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Professional Identity, Commitment and Gender in Engineering:
Exploring the (mis)match between dispositions and cultures

by

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Abstract

This dissertation examines the gendered experience of professional engineers in Alberta, Canada. The study is based on qualitative interview data collected from men and women trained in engineering (*n*=36) and textual analysis of materials produced by engineering organizations (Association of Professional Engineers, Geologists and Geophysicists of Alberta; the Consulting Engineers Association in Alberta; the Engineering Alumni Association at the University of Alberta; and the School of Engineering at the University of Calgary). Drawing on the theoretical insights of Bourdieu, in combination with Connell's constructionist perspective on gender, the dominant norms of the profession, the idealized traits and dispositions of engineers, and the impacts of a (mis)match between these broader norms and individual traits on commitment, are examined.

The dissertation is structured around chapters that: 1) describe the dominant ideals of the engineering field; 2) examine whether the norms of engineering reflect gendered and racialized ideals; 3) argue for attention to professional identity and personal alignment with the profession over traditional notions of retention; 4) examine three key traits of engineers (or the engineering habitus): a strong work ethic, individual responsibility, and being rational problem-solvers; 5) analyze a primary engineering trait, technical orientation, in relation to retention and gender; 6) describe masculinities enacted in the profession and how they parallel differences in commitment and the engineering habitus; and 7) explore women's perceptions of "gendered personalities", structural issues in the balancing of family and work, and the relationship between organizational support of work-life balance and commitment to the profession.

Through these analyses I find that women, and those less tied to the technical, are less likely to be committed to the profession. Yet this conclusion is far from determined as multiple factors come into play including a professional culture that pushes engineers to their limits, organizations that do not support or provide work-life balance opportunities, an emphasis on individual responsibility within rigid structures, and an ideal of "making a difference" in a field that reinforces the status quo. These factors, when further combined with gendered norms, create a profession in which the retention is far from that of a simple pipeline.

Acknowledgement

Conceiving, conducting and completing this project were possible due to the wonderful help and support of a range of peopleI want to begin by thanking the 36 men and women who agreed to participate in the interviews on which this dissertation is based. I am very grateful for their willingness to openly and honestly share their experiences. Thanks also to the Association for Professional Engineers, Geologists and Geophysicists (APEGGA) and Consulting Engineering Association (CEA) for providing assistance with recruitment and understanding the profession. Thanks to WISEST at the University of Alberta, in particular Grace Ennis and former Vice Chair Dr. Margaret-Ann Armour, for suggestions, friendship and opportunities to be involved in an organization trying to improve the experiences of women in non-traditional fields.

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Chapter 1: Introduction

Don[1] spent his entire career working as an engineer. The first member of his family to attend university, the choice to study engineering was easy - he had always been interested in technical and mechanical things. Finding employment after graduation had been challenging, but once hired he remained with the same company for nearly 30 years and although he was offered mobility and management opportunities these were of little interest. His interest was in the mechanical: "Well, I'm kind of a tinkerer at heart, so if I'm not doing it here, potentially getting paid for it, I'd be doing it at home, doing something else. … It's just my personality; that's me." Although in his sixties, when asked about his aspirations for the future, rather than talk about retirement, he spoke of his plans to continue in his technical position and devote time to his hobbies, which include metalworking and woodworking. When we spoke about what one needed to be successful in life he responded: "In life in general? Again, I can't imagine somebody not wanting families and so forth, but to me, I'm blessed with wife and kids and grandkids and family, extended family. That's happiness to me."

Like Don, Michelle was working in a technical engineering position at the time we met; yet her path to this position was very different from Don's. For Michelle studying engineering was a second choice, a pragmatic choice, which instilled in her the engineering mindset: "I felt that my creative, artistic side had *really* absolutely been pushed back down to the back, and my approach was

[1] All names used are pseudonyms.

trained into being a very logical way of approaching things, and I actually felt more like an engineer by the end." As an engineer Michelle excelled, being promoted rapidly and gaining increasing responsibility in project management, the aspect of the profession that she most enjoyed. Then Michelle became a mother. She returned to work four months after the birth of her first child, planning to continue in her previous position working reduced hours. But doing this turned out to be "impossible": "I guess I didn't realize I had to make that trade-off at the time. I think *now* I have made the trade-off, so it doesn't bother me in the way it did initially, but initially, it was quite a loss of status and interesting work." When we spoke she continued to work limited hours doing less enjoyable work, but she did not foresee that changing since her husband, also an engineer, had been very successful. When asked what about engineering she would recommend to others, Michelle emphasized the compensation received for a relatively short period of study and that it is "very rewarding to solve problems and to design things and see them built. It's nice to be the point person for when people have problems and they need help, and to be able to help them; I love that about it."

