16,3	19,6	22,9	34,0	22,8
-	34,1	36,7	37,7	37,5	44,2	33,9	50,7	35,8	39,1
Very well prepared	52,3	32,1	34,9	26,6	37,2	41,1	21,4	15,1	32,7
Respondents (N)	44	305	212	64	172	56	140	53	2814

Question H: How would you rate your abilities within the listed fields; Project management; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	46,5	28,2	29,1	23,4	32,0	25,9	29,5	15,4	28,7
Fairly good	46,5	51,5	59,2	64,1	54,7	69,0	54,7	50,0	55,7
Not very good	7,0	13,4	9,4	10,9	11,6	3,4	13,7	21,2	11,5
Poor	,0	2,6	0,5	,0	1,2	,0	2,2	1,9	1,5
Do not know	,0	4,3	1,9	1,6	,6	1,7	,0	11,5	2,6
Respondents (N)	43	305	213	64	172	58	139	52	2818

Question H: How would you rate your abilities within the listed fields; Rote learning; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	11,6	18,4	9,0	6,3	12,8	13,8	8,7	23,1	13,8
Fairly good	53,5	40,1	45,3	64,1	42,4	55,2	47,8	59,6	46,1
Not very good	30,2	29,3	34,0	20,3	36,0	27,6	34,8	9,6	30,3
Poor	4,7	11,5	9,9	3,1	8,1	3,4	8,7	7,7	8,9
Do not know	,0	,7	1,9	6,3	,6	,0	,0	,0	1,0
Respondents (N)	43	304	212	64	172	58	138	52	2811

Question H: How would you rate your abilities within the listed fields; Teamwork skills; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	65,9	53,6	52,8	42,2	51,7	63,8	47,1	36,5	52,6
Fairly good	29,5	41,8	44,8	46,9	42,4	34,5	49,3	61,5	43,1
Not very good	4,5	3,3	1,9	9,4	5,2	1,7	3,6	1,9	3,5
Poor	,0	,7	,0	1,6	,6	,0	,0	,0	,4
Do not know	,0	,7	0,5	,0	,0	,0	,0	,0	,3
Respondents (N)	44	304	212	64	172	58	138	52	2813

Question H: How would you rate your abilities within the listed fields; Individual written assignments; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	27,3	41,6	33,5	43,8	25,1	27,6	26,8	42,3	34,7
Fairly good	59,1	48,9	51,4	45,3	58,5	60,3	56,5	50,0	52,7
Not very good	11,4	8,2	11,8	6,3	12,9	12,1	13,8	3,8	10,3
Poor	2,3	1,0	2,8	4,7	1,8	,0	1,4	1,9	1,7
Do not know	,0	,3	0,5	,0	1,8	,0	1,4	1,9	,7
Respondents (N)	44	305	212	64	171	58	138	52	2814

Question H: How would you rate your abilities within the listed fields; Idea creation; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	59,1	33,0	33,5	39,1	38,0	41,4	34,5	5,8	35,0
Fairly good	36,4	54,8	52,8	50,0	45,0	48,3	50,4	53,8	51,1
Not very good	4,5	9,9	12,3	9,4	15,8	10,3	10,8	40,4	12,2
Poor	,0	1,0	,5	1,6	,6	,0	2,2	,0	,8
Do not know	,0	1,3	,9	,0	,6	,0	2,2	,0	1,0
Respondents (N)	44	303	212	64	171	58	139	52	2810

Question H: How would you rate your abilities within the listed fields; Organisational talent; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	18,2	26,9	27,8	25,4	25,0	27,6	24,5	30,8	26,3
Fairly good	56,8	49,5	46,7	44,4	52,9	62,1	54,0	48,1	51,0
Not very good	22,7	18,4	18,9	23,8	18,6	5,2	18,0	17,3	17,7
Poor	,0	1,0	2,4	4,8	1,2	1,7	1,4	1,9	1,6
Do not know	2,3	4,3	4,2	1,6	2,3	3,4	2,2	1,9	3,4
Respondents (N)	44	305	212	63	172	58	139	52	2816

Question H: How would you rate your abilities within the listed fields; Conflict management; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	34,1	26,9	27,1	14,1	24,4	29,3	29,5	23,1	26,5
Fairly good	50,0	50,5	52,3	57,8	57,0	53,4	54,0	40,4	52,3
Not very good	13,6	16,7	16,4	23,4	15,7	15,5	15,1	28,8	16,9
Poor	2,3	3,6	2,8	3,1	1,7	,0	,7	5,8	2,6
Do not know	,0	2,3	1,4	1,6	1,2	1,7	,7	1,9	1,6
Respondents (N)	44	305	214	64	172	58	139	52	2823

Question H: How would you rate your abilities within the listed fields; Laboratory experimenting; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	6,8	14,8	10,8	10,9	8,7	20,7	16,5	44,2	14,6
Fairly good	40,9	43,6	43,7	54,7	52,3	48,3	53,2	42,3	46,7
Not very good	38,6	25,6	27,2	26,6	21,5	22,4	25,9	13,5	25,2
Poor	13,6	7,2	8,0	3,1	9,9	6,9	2,2	,0	6,9
Do not know	,0	8,9	10,3	4,7	7,6	1,7	2,2	,0	6,7
Respondents (N)	44	305	213	64	172	58	139	52	2821

Question H: How would you rate your abilities within the listed fields; Oral communication; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	38,6	38,8	37,3	54,7	36,6	44,8	23,0	19,2	42,9
Fairly good	43,2	45,1	48,1	40,6	49,4	50,0	51,1	65,4	48,0
Not very good	15,9	14,5	12,3	1,6	12,2	5,2	22,3	15,4	7,8
Poor	2,3	1,0	1,4	3,1	1,2	,0	3,6	,0	,9
Do not know	,0	,7	,9	,0	,6	,0	,0	,0	,4
Respondents (N)	44	304	212	64	172	58	139	52	2818

Question H: How would you rate your abilities within the listed fields; Ability to work independently; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	40,9	43,4	46,0	29,7	36,8	31,0	35,3	48,1	34,6
Fairly good	52,3	48,7	44,1	50,0	54,4	56,9	46,8	46,2	49,0
Not very good	6,8	7,6	8,0	15,6	7,0	12,1	15,1	3,8	14,4
Poor	,0	,0	1,4	1,6	1,8	,0	1,4	1,9	1,3
Do not know	,0	,3	,5	3,1	,0	,0	1,4	,0	,7
Respondents (N)	44	304	213	64	171	58	139	52	2813

Question H: How would you rate your abilities within the listed fields; Written communication; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very good	40,9	40,1	40,8	38,1	35,1	32,8	30,9	37,3	37,7
Fairly good	52,3	52,0	47,9	49,2	52,6	51,7	57,6	51,0	51,8
Not very good	6,8	6,9	10,8	12,7	11,1	12,1	10,8	11,8	9,5
Poor	,0	,3	,0	,0	,6	3,4	,7	,0	,6
Do not know	,0	,7	,5	,0	,6	,0	,0	,0	,4
Respondents (N)	44	304	213	63	171	58	139	51	2811

Question I: Assess your progress within the following areas since you started your engineering programme; Responsible use of technology; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	10,0	9,2	7,8	21,7	13,3	25,9	9,6	15,7	11,9
Some progress	57,5	38,4	42,7	45,0	39,8	29,6	47,1	33,3	40,4
Minor progress	17,5	24,8	29,6	20,0	25,9	29,6	24,3	25,5	25,7
No progress	10,0	15,6	10,2	8,3	13,3	1,9	9,6	17,6	11,9
Do not know	5,0	11,9	9,7	5,0	7,8	13,0	9,6	7,8	10,0
Respondents (N)	40	294	206	60	166	54	136	51	2709