Aged 28, Amy was single, had no children, and was completing a program in a health-care field while working part time as an engineer. Her training was in environmental engineering, an area she selected thinking she would "design things and help people [*laughs*]. Oh, how naïve." After graduation Amy looked for engineering work, hoping that "real" work would be more enjoyable than what she had been given during the work experience terms she had completed as part of her engineering co-op program. She also hoped she would overcome her feelings of inferiority and lack of confidence. None of this happened. For two years Amy worked full-time for a large utility company, an experience she described very negatively. Her boss was frustrated and would yell. She faced difficulties in dealing with unionized workers. "I felt like an imposter right, so really it took every ounce of energy to be professional in that way and to speak like I knew what I was talking about to people – and to men, middle-aged men talking down to me and you know and trying to combat that." After some soul searching, travel, and unskilled jobs, she began a health care program. While engineering did help her develop problem-solving skills, fit her preference for an organized and structured work environment, and was something she was proud of having completed, it was almost the opposite of what she wanted to be. Engineering, she stated, is "left brain, very analytical, not really thinking of – not feeling, not caring, you know, in that way. I'm a healer, I'm a caring, listening, feeling person."

Don, Michelle and Amy were three of the 36 individuals I interviewed in developing a profile of the engineering profession in Alberta. Through advertisements, emails and word of mouth, I recruited people trained in the profession to talk about their career path, their aspirations, and their views of the profession. Through their narratives my notions of what it was to "be an engineer" were challenged, my understanding of what would lead one to stay or leave the profession was broadened, and my assumptions about gender in the profession were brought into question. Rather than an engineer being someone technically oriented and unsocial, interpersonal skills and a desire to use engineering to "make a difference" were presented as necessary for success. Rather than being employed as an engineer, commitment and identification with the profession came to the fore as critical. Rather than males' experiences versus females' experiences, a range of ways in which gender was enacted and emphasized in the profession were found.

This research project focuses upon a "densely masculine"[2] domain - the engineering profession. This is a profession that remains overwhelmingly male-dominated: women made up only 11.1 percent of engineers in Canada in 2001 (Canadian Coalition on Women in Engineering, Science, Technology and Trades [CCWESTT] 2006) and left the field at disproportionately higher rates than their male colleagues (Preston 2004; Ranson 2003). Paradoxically it is also a profession dominated by discourses of success as merit based and of recruiting "the best and the brightest." Motivated alternately by economics, feminism, and productivity, bringing women into sciences and engineering (S&E) has been an actively pursued policy goal since the 1960s (Haas and Perrucci 1984; Rossi 1965) spurring numerous studies exploring why women do not enter S&E, how they can be encouraged, what needs to be changed about the education, and so forth.

Building upon this research, I move beyond the conceptualization of "gender" as female and "fixing the problem" as training more engineers through an analysis that deconstructs the culture of engineering and the identity tied to being an engineer. Drawing upon Pierre Bourdieu's (2004, 2001) theorizing, I emphasize both the broader structural / cultural constraints that exist in the field and the individual / subjective elements of being an engineer. In an attempt to overcome the strongly structural nature of Bourdieu's theorizing (Jenkins 1992),

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[2] The phrase "densely masculine" was used by Sue Lewis at the GASAT 12 conference in reference to the masculine culture of science, engineering and technology in Australia. Although the origins of the phrase are unclear, it has been very useful in conceptualizing the engineering field.

I use the work of Connell (2002, 2005), Lorber (1994), and West and Zimmerman (1987) to conceptualize gender as multiple and constructed. Throughout this analysis I argue for the importance of commitment to the profession over traditional notions of retention, examine the extent to which diversity is a goal/reality in the field, and relate the pervasiveness of an individualized discourse (Bauman 2001, Beck and Beck-Gernsheim 2002) in the profession. The context of this research, the economic boom of the mid to late 2000s in Alberta, is also an important element of this project as it represents a time of strong "pull" (labor shortages) where engineers were in very high demand and employment was readily available.