Question I: Assess your progress within the following areas since you started your engineering programme; Sustainability; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	7,5	7,5	7,3	13,3	10,2	20,0	6,6	11,8	9,3
Some progress	42,5	35,2	35,0	58,3	29,5	36,4	36,8	23,5	35,7
Minor progress	37,5	27,6	32,0	11,7	36,7	23,6	30,9	45,1	29,8
No progress	12,5	20,8	18,4	5,0	16,3	16,4	16,9	13,7	17,5
Do not know	,0	8,9	7,3	11,7	7,2	3,6	8,8	5,9	7,6
Respondents (N)	40	293	206	60	166	55	136	51	2710

Question I: Assess your progress within the following areas since you started your engineering programme; Understanding of the role of technology in society; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	17,5	22,8	15,6	36,7	10,8	29,1	14,7	21,6	20,1
Some progress	47,5	37,1	46,8	35,0	41,0	30,9	41,9	33,3	39,4
Minor progress	25,0	27,2	27,3	21,7	28,9	25,5	28,7	37,3	27,5
No progress	7,5	8,5	7,8	5,0	15,7	12,7	10,3	3,9	9,5
Do not know	2,5	4,4	2,4	1,7	3,6	1,8	4,4	3,9	3,5
Respondents (N)	40	294	205	60	166	55	136	51	2711

Question I: Assess your progress within the following areas since you started your engineering programme; Idea creation; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	45,0	16,9	20,0	27,1	28,3	31,5	11,0	3,9	20,7
Some progress	42,5	44,4	42,9	50,8	41,0	40,7	54,4	33,3	44,3
Minor progress	12,5	26,1	32,7	16,9	24,1	24,1	26,5	54,9	27,0
No progress	,0	7,5	2,4	1,7	4,2	1,9	2,2	3,9	4,3
Do not know	,0	5,1	2,0	3,4	2,4	1,9	5,9	3,9	3,7
Respondents (N)	40	295	205	59	166	54	136	51	2708

Question I: Assess your progress within the following areas since you started your engineering programme; Individual written assignments; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	12,5	16,3	12,1	27,1	13,2	14,5	8,0	13,7	14,4
Some progress	40,0	46,4	35,0	47,5	41,9	45,5	42,3	56,9	43,5
Minor progress	45,0	29,5	37,4	22,0	35,3	30,9	35,8	21,6	32,4
No progress	2,5	6,1	12,6	1,7	8,4	7,3	9,5	5,9	7,7
Do not know	,0	1,7	2,9	1,7	1,2	1,8	4,4	2,0	2,1
Respondents (N)	40	295	206	59	167	55	137	51	2719

Question I: Assess your progress within the following areas since you started your engineering programme; Career planning; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	15,0	15,6	5,3	25,0	12,7	20,0	5,8	5,9	12,8
Some progress	35,0	31,6	22,8	28,3	27,3	34,5	34,3	25,5	29,8
Minor progress	35,0	35,0	37,4	33,3	35,2	32,7	37,2	45,1	35,8
No progress	15,0	15,6	31,1	13,3	21,8	10,9	20,4	19,6	19,3
Do not know	,0	2,0	3,4	,0	3,0	1,8	2,2	3,9	2,3
Respondents (N)	40	294	206	60	165	55	137	51	2714

Question I: Assess your progress within the following areas since you started your engineering programme; Conflict management; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	27,5	4,8	15,2	13,3	11,5	9,1	6,6	3,9	9,3
Some progress	40,0	24,5	43,1	26,7	38,2	45,5	38,0	23,5	33,7
Minor progress	22,5	38,4	34,8	50,0	36,4	34,5	40,9	45,1	37,7
No progress	10,0	27,6	4,4	8,3	12,1	9,1	12,4	25,5	16,3
Do not know	,0	4,8	2,5	1,7	1,8	1,8	2,2	2,0	3,0
Respondents (N)	40	294	204	60	165	55	137	51	2709

Question I: Assess your progress within the following areas since you started your engineering programme; Laboratory experimenting; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	,0	13,6	8,8	11,7	7,8	16,4	12,4	58,8	13,2
Some progress	30,0	30,2	26,8	35,0	29,9	29,1	40,9	31,4	31,0
Minor progress	47,5	25,1	22,9	33,3	31,1	25,5	35,8	7,8	27,3
No progress	22,5	27,5	35,6	20,0	25,1	27,3	8,8	,0	24,8
Do not know	,0	3,7	5,9	,0	6,0	1,8	2,2	2,0	3,7
Respondents (N)	40	295	205	60	167	55	137	51	2719

Question I: Assess your progress within the following areas since you started your engineering programme; Environmental impact assessment; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	7,5	5,4	6,8	10,0	8,4	21,8	10,9	7,8	8,6
Some progress	20,0	21,0	22,3	33,3	22,8	30,9	32,1	19,6	24,2
Minor progress	40,0	29,2	39,3	31,7	35,9	18,2	32,8	37,3	32,1
No progress	30,0	39,3	27,2	20,0	28,1	27,3	18,2	29,4	30,5
Do not know	2,5	5,1	4,4	5,0	4,8	1,8	5,8	5,9	4,6
Respondents (N)	40	295	206	60	167	55	137	51	2721

Question I: Assess your progress within the following areas since you started your engineering programme; Oral communication; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	15,0	6,1	12,1	23,3	14,5	12,7	7,4	9,8	10,4
Some progress	47,5	38,3	47,1	41,7	41,6	50,9	40,4	41,2	42,3
Minor progress	32,5	38,6	33,5	33,3	36,1	30,9	40,4	39,2	36,4
No progress	5,0	14,6	5,3	1,7	6,6	3,6	9,6	7,8	9,0
Do not know	,0	2,4	1,9	,0	1,2	1,8	2,2	2,0	1,8
Respondents (N)	40	295	206	60	166	55	136	51	2717

Question I: Assess your progress within the following areas since you started your engineering programme; Organisational talent; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	10,0	5,1	11,2	11,7	10,4	12,7	6,6	3,9	8,2
Some progress	47,5	27,6	41,7	53,3	42,1	43,6	41,6	25,5	37,0
Minor progress	32,5	40,5	33,0	25,0	36,0	30,9	39,4	43,1	36,6
No progress	10,0	20,4	10,7	6,7	7,3	3,6	8,0	21,6	13,0
Do not know	,0	6,5	3,4	3,3	4,3	9,1	4,4	5,9	5,2
Respondents (N)	40	294	206	60	164	55	137	51	2711

Question I: Assess your progress within the following areas since you started your engineering programme; Problem identification; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	17,5	19,7	25,2	18,3	23,8	22,2	17,0	17,6	20,9
Some progress	55,0	50,3	52,4	55,0	47,6	51,9	58,5	35,3	51,2
Minor progress	27,5	19,0	18,0	23,3	24,4	22,2	20,0	33,3	21,0
No progress	,0	7,1	1,9	,0	3,7	,0	,7	9,8	3,9
Do not know	,0	3,7	2,4	3,3	,6	3,7	3,7	3,9	2,9
Respondents (N)	40	294	206	60	164	54	135	51	2703

Question I: Assess your progress within the following areas since you started your engineering programme; Project management; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	30,0	6,8	27,2	18,3	25,5	29,1	17,5	3,9	17,4
Some progress	42,5	36,9	50,0	50,0	46,1	47,3	51,8	27,5	43,6
Minor progress	22,5	35,3	18,9	26,7	21,8	14,5	25,5	35,3	26,7
No progress	5,0	14,9	1,9	1,7	5,5	7,3	4,4	29,4	9,0
Do not know	,0	6,1	1,9	3,3	1,2	1,8	,7	3,9	3,3
Respondents (N)	40	295	206	60	165	55	137	51	2717

Question I: Assess your progress within the following areas since you started your engineering programme; Teamwork skills; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	35,	17,7	38,3	38,3	30,9	40,0	29,9	11,8	28,0
Some progress	40,0	51,2	43,7	48,3	43,6	40,0	48,9	58,8	47,3
Minor progress	22,5	22,9	14,6	13,3	20,0	14,5	17,5	23,5	19,2
No progress	2,5	6,8	1,9	,0	4,8	1,8	2,9	3,9	4,2
Do not know	,0	1,4	1,5	,0	,6	3,6	,7	2,0	1,3
Respondents (N)	40	293	206	60	165	55	137	51	2710

Question I: Assess your progress within the following areas since you started your engineering programme; Self-reflexivity; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	35,0	21,4	21,8	30,0	27,1	23,6	14,0	9,8	22,1
Some progress	37,5	43,7	49,0	41,7	39,8	50,9	51,5	41,2	45,2
Minor progress	22,5	23,1	23,3	18,3	23,5	20,0	26,5	35,3	23,5
No progress	2,5	9,2	3,4	1,7	4,8	1,8	2,8	9,8	5,5
Do not know	2,5	2,7	2,4	8,3	4,8	3,6	5,9	3,9	3,7
Respondents (N)	40	295	206	60	166	55	136	51	2717

Question I: Assess your progress within the following areas since you started your engineering programme; Ability to work independently; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	17,9	22,4	10,2	30,5	16,3	21,8	6,6	19,6	17,7
Some progress	41,0	42,0	45,6	33,9	39,8	50,9	45,3	45,1	43,2
Minor progress	35,9	26,4	32,5	28,8	36,1	20,0	39,4	27,5	30,2
No progress	5,1	7,8	9,2	5,1	6,0	5,5	6,6	5,9	7,2
Do not know	,0	1,4	2,4	1,7	1,8	1,8	2,2	2,0	1,7
Respondents (N)	39	295	206	59	166	55	137	51	2714

Question I: Assess your progress within the following areas since you started your engineering programme; Written communication; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	5,0	14,6	19,0	25,0	16,3	9,1	6,6	15,7	14,5
Some progress	57,5	46,1	47,8	45,0	43,4	58,2	46,0	37,3	47,1
Minor progress	30,0	29,5	26,3	28,3	33,1	25,5	38,0	41,2	30,4
No progress	7,5	8,1	5,4	1,7	6,6	5,5	6,6	3,9	6,5
Do not know	,0	1,7	1,5	,0	,6	1,8	2,9	2,0	1,5
Respondents (N)	40	295	205	60	166	55	137	51	2717

Question I: Assess your progress within the following areas since you started your engineering programme; Social responsibility; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	17,5	10,5	17,0	16,7	15,7	14,5	15,3	9,8	13,8
Some progress	30,0	34,7	48,1	45,0	41,0	45,5	43,1	37,3	40,3
Minor progress	37,5	29,6	23,3	28,3	27,1	21,8	27,0	31,4	27,4
No progress	12,5	18,7	7,3	8,3	12,7	12,7	9,5	19,6	13,5
Do not know	2,5	6,5	4,4	1,7	3,6	5,5	5,1	2,0	4,9
Respondents (N)	40	294	206	60	166	55	137	51	2716

Question I: Assess your progress within the following areas since you started your engineering programme; Rote learning; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	2,5	7,8	5,8	8,3	3,6	5,6	2,2	17,6	6,3
Some progress	30,0	28,1	22,8	38,3	26,5	38,9	26,5	45,1	29,0
Minor progress	45,0	39,7	43,7	35,0	42,8	37,0	50,0	25,5	41,1
No progress	20,0	22,7	24,3	8,3	22,9	14,8	16,9	9,8	20,3
Do not know	2,5	1,7	3,4	10,0	4,2	3,7	4,4	2,0	3,3
Respondents (N)	40	295	206	60	166	54	136	51	2712

Question I: Assess your progress within the following areas since you started your engineering programme; Knowledge on energy minimization; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	12,5	13,6	10,2	13,3	9,6	18,2	12,4	11,8	12,6
Some progress	25,0	23,4	20,0	25,0	24,7	30,9	28,5	31,4	24,7
Minor progress	32,5	26,1	32,2	36,7	34,3	29,1	35,8	21,6	30,3
No progress	30,0	32,5	33,7	21,7	27,1	18,2	16,8	33,3	28,3
Do not know	,0	4,4	3,9	3,3	4,2	3,6	6,6	2,0	4,2
Respondents (N)	40	295	205	60	166	55	137	51	2717

Question I: Assess your progress within the following areas since you started your engineering programme; Knowledge of economics; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Major progress	12,5	4,1	2,0	16,7	13,2	20,0	1,5	9,8	7,2
Some progress	32,5	11,2	12,7	26,7	23,4	29,1	19,7	13,7	17,3
Minor progress	37,5	33,6	36,6	26,7	34,1	30,9	43,1	19,6	34,2
No progress	17,5	47,1	44,9	28,3	27,5	18,2	28,5	52,9	37,6
Do not know	,0	4,1	3,9	1,7	1,8	1,8	7,3	3,9	3,6
Respondents (N)	40	295	205	60	167	55	137	51	2719

Question J: Now there will be some statements that people have made about science, technology or the environment. For each statement, please tell me how much you agree or disagree; Thanks to scientific and technological advances, the Earth's natural resources will be inexhaustible; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Totally agree	20,5	8,2	8,8	14,8	5,5	9,1	9,5	3,9	8,8
Tend to agree	23,1	23,5	25,5	34,4	24,4	25,5	28,5	19,6	25,2
Neither agree nor disagree	12,8	16,7	11,3	21,3	15,9	16,4	16,8	15,7	15,7
Tend to disagree	23,1	25,9	28,9	14,8	26,8	21,8	19,7	31,4	25,0
Totally disagree	20,5	23,2	22,5	13,1	23,8	20,0	23,4	27,5	22,4
Do not know	,0	2,4	2,9	1,6	3,7	7,3	2,2	2,0	2,9
Respondents (N)	39	293	204	61	164	55	137	51	2703

Question J: Now there will be some statements that people have made about science, technology or the environment. For each statement, please tell me how much you agree or disagree; Science and technology can sort out any problem; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Totally agree	10,5	12,7	8,3	18,0	7,3	14,8	11,7	7,8	11,3
Tend to agree	34,2	33,3	33,3	41,0	32,3	29,6	36,5	23,5	33,3
Neither agree nor disagree	18,4	12,7	11,8	16,4	21,3	25,9	19,7	29,4	16,7
Tend to disagree	23,7	22,3	26,5	18,0	22,0	14,8	14,6	23,5	21,3
Totally disagree	13,2	17,9	18,6	6,6	15,2	9,3	16,1	15,7	15,8
Do not know	,0	1,0	1,5	,0	1,8	5,6	1,5	,0	1,5
Respondents (N)	38	291	204	61	164	54	137	51	2690

Question J: Now there will be some statements that people have made about science, technology or the environment. For each statement, please tell me how much you agree or disagree; Science and technology cannot really play a role in improving the environment; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Totally agree	2,6	2,7	1,5	4,9	4,2	3,7	2,2	,0	2,7
Tend to agree	,0	3,1	5,4	11,5	4,2	11,1	5,8	,0	4,9
Neither agree nor disagree	5,1	2,4	2,0	9,8	3,0	5,6	6,6	9,8	4,0
Tend to disagree	30,8	18,6	19,1	23,0	23,0	31,5	21,2	11,8	21,1
Totally disagree	61,5	72,5	70,1	50,8	64,2	42,6	63,5	78,4	66,0
Do not know	,0	,7	2,0	,0	1,2	5,6	,7	,0	1,3
Respondents (N)	39	291	204	61	165	54	137	51	2695