In the remainder of this introductory chapter I will begin by describing the rationale behind undertaking a study of engineers and gender in this profession. In line with the emphasis on reflexivity found in both feminist approaches and Bourdieu's methodological approach, I will then describe my personal path to this project, to help the reader understand the subjective factors at play in my reading of the data and presentation of the results. I will then briefly introduce the key methods used before providing an outline of the upcoming chapters.

Rationale, significance and motivation

Why engineers?

My focus on engineering is motivated by two interrelated factors: the continuing low numbers of women in the field and its "densely masculine" culture. In regards to numbers, engineering has continually been one of the most male dominated of the professions and scientific fields (McIlwee and Robinson

1992; Olson 1977). It is also a large profession: as of October 29, 2008 there were 42,894 engineers who were members of the Association for Professional Engineers, Geologists, and Geophysicists of Alberta (APEGGA). This group was overwhelmingly male: only 11.2 percent of the members were female (email communication with APEGGA research assistant dated October 29, 2008). While the number of women in engineering has increased - in 2001 women made up 11.1 percent of total engineers in Canada which reflects a 6.4 percent increase from ten years earlier (Statistics Canada cited by CCWESTT 2006) and is up from only 0.02% in 1970 (Sidlofsky and Goodings 1973) - women remain far below parity. Indeed, the number of women entering engineering shows a troubling trend: in 2001, 20.6 percent of students in engineering were female, but this number has been steadily dropping (0.5 to 1 percent per year), such that by 2008 women made up 17.1 percent of the 57,010 students enrolled in engineering (Canadian Council of Professional Engineers [CCPE] 2009:3). Furthermore, women appear to be considerably more likely to drop out of professional engineering; of the 317 engineering graduates that participated in Ranson's (2003) study, 19 percent of women, versus 4 percent of men, had left engineering. There is also a growing gender wage gap reported in the literature, whereby women and men earned near identical salaries following graduation, but women's salaries increasingly fell behind men's salaries over time (Frehill, Javurek-Humig and Jeser-Canavale 2006; Jagacinski, LeBold and Linden 1987; Sidlofsky and Goodings 1973). Furthermore, across science and engineering fields the numbers of women decreases as the level of decision-making increases (Madill et al. 2003).

Engineering is also of interest because of the ways in which the "culture of engineering," which consists of the norms and values of "correct engineering," has been defined by (male) engineers (Dryburgh 1999; Miller 2004). Styhre, Backman and Borjesson (2005), in their analysis of Volvo, identify how engineering culture is "masculine" due to the priority given to technicality, the favoring of action over talk, and the idolatry of strong leaders. Linked with this masculinity are the dominant norms of objectivity, rationality and meritocracy (e.g., Shih 2006). [3] These norms, while theoretically positive for the promotion of gender equity (for gender should become an irrelevant variable in a meritocratic and objective system) may, in reality, be masking and/or supporting inequity because what is deemed "fair" is, in itself, constructed. Amancio (2005:73) identifies one way that this may occur – through arguments that "science and advocacy" are incompatible. By constructing science and engineering as objective and free of bias, the challenges of feminism (or any other power-oriented critique) become moot.

Why gender?

The majority of work done to date on "gender in S&E" has focused upon increasing the numbers of women in the professions. Probably the most frequent argument for bringing in more women has been building a strong workforce. This argument focuses on diversity as a way to maximize innovation, maintain an edge in the global economy, and ensure a bright economic future (Emerson 2005; Fox 1998; Frehill et al. 2006; Herzig 2006). Members of the National Science

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[3] These concepts will be developed further in Chapters Three and Four.

Foundation's Committee on Science, Engineering and Public Policy (COSEPUP) (2006) stated, "Neither our academic institutions nor our nation can afford such under use of precious human capital in science and engineering. The time to take action is now" (p.1). Other writings, particularly those of radical feminists, emphasize the need for more women based on the different point-of-view that women bring to science and engineering problems, a point-of-view that is believed to be more holistic, people-centered and integrative (e.g., Smith in *Introduction* to Hacker 1990; Hubbard 1984).

Both the economic and "different viewpoint" arguments are important rationales for continued emphasis on the number of women in S&E; they are, however, both problematic. By tying an increase in the numbers of women to market gain and national prominence we overlook the subjective experiences of women (and men) in engineering. By emphasizing only the benefits of having more (and thus looking for ways to "push" more women in) we overlook the factors that lead women away from these options. As Carter and Kirkup (1990a) ask, "Although there are rewards for women and there is challenging work to be found in engineering, is it worth the high price women pay economically and psychologically?" (p.154). Focusing on women "doing things differently" is also problematic because it ignores research indicating that the similarities between women's and men's values and traits is much greater than any differences that may exist (Hyde 2005, cited in Frehill et al. 2006).