Question J: Now there will be some statements that people have made about science, technology or the environment. For each statement, please tell me how much you agree or disagree; The applications of science and technology can threaten human rights; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Totally agree	2,6	8,6	6,4	11,5	6,1	5,5	3,6	5,9	6,9
Tend to agree	25,6	24,0	25,5	27,9	18,9	12,7	19,7	15,7	22,0
Neither agree nor disagree	20,5	21,2	22,5	24,6	29,9	25,5	20,4	35,3	23,6
Tend to disagree	23,1	22,9	16,7	18,0	22,6	18,2	24,1	23,5	21,2
Totally disagree	25,6	19,9	21,6	8,2	15,9	30,9	24,8	19,6	20,7
Do not know	2,6	3,4	7,4	9,8	6,7	7,3	7,3	,0	5,5
Respondents (N)	39	292	204	61	164	55	137	51	2700

Question J: Now there will be some statements that people have made about science, technology or the environment. For each statement, please tell me how much you agree or disagree; New inventions will always be found to counteract any harmful effect of scientific and technological developments; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Totally agree	12,8	4,5	4,4	9,8	3,0	3,6	2,9	2,0	4,5
Tend to agree	35,9	25,3	27,5	27,9	23,0	32,7	30,7	23,5	27,1
Neither agree nor disagree	15,4	26,0	27,9	29,5	29,1	25,5	25,5	27,5	26,5
Tend to disagree	25,6	20,9	21,6	14,8	21,2	16,4	18,2	25,5	20,4
Totally disagree	5,1	14,4	8,3	6,6	9,7	7,3	13,9	13,7	11,2
Do not know	5,1	8,9	10,3	11,5	13,9	14,5	8,8	7,8	10,3
Respondents (N)	39	292	204	61	165	55	137	51	2702

Question J: Now there will be some statements that people have made about science, technology or the environment. For each statement, please tell me how much you agree or disagree; The benefits of science are greater than any harmful effects it may have; per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Totally agree	35,9	27,3	24,0	21,7	21,8	37,0	23,4	27,5	26,4
Tend to agree	28,2	31,4	26,5	26,7	33,3	16,7	36,5	35,3	29,8
Neither agree nor disagree	25,6	21,8	25,0	21,7	26,7	27,8	19,7	15,7	23,2
Tend to disagree	2,6	10,9	11,8	21,7	10,9	11,1	10,9	11,8	11,4
Totally disagree	5,1	5,1	6,9	5,0	2,4	1,9	4,4	5,9	4,7
Do not know	2,6	3,4	5,9	3,3	4,8	5,6	5,1	3,9	4,4
Respondents (N)	39	293	204	60	165	54	137	51	2699

Question K: And now, there will be a few questions on how you *engage* with science and technology. Do you watch or listen to media programmes about scientific or technologic issues? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	46,2	37,3	40,7	40,0	46,6	49,1	41,9	28,0	40,8
Yes, occasionally	46,2	48,3	47,1	46,7	43,6	41,5	48,5	64,0	47,3
No, hardly ever	7,7	10,3	9,3	11,7	8,6	3,8	7,4	6,0	8,8
No, never	,0	3,1	2,0	1,7	1,2	3,8	2,2	2,0	2,4
Do not know	,0	1,0	1,0	,0	,0	1,9	,0	,0	,7
Respondents (N)	39	292	204	60	163	53	136	50	2682

Question K: And now, there will be a few questions on how you *engage* with science and technology. Do you talk to friends or family about scientific or technologic issues? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	33,3	51,0	39,2	31,7	47,5	45,3	41,5	48,0	45,1
Yes, occasionally	53,8	42,1	47,5	56,7	39,4	43,4	50,4	42,0	45,0
No, hardly ever	12,8	6,2	9,8	11,7	11,3	5,7	7,4	10,0	8,3
No, never	,0	,3	2,5	,0	1,3	3,8	,7	,0	1,1
Do not know	,0	,3	1,0	,0	,6	1,9	,0	,0	,5
Respondents (N)	39	292	204	60	160	53	135	50	2674

Question K: And now, there will be a few questions on how you *engage* with science and technology. Do you attend public meetings or debates about science and technology? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	2,6	3,1	3,4	1,7	4,9	5,7	3,6	4,0	3,6
Yes, occasionally	20,5	14,4	11,8	25,0	14,7	22,6	16,8	8,0	15,5
No, hardly ever	53,8	44,2	41,7	51,7	47,9	30,2	46,0	36,0	43,6
No, never	23,1	38,0	42,2	21,7	32,5	39,6	33,6	52,0	36,8
Do not know	,0	,3	1,0	,0	,0	1,9	,0	,0	,5
Respondents (N)	39	292	204	60	163	53	137	50	2685

Question K: And now, there will be a few questions on how you *engage* with science and technology. Do you sign petitions or join street demonstrations on matters of nuclear power, biotechnology or the environment? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	,0	1,0	1,0	3,3	1,2	1,9	1,5	4,0	1,4
Yes, occasionally	13,2	7,6	8,3	11,7	11,0	9,4	8,8	10,0	9,0
No, hardly ever	18,4	23,4	16,7	20,0	19,0	20,8	17,5	16,0	20,1
No, never	68,4	65,6	70,1	63,3	67,5	66,0	70,8	66,0	67,3
Do not know	,0	2,4	3,9	1,7	1,2	1,9	1,5	4,0	2,3
Respondents (N)	38	291	204	60	163	53	137	50	2679

Question K: And now, there will be a few questions on how you *engage* with science and technology. Do you donate money to fundraising campaigns for medical research such as research into cancer? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	5,1	5,8	4,4	5,0	6,1	9,4	3,7	8,0	5,7
Yes, occasionally	33,3	27,7	25,1	20,0	29,4	24,5	25,0	34,0	26,9
No, hardly ever	25,6	24,3	26,1	30,0	26,4	24,5	32,,4	30,0	26,4
No, never	35,9	40,8	43,3	43,3	35,6	39,6	38,2	28,0	39,6
Do not know	,0	1,4	1,0	1,7	2,5	1,9	,7	,0	1,3
Respondents (N)	39	292	203	60	163	53	136	50	2680

Question K: And now, there will be a few questions on how you *engage* with science and technology. Do you participate in the activities of a non-governmental organisation dealing with science and technology related issues? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, regularly	2,6	2,1	2,5	1,7	6,1	7,5	2,2	4,0	3,2
Yes, occasionally	20,5	22,7	14,2	11,9	16,6	15,1	14,6	18,0	17,9
No, hardly ever	38,5	28,9	23,5	37,3	20,9	24,5	26,3	26,0	26,9
No, never	38,5	42,3	55,4	47,5	49,1	49,1	51,8	44,0	47,4
Do not know	,0	4,1	4,4	1,7	7,4	3,8	5,1	8,0	4,6
Respondents (N)	39	291	204	59	163	53	137	50	2679

Question L: Prioritise how important the issues below are to you using the numbers from 1-5. Please write 1 at the issue that you find most important, 2 at the second-most important issue, etc; per cent

Respondents assessing issue as **most important**	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
To prevent pollution	7,7	14,1	9,0	23,7	18,3	14,8	6,6	9,8	13,1
To ensure resources for future generations	33,3	37,6	34,3	33,9	34,8	29,6	44,1	41,2	36,5
To generate economic growth in Denmark	30,8	13,4	20,9	10,2	19,5	20,4	16,9	11,8	17,0
To combat global climate changes	17,9	20,3	20,9	15,3	15,2	22,2	12,5	11,8	18,3
To improve living conditions of people in developing countries	10,3	14,5	14,9	16,9	12,2	22,2	19,1	25,5	15,9
Respondents (N)	39	290	201	59	164	54	136	51	2675

Question L: Prioritise how important the issues below are to you using the numbers from 1-5. Please write 1 at the issue that you find most important, 2 at the second-most important issue, etc; per cent

Respondents assessing issue as **least important**	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
To prevent pollution	17,9	9,7	9,5	6,8	10,4	9,3	14,0	11,8	10,4
To ensure resources for future generations	5,1	3,1	5,5	10,2	5,5	14,8	5,9	3,9	5,7
To generate economic growth in Denmark	30,8	41,4	36,3	61,0	37,2	29,6	30,9	47,1	38,6
To combat global climate changes	12,8	14,8	15,4	6,8	17,1	16,7	18,4	15,7	15,3
To improve living conditions of people in developing countries	33,3	31,0	33,3	15,3	29,9	25,9	30,1	21,6	29,6
Respondents (N)	39	290	201	59	164	54	136	51	2675

Question L: Prioritise how important the issues below are to you using the numbers from 1-5. Please write 1 at the issue that you find most important, 2 at the second-most important issue, etc; per cent

Mean (Average score when most important is coded as 1, second-most important as 2, etc.)	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
To prevent pollution	3,13	2,97	3,03	2,61	2,91	2,85	3,17	2,96	2,97
To ensure resources for future generations	2,21	2,21	2,30	2,36	2,20	2,69	2,10	2,29	2,26
To generate economic growth in Denmark	3,00	3,59	3,30	4,05	3,40	3,37	3,33	3,67	3,47
To combat global climate changes	3,05	2,90	2,89	2,93	3,03	2,91	3,10	3,16	2,96
To improve living conditions of people in developing countries	3,62	3,33	3,48	3,05	3,46	2,89	3,26	2,92	3,30
Respondents (N)	39	290	201	59	164	54	136	51	2675

Question M: Prioritise between the statements below on the role of engineers in society. Please write 1 at the statement that you find most important, 2 at the second-most important statement and 3 at the third most important; per cent

Respondents assessing issue as **most important**	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Engineers should contribute to solving problems related to climate change and environmental degradation	30,8	34,5	37,4	46,6	31,7	34,6	40,7	31,4	35,7
Engineers should contribute to ensuring that technological development is utilised in a fair and responsible way	25,6	28,6	27,6	36,2	32,9	36,5	28,9	29,4	30,0
Engineers should contribute to creating an overview of complex interrelations between different scientific and technical fields	43,6	36,9	35,0	17,2	35,4	28,8	30,4	39,2	34,2
Respondents (N)	39	290	203	58	164	52	135	51	2666

Question M: Prioritise between the statements below on the role of engineers in society. Please write 1 at the statement that you find most important, 2 at the second-most important statement and 3 at the third most important; per cent

Respondents assessing issue as **least important**	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Engineers should contribute to solving problems related to climate change and environmental degradation	41,0	37,6	37,9	31,0	38,4	32,7	31,1	27,5	36,0
Engineers should contribute to ensuring that technological development is utilised in a fair and responsible way	38,5	31,4	24,6	29,3	26,8	32,7	36,3	31,4	30,4
Engineers should contribute to creating an overview of complex interrelations between different scientific and technical fields	20,5	31,0	37,4	39,7	34,8	34,6	32,6	41,2	33,6
Respondents (N)	39	290	203	58	164	52	135	51	2666

Question N: What is sustainability about in your opinion? Please indicate the items listed below that you find related to the concept of sustainability

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Ethics	51,3	42,5	40,7	35,6	43,3	46,2	40,0	42,0	42,1
Global context	76,9	68,2	60,8	52,5	65,9	69,2	63,0	64,0	65,2
Law	5,1	6,5	5,9	15,3	7,3	15,4	7,4	8,0	7,8
Technological context	59,0	47,3	57,4	37,3	43,9	63,5	45,9	38,0	49,2
Natural context	92,3	88,4	85,3	69,5	81,1	76,9	90,4	88,0	85,0
Life-long learning	17,9	17,8	21,6	42,4	28,0	25,0	18,5	18,0	21,8
Politics	23,1	26,4	23,5	15,3	25,0	21,2	18,5	24,0	23,5
Societal context	38,5	45,5	52,9	28,8	48,2	44,2	40,7	40,0	45,1
Social responsibility	56,4	58,9	42,6	57,6	48,8	48,1	54,1	60,0	52,9
Economic context	48,7	57,5	59,8	35,6	51,8	51,9	59,3	52,0	55,1
Respondents (N)	39	292	204	59	164	52	135	50	2683
Average number of answers	4,69	4,59	4,50	3,90	4,43	4,62	4,38	4,34	4,47

Question O: To what extent do you regard your educational institution an organisation with a focus on sustainability? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Very much	25,6	38,4	27,5	30,5	12,8	19,2	17,0	13,7	27,1
To some extent	48,7	43,2	46,6	45,8	56,7	57,7	57,8	45,1	48,9
To a minor extent	23,1	9,2	11,8	11,9	18,9	9,6	12,6	27,5	12,7
Not at all	,0	1,4	4,4	3,4	4,9	5,8	3,0	3,9	3,1
Do not know	2,6	7,9	9,8	8,5	6,7	7,7	9,6	9,8	8,2
Respondents (N)	39	292	204	59	164	52	135	51	2678

The following questions were asked to respondents with no previous participation in survey round 1 only.

Question P: What is your educational background? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Primary or lower secondary school	,0	,0	,0	,0	,0	,0	,0	,0	0
Upper secondary school or high school	60,0	72,2	44,7	73,3	52,6	33,3	68,2	95,7	63,2
Business, commercial or technical college	20,0	21,3	47,4	20,0	47,4	38,1	27,3	4,3	28,4
Other	20,0	6,5	7,9	6,7	,0	28,6	4,5	,0	8,3
Respondents (N)	5	108	38	15	38	21	22	23	767

Question Q: How many people aged 15 years or more live in your household, yourself included? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
1	40,0	49,1	59,5	20,0	55,3	22,7	33,3	29,2	43,8
2	40,0	22,2	27,0	26,7	13,2	45,5	33,3	45,8	27,4
3	,0	12,0	5,4	26,7	7,9	18,2	19,0	8,3	12,3
4	20,0	5,6	5,4	13,3	18,4	9,1	4,8	4,2	7,8
5	,0	4,6	2,7	6,7	,0	4,5	4,8	,0	3,6
6	,0	,9	,0	6,7	5,3	,0	4,8	4,2	1,9
12	,0	,9	,0	,0	,0	,0	,0	,0	,4
14	,0	,9	,0	,0	,0	,0	,0	,0	,4
17	,0	,9	,0	,0	,0	,0	,0	,0	,4
20	,0	,0	,0	,0	,0	,0	,0	4,2	,3
103	,0	,0	,0	,0	,0	,0	,0	4,2	,3
200	,0	,9	,0	,0	,0	,0,	,0	,0	,4
270	,0	,9	,0	,0	,0	,0	,0	,0	,4
1000	,0	,9	,0	,0	,0	,0	,0	,0	,4
Respondents (N)	5	108	37	15	38	22	21	24	769

Question R: How many children aged 0 to 14 years old or more live in your household? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
0	60,0	89,6	86,5	86,7	88,2	85,0	90,5	95,8	88,4
0,5	,0	,0	2,7	,0	,0	,0	,0	,0	,3
1	20,0	6,6	10,8	13,3	11,8	10,0	,0	4,2	8,0
2	20,0	2,8	,0	,0	,0	5,0	4,8	,0	2,6
3	,0	,9	,0	,0	,0	,0	4,8	,0	,7
Respondents (N)	5	106	37	15	34	20	21	24	745