Rather than finding ways to tap into women's "new ideas" and not "waste" their training, my motivation in undertaking this project is most clearly reflected in the following words of Alice Rossi (1965):

> Marriage, parenthood, and meaningful work are major experiences in the adventure of life. No society can consider that the disadvantages of women have been overcome so long as the pursuit of a career exacts a personal deprivation of marriage and parenthood, or the pursuit of happiness in marriage and family life robs a woman of fulfillment in meaningful work. (p.1197)

Although made over 40 years ago, this statement captures many of the critical issues that continue to impact women's *and men's* careers.[4] Based on this, I approach the careers of engineers with an eye not only on how to change environments to promote retention, but also with attention to what retention is, how professional identity is experienced, and how being an engineer is gendered. By drawing on a social constructionist view of gender I have worked to understand how engineering as a profession is gendered, how this gendered nature works well for *some* men and *some* women, and what aspects push some individuals to question their place in the field.

Positioning Myself

As I will describe in detail in the Research Methods Appendix (Appendix A) I have been guided in this project by a feminist epistemology, which entails reflexivity towards my position as researcher and my normative and political perspectives. In line with this, I recognize that my location was critical in my choice of this topic, the research questions posed, and my collection and analysis of data. Here I will briefly locate myself in relation to "gender and engineering," in particular how I have come to be interested in this topic and why I have

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[4] The importance of equity has been repeated numerous times since Rossi's paper was published (e.g. Fox 1998; Herzig 2006; Prokos and Padavic 2005).

focused my attention on notions of success, equity and balance for both men and women.

As I have been asked numerous times, I must start by saying I was not "turned off" by math, science or engineering at some point in my education. My choice to study sociology was about a desire to "change something," which I did not see as a part of sciences or engineering. While completing my MA, I was introduced to the literature on gender and science, in particular the work of Donna Haraway (1991). Here I read of how the questions science asks and the assumptions it makes are constructed and gendered. A few years later I was hired to assist with a research project exploring the career-decision making of women in science, engineering and technology (SET) lead by Dr. Helen Madill. Working on this project, I had the chance to engage with the literature and conduct interviews and focus groups with women from postsecondary students through to decision-makers in large organizations. I heard from first year undergraduates how gender was not a problem anymore, from new graduates who were finding their first positions to be challenging in ways they never expected (do you go for beer after work when everyone is like your dad?), and from professionals who had found ways to "make it work." The richness of these women's experiences, their differences and similarities, struck and amazed me. Yet when I began to review the research literature, what I found lacked much of the variety and nuance of what I had heard. While there were exceptions, the emphasis on "fixing the problem" seemed to lead to work that neglected the multiple pressures in individuals' lives, the role of organizational structures, and the impact of "common sense" in the continued relations of power. The literature also did not examine the women that participants frequently referred to — the women who left.

While working on these projects I also had my first experiences of something participants kept talking about: the difficulty balancing work and life and the importance of finding a workplace that "fit." Through my own experience, my understanding of how these issues impact an individual's enjoyment of life became much clearer. They brought to mind childhood memories of my father, who worked in the Alberta energy sector. Through his experiences I had seen the expectations of the Oil & Gas industry, the long hours, the toll that a culture focused on profit had on its employees. As a young adult who worked for many summers in the office of this company I had seen firsthand who held which jobs (man = engineer, woman = secretary) and what were the accepted behaviors and dress for each group. While there were the "exceptional" women in roles with more decision-making power, they were clearly that – they were exceptions. My research, therefore, stems from both an academic interest in contributing to a more nuanced research literature and a deeply felt sense that individuals' well-being and personal growth must come before profit.