Question S: Please indicate the highest level of education completed by your mother; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Elementary school (primary and lower secondary school)	,0	9,6	2,6	14,3	13,2	27,3	4,5	12,5	11,4
Upper secondary school or high school	,0	7,7	7,9	,0	13,2	9,1	4,5	4,2	7,6
Business, commercial or technical college	,0	1,0	13,2	14,3	5,3	,0	13,6	8,3	4,6
Vocational training (e.g. builder, carpenter, electrician or corresponding level)	20,0	8,7	26,3	7,1	10,5	13,6	4,5	8,3	11,4
Short term further education (e.g. real estate agent, information technologist, police officer or corresponding level)	20,0	12,5	13,2	,0	7,9	18,2	22,7	20,8	13,6
Medium lenght higher education (e.g. BSc, BA degree, nurse, school teacher or corresponding level)	60,0	31,7	23,7	28,6	21,1	22,7	36,4	29,2	28,9
Masters level degree (MSc, MA degree or similar)	,0	23,1	10,5	14,3	15,8	4,5	13,6	12,5	16,4
PhD level degree (postgraduate or graduate degree programme)	,0	1,9	0,0	7,1	,0	,0	,0	,0	1,2
Other	,0	3,8	2,6	14,3	13,2	4,5	,0	4,2	5,0
Respondents (N)	5	104	38	14	38	22	22	24	758

Question T: Please indicate the highest level of education completed by your father; Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Elementary school (primary and lower secondary school)	,0	10,5	13,2	,0	13,2	13,6	,0	8,3	10,0
Upper secondary school or high school	,0	3,8	7,9	14,3	2,6	13,6	,0	,0	5,3
Business, commercial or technical college	20,0	,0	5,3	21,4	2,6	,0	9,1	,0	2,8
Vocational training (e.g. builder, carpenter, electrician or corresponding level)	20,0	18,1	36,8	14,3	26,3	31,8	40,9	29,2	25,0
Short term further education (e.g. real estate agent, information technologist, police officer or corresponding level)	20,0	5,7	10,5	14,3	5,3	18,2	9,1	8,3	8,8
Medium lenght higher education (e.g. BSc, BA degree, nurse, school teacher or corresponding level)	20,0	11,4	15,8	21,4	18,4	13,6	22,7	8,3	14,1
Masters level degree (MSc, MA degree or similar)	20,0	41,9	7,9	,0	23,7	4,5	18,2	33,3	26,9
PhD level degree (postgraduate or graduate degree programme)	,0	5,7	0,0	7,1	2,6	,0	,0	8,3	3,8
Other	,0	2,9	2,6	7,1	5,3	4,5	,0	4,2	3,4
Respondents (N)	5	105	38	14	38	22	22	24	761

Question U: Does/Did any of your family have a job or a university qualification in natural science, technology or engineering (for instance, physics, chemistry, biology, medicine)? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes, your father	20,0	32,7	10,5	13,3	28,9	4,5	27,3	26,1	24,2
Yes, your mother	20,0	20,6	7,9	26,7	15,8	,0	9,1	8,7	14,8
Yes, another member of your family	40,0	39,3	36,8	13,3	26,3	45,5	36,4	13,0	35,4
Total, yes	80,0	65,4	52,6	40,0	52,6	45,5	63,6	34,8	57,0
No, no one in your family	20,0	34,6	47,4	60,0	47,4	54,5	36,4	65,2	43,0
Respondents (N)	5	107	38	15	38	22	22	23	772

Sum of yes-answers is higher than ”Total, yes” indicates due to possibility of more than one positive answer when more family members with job or education within the field specified.

Question V: Do any of your immediate family members hold an engineering degree? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
No	80,0	50,5	65,8	80,0	57,9	54,5	63,6	66,7	57,3
Yes	20,0	49,5	34,2	20,0	42,1	45,5	36,4	33,3	42,7
Father or stepfather	,0	20,8	7,9	13,3	15,8	9,1	18,2	12,5	15,8
Mother or stepmother	,0	3,8	2,6	13,3	7,9	,0	,0	4,2	3,8
Brother or stepbrother	,0	6,6	13,2	13,3	2,6	13,6	9,1	8,3	8,3
Sister or stepsister	,0	4,7	5,3	6,7	,0	4,5	4,5	4,2	4,3
Other	20,0	25,5	13,2	,0	23,7	22,7	9,1	16,7	20,6
Respondents (N)	5	106*	38	15	38	22	22	24	771

Sum of yes-answers is higher than total ”Yes” indicates due to possibility of more than one positive answer when more family members hold an engineering degree.
* In the case of DTU N is 107 for the main yes/no answer.

Question X: Do you hold a Danish citizenship? Per cent

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Yes	100,0	94,4	97,4	26,7	94,7	68,2	100,0	91,7	88,6
No	,0	5,6	2,6	73,3	5,3	31,8	,0	8,3	11,4
Respondents (N)	5	108	38	15	38	22	22	24	774

Question Xa: In which geographical area are you a citizen? Per cent
(only asked to those answering "No" to previous question)

	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Weighted total
Nordic countries	,0	80,0	100,0	9,1	,0	,0	,0	,0	21,2
(Other) Europe	,0	20,0	,0	72,7	50,0	42,9	,0	50,0	47,3
US	,0	,0	,0	,0	,0	,0	,0	,0	0
(Other) North or Central America	,0	,0	,0	,0	,0	,0	,0	,0	0
South America	,0	,0	,0	9,1	,0	,0	,0	50,0	5,3
Asia	,0	,0	,0	9,1	,0	57,1	,0	,0	23,7
Africa	,0	,0	,0	,0	50,0	,0	,0	,0	2,6
Australia or Oceania	,0	,0	,0	,0	,0	,0	,0	,0	0
Respondents (N)	0	5	1	11	2	7	0	2	85

Appendix 11. Analysis of importance development

Importance of skills for successful engineering. Comparison of 2011 level with 2010 level

On an aggregate level, the importance of Interpersonal and Professional Skills neither increases nor decreases during the freshman year. This holds for the entire year group in total as for the year group split into groups based on their initial importance estimates of the two types of skills (see Chapter 4). All groupings, however, seem to downscale their estimate of how important Math/Science Skills are to successful engineering during the freshman year.

Table 1. Aggregate level development between 2010 and 2011, split in importance groupings and total, weighted data.

		IPP importance (6 items)		M/S importance (3 items)	
Index from 0-100		2010	2011	2010	2011
Double	Mean	73.2	73.6	91.9	89.5
	SEM	0.4	0.4	0.3	0.4
	N	882	762	882	762
IPP	Mean	71.1	69.8	64	59.5
	SEM	0.3	0.3	0.4	0.5
	N	744	652	744	652
M/S	Mean	47.9	48.1	90.2	88.2
	SEM	0.4	0.4	0.3	0.4
	N	743	650	743	650
Not	Mean	47.1	46.7	62.9	57.8
	SEM	0.3	0.4	0.4	0.5
	N	889	761	889	761
	Mean	59.9	59.5	77	73.4
	SEM	0.3	0.3	0.3	0.4
Total	N	3305	2864	3436	2967
Cronbach's alpha		0.75	0.73	0.75	0.78

Weighted, total responses.
The response options were of a Likert 4 point scale type ranging from not important to crucial and supplemented with a "Do not know" option that is treated as missing data. The four response options not important, somewhat important, very important, and crucial were given numerical values with equal range.

It seems the engineering students come to perceive math/science skills as somewhat less important for successful engineering after their first academic year than they initially thought. In total there is no change in the perceived level of importance of IPP skills. Underneath this overall finding there is a large variation in the importance perception development of the four groups. When focusing solely on the individual members of the population who answer both questionnaires, a tendency that nuances the general picture can be found.