Research Methods: a critical, feminist exploration of engineering

Drawing upon Pierre Bourdieu's theoretical and methodological ideas, my project involves using two forms of data to construct an understanding of the engineering field and the gendered experiences of individuals trained in the profession: semi-structured interviews, and textual analysis of materials created by professional associations and Alberta University Engineering Faculty magazines. The in-depth qualitative interviews I conducted with 36 individuals, who had been trained as engineers and were living in Alberta in 2007 to 2008, are my primary source. The individuals who participated in this study included 18 women and 18 men. While initially I had planned to sample parallel numbers of men and women who were "engineers" and "had left engineering" this distinction did not clearly apply to engineers' lived experiences, as I will discuss in Chapter Five. Rather, commitment to the profession and self-identification were the key distinctions. Of the study participants, 25 continued to work in (or look for employment in) engineering roles (14 males, 11 females) and 11 had left engineering (five males, seven females). In these one-on-one interviews, which lasted from 45 minutes to two hours, the participants shared with me the factors that had led them to study engineering, their experiences of their workplaces, their aspirations for the future, and their perceptions of success and retention in the engineering field (see Appendix A for a more detailed discussion of Research Methods, Appendix B for the demographics survey, and Appendix C for the interview protocol. Details on participant demographics are also provided at the end of Appendix A). Their voices and experiences, while not representative of all engineers, provided important insights into the range of factors and issues faced by engineers and the multiple ways in which both "gender" and "engineer" are enacted. Their words gave a view into the engineering habitus.

The materials published by the professional association provided an additional critical context for the study. I examined materials produced by APEGGA, the Consulting Engineers Association (CEA), the engineering alumni association at the University of Alberta, and the Schulich School of Engineering at the University of Calgary from the 2007 and 2008 period. Their content was analyzed both quantitatively and qualitatively, with the focus being on the qualitative. The quantitative component allowed some assessment of the magnitude of themes, while the qualitative enabled analysis of the deeper symbolic meanings (Berg 1995:176). The textual materials were first examined for who was presented in images and how they were presented. Were males and females both represented? Were people of color and Caucasians imaged? In what kinds of attire were individuals shown (e.g., business wear, scientific lab coats, field work clothes)? What roles were they enacting (e.g., designer, scientist, spouse)? Did these roles vary by who was shown? The content analysis results, I will argue, while not presenting the "reality" of the profession do enable some assessment of the predominant image of an engineer at the time of the study. The more critical aspect of the textual analysis was the qualitative component which highlighted the themes, norms and values presented. Every text was read closely, with attention to the metaphors and ideals being presented and how these ideals were used – to sell products, to recruit employees, to profile "success stories". (Details on the analysis can be found in Appendix A). As will be seen in subsequent chapters, this analysis has become a critical component in my understanding of the engineering field.

Leading up to and during the data collection I felt, in many ways, like an anthropologist in an unfamiliar world. The engineers I interviewed were curious, confused, and perhaps suspicious, of my interest in them. They laughed nervously that they were my lab rats. I laughed nervously back. Leading up to the project, through my involvement with Dr. Madill's project and work with Women in Scholarship, Engineering, Science, and Technology (WISEST) at the University of Alberta, I had opportunities to engage with women engineers and scientists.

During interviews I was taken on tours of participants' workspaces, in one instance of the shop floor where the "real engineering" took place. I was told of projects and read about innovations. Thus this project, while not ethnographic in the sense of a full immersion into a culture, includes moments where I was a foreigner glimpsing into the realm of the engineer.

Overview: Research Questions and Chapters

This dissertation tells a story about people who have been trained in engineering and their attempts to find a place in the profession. In Chapter Two I will provide an overview of the research literature that helped conceptualize this project and influenced the interpretation of my results. The focus of the literature review will be research on gender in engineering, beginning with an overview of the extensive work conducted on women's educational experiences in engineering and science fields, a brief discussion of the equally large literature on gendered organizations, followed by an outline of research on women in the engineering profession and examinations of retention in the field. I will then introduce the theoretical perspective on gender used for this project. I will conclude this chapter with a discussion of Bourdieu's theoretical approach and acknowledgement of the tensions – and possibilities – that arise in combining a social constructionist view of gender with Bourdieu's more structuralist approach.

In the following chapters I will move to answering the three research questions that were developed using Bourdieu's theoretical tools that have guided my study of gender and professional identity in engineering:

1. *What is the shape of the engineering field and how does it intersect with the broader social field of gender?*

2. *What is the form of the engineering habitus and how is its enactment gendered?*

3. *How does a (mis)match between the dispositions of an engineer and the structures of the engineering field influence an individual's commitment to the engineering profession?*

In Chapter Three I will describe the shape of the engineering field in terms of the extent to which the profession is autonomous in relation to other social fields. Central to this discussion will be the impact of the socioeconomic climate, in particular the rapidly expanding economy in Alberta in 2007 to 2008, and the emphasis on corporate profitability. I will then move to mapping the ideals in the field. Here I will argue that one of the central elements that differentiates engineers from others working in the private industrial sector, in particular those trained in management, is the professional code of ethics engineers agree to uphold. Through a textual analysis that focuses on the materials produced by APEGGA, the tension between ethics and corporate profitability will be examined. I will continue using the textual materials to examine the dominant ideals in engineering, in particular the emphasis on efficiency, innovation, and making a difference. A map of the field will be further developed through a description of some of the major organizational trends reported by participants: high pressure and negative workplaces; an emphasis on rigidity and hierarchies; preference for teams; and tensions between leaders and engineers.