Table 2. Development between 2010 and 2011 of respondents asking both times, split in importance groupings and total, unweighted data

		IPP importance		M/S importance	
Index from 0-100		2010	2011	2010	2011
Double	Mean	73.2	67.6	91.8	81.6
	SEM	0.7	0.9	0.7	1.1
	N	197	182	197	190
IPP	Mean	70.8	66.0	63.1	64.0
	SEM	0.7	1.0	1.0	1.4
	N	173	160	173	166
M/S	Mean	48.8	54.4	90.4	80.6
	SEM	0.7	1.2	0.7	1.3
	N	181	174	181	177
Not	Mean	47.4	51.9	61.9	65.7
	SEM	0.7	1.0	0.9	1.2
	N	201	179	201	187
	Mean	59.9	59.8	76.9	73.6
	SEM	0.6	0.6	0.6	0.7
Total	N	762	751	785	779
Cronbach's alpha		0,75	0,71	0,77	0.77
Unweighted. only individuals answering both in 2010 and 2011					

The exclusion of respondents that answer at only one of the questions allows for a tracking of individuals' over-time development. The students that were initially identified as unimpressed seem to become much more convinced of the importance of both math/science skills and IPP skills after a year's studies. This group increases its math/science importance score with 4 percentage points. The development in these students' perceived importance of interpersonal and professional skills is even higher. They go from 47-52 on the 100 point scale.

The overall maintenance of the initial level of perceived importance of interpersonal and professional skills covers a tendency for the groups with the highest initial levels (the IPP focused group and the double focused group) declining in their average levels, whereas both the unimpressed and the math/science focused group tend to experience IPP skills as more important than they did on average in their first month as engineering students.

The not impressed group increases its average level of perceived importance of IPP with 4.4 points on a 0-100 point scale. The math/science focused group equally experiences an average increase in estimated importance level of IPP skills with 4.7 points. On the other hand, the IPP focused group and the double focused group both generally downgrade their estimate of the importance of IPP skills to becoming a succesfull engineer (with 5.2 and 6.2 points respectively).

It is solely the math/science focused and the double focused groups that are responsible for the decrease in importance level of math/science skills (a 10.0 and 9.9 points reduction on a 100 point scale respectively). The IPP focused group thinks of math/science skills as neither more nor less important for becoming a successful engineer in comparison to what they initially felt. The group of not impressed students that were below median in their estimates of the importance of both two types of skills has come to consider math/science skills as 4.0 points more important than their initial mean score.

In sum, engineering students do not become more double focused across time. Contrarily, the mean perceived importance scores for all the students decrease or stay the same. The four groups do not show the same over time development, though. The groups that were initially above median in IPP importance estimate have downgraded their importance estimate of this skill type, whereas the groups that were initially below median level in their estimate of the importance of IPP skills for engineering now find this kind of skills more important. In the same way the groups with a starting point above median in their estimate of the importance of math/science skills in engineering have come to think that these skills are much less crucial to the profession. And the students with the lowest estimates of the importance of math/science skills in engineering are in average either at the same level or they find math/science skills more important after the first year. Although differences in actual importance estimates are still clear between the four groups, we see that an alignment of the groups may have begun. This could indicate that the engineering students are beginning to become socialized into the norms and perceptions prevailing in the professional field they are in a process of getting into[1].

When median level estimates of the engineering student importance assessment are based on the total answers in 2010 added to the total answers in 2011 a baseline for assessing the development of the entire year group

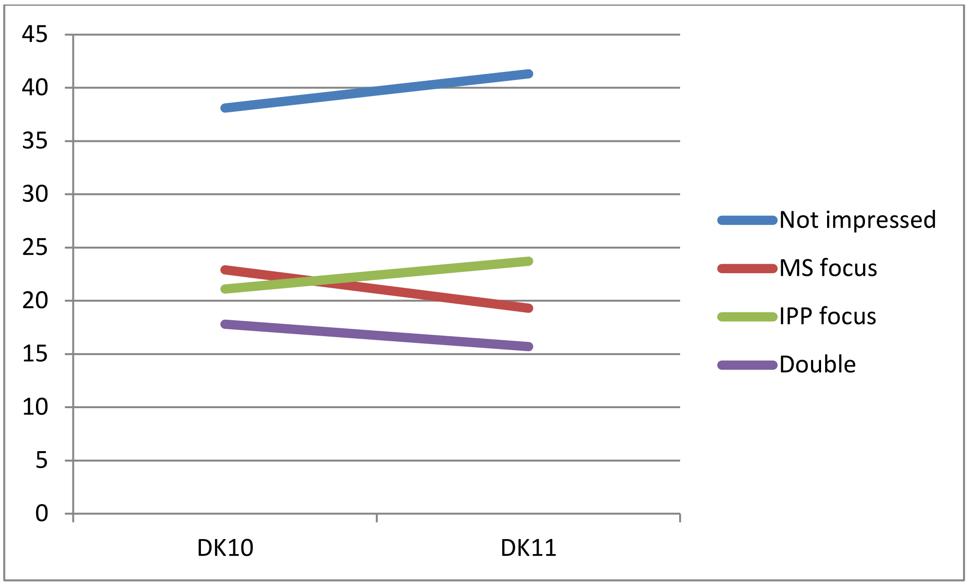
Table 3. Share of students at each year group on the basis of above/below median level estimates that take into consideration the medians of 2010 and 2011 in sum

	Percentages	DK10	DK11
	Not impressed	38,1	41,3
	MS focus	22,9	19,3
	IPP focus	21,1	23,7
	Double focus	17,8	15,7
	N	1514	1049

Or shown graphically:

[1] See also Atman et al 2008 for more on the role of discipline-specific discourse learning among engineering students.

Figure 1.Share of students belonging in each importance group in 2010 and 2011 on the basis of above/below median level estimates that take into consideration the medians of 2010 and 2011 in sum



Double focused students form a smaller share of the engineering students from beginning to the end of the first year. This group tends to downgrade their perceptions of the importance of both interpersonal and professional skills and math/science skills. Along with the unimpressed students, the double focused engineering students are overrepresented among the drop-outs.

Appendix 12. Dropout Analysis

520 of the initial 3630 members of the population are not part of the 2011-population.

This gives a dropout rate of 14%. Of the total group of 1682 responding members of the population the dropout rate is 8%.

Whereas the female share of the entire population is 23.8%, the female share of the dropouts is 24.2%.

Institutional distribution of dropouts

Percentages	AU-HIH	DTU	AAU	VIA	SDU	IHK	IHA	AU	Total
Share of population	3.2	33.9	16.8	8.4	12.3	9.7	11.6	4.2	100 (3630)
Share of dropouts	2.6	9.2	10.2	43.8	11.0	18.2	14.7	21.7	14.3 (520)
Share of previously responding dropouts	1.3	4.1	6.1	9.0	7.8	13.7	12.4	22.4	7.8 (131)

Out of the 3630 people that enrolled in a Danish engineering education 14% (N=520) appear to have left it before the end of the academic year. This rather high amount of drop-outs should not necessarily give rise to alarm, since some of the people behind this figure may have been applicants for a higher education with an engineering degree as one among other priorities when they applied, and if they chose another education, and the education institutions did not register this fast enough, they would still occur in the data.

Out of the 1682 people that did answered to the first survey the dropout rate was just 7.8% (N=131).

The fact that this group answered the first survey before they decided to leave their engineering programme makes it possible to examine them further.

A Chi-Square Goodness of fit test shows that the distribution of respondents in importance groups is statistically significant different from average among the students who drop out. Among them, the two extreme groups in relation to perceived importance of math/science skills and interpersonal and professional skills were overrepresented, and the two specialised groups conversely underrepresented in comparison to among average respondents.

Distribution of dropouts on importance groupings

Percentages	Double focus	IPP focus	M/S focus	Not impressed	Total
Share in responding population (weighted)	27	23	23	27	100 (3258)
Share of responding dropouts (unweighted	30	18	19	33	100 (110)
Dropout rate of importance group	8.1	5.5	6.3	8.7	7.1 (110)

In comparison to the drop-out rates of the m/s focused respondents and of the IPP focused both at 6%, the unimpressed group of newly enrolled engineering students had a drop-out rate of 9% over just seven months, which lower confidence levels and lower ratings of different sources of motivations to study engineering could be one explanation to which parallels previous findings in the Academic Pathways framework that high psychological motivation and high interpersonal and professional confidence are precursors of retention in engineering (Otto et al 2010, Eris et al 2010, Atman et al 2010). In spite of higher than average levels of both confidence and motivation, the drop-out rates of double focused engineering students were also higher than average (8%).

DANISH CENTRE FOR STUDIES IN RESEARCH AND RESEARCH POLICY (CFA)
PART OF SCHOOL OF BUSINESS AND SOCIAL SCIENCES

THE WINNER OF DKK 10 000 IS FOUND

Rikke Hansen was randomly selected among the many newly enrolled engineering students who answered the survey they received in September.

The responses provided by the engineering students give valuable information about the qualifications and expectations of newly enrolled engineering students. This information will provide a crucial basis for further improvement of Danish engineering degree programmes.

The Danish Centre for Studies in Research and Research Policy is engaged in research on engineering education and forms part of a large research project, PROCEED involving researchers from all over Denmark.

Rikke Hansen studies at the Technical University of Denmark (DTU) and wants to become a civil engineer.

DANSK CENTER FOR FORSKNINGSANALYSE (CFA)
PART OF SCHOOL OF BUSINESS AND SOCIAL SCIENCES

VINDEREN AF 10.000 KRONER ER FUNDET

Rikke Hansen blev den heldige vinder af 10.000 kroner. Hendes navn er trukket tilfældigt ud blandt de mange ingeniørstuderende, som havde svaret på spørgsmålene i den spørgeskemaundersøgelse, som i september måned blev sendt ud til alle Danmarks nyoptagne ingeniørstuderende.

De mange besvarelser giver en indsigt i de ingeniørstuderendes forudsætninger og forhåbninger i starten af deres uddannelsesforløb. Det er viden, som skal komme de ingeniørfaglige uddannelsesmiljøer til gavn og bidrage til, at de kan gøre danske ingeniøruddannelser endnu bedre.

CFA's arbejde med ingeniøruddannelse indgår i forskningsprojektet PROCEED, som foregår i et samarbejde mellem forskere fra hele landet. PROCEED er finansieret af Det Strategiske Forskningsråd og kører frem til 2013.

Rikke Hansen læser til civilingeniør i byggeteknologi på DTU.

DANISH CENTRE FOR STUDIES IN RESEARCH AND RESEARCH POLICY (CFA)
PART OF SCHOOL OF BUSINESS AND SOCIAL SCIENCES

You are here: AU » About Aarhus University » Department of Political Science and Government » Research » Research centres and units » The Danish Centre for Studies in Research and Research Policy » News » News archive » **Ten engineering students win 1000 DKK each**

TEN ENGINEERING STUDENTS WIN 1000 DKK EACH

Ten winners were randomly selected among the many engineering students in the year group from 2010 on all Danish engineering educations who answered the survey they received in May.

The responses provided by the engineering students give valuable information about the educational expectations and development of engineering students. This information will provide a crucial basis for further improvement of Danish engineering degree programmes.

The Danish Centre for Studies in Research and Research Policy is engaged in research on engineering education and forms part of a large research project, PROCEED involving researchers from all over Denmark.

The ten winners come from Engineering College of Aarhus, University of Southern Denmark, Aalborg University, Technical University of Denmark, and VIA University College.









The pictures show from the top in reading direction:
Jonas Schøler Holmriis, studying at Engineering College of Aarhus;
Nikolai Hedegaard Kristensen from Aalborg University;
Alex Juhl Burchall and Morten Hjort Løvendahl Nielsen, both studying at University of Southern Denmark;
Lærke Cecilie Bjerre from Technical University of Denmark;
Marian Vrtik studying at VIA University College;
Fabio Luis Branco Faravola studying at Aalborg University;
Cecilie Dehnfeld Nørgaard and Martin Kisha Kræmer both from Technical University of Denmark.
The last winner (no picture) studies at University of Southern Denmark.

DANSK CENTER FOR FORSKNINGSANALYSE (CFA)
PART OF SCHOOL OF BUSINESS AND SOCIAL SCIENCES

TI INGENIØRSTUDERENDE VINDER 1000 KRONER

Ti vindere er trukket tilfældigt ud blandt de mange, som har svaret på den spørgeskemaundersøgelse, som i maj måned blev sendt ud til alle Danmarks ingeniørstuderende årgang 2010.

De mange besvarelser giver en indsigt i ingeniørstuderendes uddannelsesforløb. Det er viden, som skal komme de ingeniørfaglige uddannelsesmiljøer til gavn og være med til, at danske ingeniøruddannelser kan gøres endnu bedre.

CFA's arbejde med ingeniøruddannelse indgår i forskningsprojektet PROCEED, som foregår i et samarbejde mellem forskere fra hele landet. PROCEED er finansieret af Det Strategiske Forskningsråd og kører frem til 2013.

De ti vindere er fra Ingeniørhøjskolen i Aarhus, Syddansk Universitet, Aalborg Universitet, Danmarks Tekniske Universitet og VIA University College.









Billederne viser i rækkefølge fra oven mod højre:
Jonas Schøler Holmriis, der til daglig læser til diplomingeniør i Bygningsdesign på Ingeniørhøjskolen i Aarhus;
Nikolai Hedegaard Kristensen fra Maskin og Produktion på Aalborg Universitet;
Alex Juhl Burchall, der læser til Kemiingeniør på Syddansk Universitet;
Morten Hjort Løvendahl Nielsen, der læser til diplomingeniør i Kemiteknik, også på Syddansk Universitet;
Lærke Cecilie Bjerre, der læser til diplomingeniør i Bygningsdesign på Danmarks Tekniske Universitet;
Marian Vrtik, der læser IT engineer på VIA University College;
Fabio Luis Branco Faravola fra IT, Kommunikation og Medieteknologi på Aalborg Universitet;
Cecilie Dehnfeld Nørgaard fra Teknisk Biomedicin (tidligere Sundhed og Produktion) på Danmarks Tekniske Universitet;
Martin Kisha Kræmer, der læser Kemi og teknologi også på Danmarks Tekniske Universitet.
Den tiende vinder er ingeniørstuderende på Syddansk Universitet.

Co-author Statement

I hereby declare that I am aware that the work in the paper/manuscript:

> Haase, S.; Chen, H.L.; Sheppard, S.D.; Kolmos, A. and Mejlgaard, N. (2013): What Does it Take to Become a Good Engineer? Identifying Cross-National Engineering Student Profiles According to Perceived Importance of Skills, in *International Journal of Engineering Education*, Vol. 29, Nr. 3, 2013, pp. 698-713.

of which I am a co-author, will form part of the PhD dissertation by PhD fellow Sanne Haase (0108792566), Aarhus University

who made a

- ✓ major
- proportional
- minor

contribution to the work in the research phase

who made a

- ✓ major
- proportional
- minor

contribution to the work in the writing phase.

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Date: 29 August 2013

Signature: Helen L. Chen

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- ✓ major
- proportional
- minor

contribution to the work in the writing phase.

Name: ____Sheri Sheppard______________________________

Date: ____Sept. 4, 2013______________________________

Signature: ______________________________

Sheri Sheppard

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✓ major
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contribution to the work in the research phase

who made a

✓ major
proportional
minor

contribution to the work in the writing phase.

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Date: 2-10-13

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- proportional
- minor

contribution to the work in the research phase

who made a

- ✓ major
- proportional
- minor

contribution to the work in the writing phase.

Name: Niels Mejlgaard

Date: 26 August 2013

Signature: [signature]