Developing a map of the field will continue in Chapter Four, where I discuss how the norms and values in the field reflect gendered ideals. In this chapter I will begin by looking at the dominant images of gender presented in textual materials. The focus will be on how the culture of engineering reflects masculine norms, such as rationality and the emphasis on "hard" skills. I will then explore the ways in which participants framed diversity as beneficial based on its potential to improve the financial "bottom line." Racial diversity will also be explored briefly in the latter part of this chapter. Although race was not the focus of this project, the historical dominance (both numerically and symbolically) of Caucasians will be shown as having an important impact on the values of the profession. The goal by the end of Chapters Three and Four is to have developed an image of the engineering field and to have explored how it intersects with, and acts as, a gendered field.

The second research question, which involves describing the engineering habitus, will be examined in Chapters Five, Six and Seven. In Chapter Five I will develop the idea of an engineering habitus through the emphasis of participants on the existence of natural abilities that lead one to an engineering career. The elements of the engineering habitus will be the focus of Chapters Six and Seven. In Chapter Six I will examine three key traits that were invoked repeatedly in describing what makes an engineer: a strong work ethic; individual responsibility; and being rational problem-solvers. The ways in which these traits can be seen as gendered, in the words of the participants and the norms of society more broadly, will be explored in this chapter. The seventh chapter will analyze in more depth a single accepted engineering trait, technical orientation. Here I will argue for the existence of a continuum along which one's technical interest and orientation falls and examine how this continuum intersects with enactments of gender.

Taking a Bourdieuian perspective, I will use the map of relations between the engineering field and other fields, my understanding of the engineering field, and my description of the habitus of individuals trained as engineers to answer the third research question which asks what enhances or detracts from commitment to the engineering profession. With a habitus adapted to a field, a range of options can be perceived for action –"*a space of possibles"* – which vary according to the agents' position (Bourdieu 2004:59). "When apprehended by a well constituted habitus, the various positions that are realized are so many 'possibles,' so many possible ways of doing what the agents who perceives them does (such as physics or biology)… A field contains potentialities, a probable future, which a habitus adapted to the field is able to anticipate" (Bourdieu 2004:60). The gendered importance of this is reflected in the work of Chambers (2005), who writes:

> If the habitus and field are aligned, what an individual feels inclined to do will match the expectations of the field in which her action takes place. There will be compatibility between action and expectation, and the individual is unlikely to be aware of, or consciously assess, her actions and dispositions. … As individuals tend to remain in social contexts in which they feel comfortable, their habituses are reinforced and tend to remain constant. It follows, moreover, that the social structures that influence an individual's habitus will be strengthened over time as individuals act in ways that are suggested by, and serve to reinforce, those structures. (p.331)

With a good match, or fit, between habitus and field, one's ability to function within the field is maximized, in large part because the majority of what happens within that social world (in this case engineering) "makes sense." Without a good match individuals are left to question either themselves and/or the field.

What leads to a match or mismatch, and the consequences of this (mis)match, is central to this dissertation. In examining this I will argue in Chapter Five for an emphasis on commitment, rather than retention, as a way to understand a match or mismatch. Through focusing on commitment, I will argue, one can move beyond where the person is employed at the time of the interview to their professional identity and personal alignment with the profession. This understanding of commitment will be used in Chapters Six and Seven to examine the ways in which self-identification in terms of traits that are part of the engineering habitus enhance commitment.

In Chapters Eight and Nine I will turn from the engineering habitus to focus on gender. In Chapter Eight the analysis will look at the forms of masculinity enacted in the profession. I will argue that differences in masculinities parallel differences in commitment and alignment with the engineering habitus. Central to this analysis will be examining how men vary in their emphasis on personal and/or family lives, ideas of what constitutes engineering success, and beliefs that retention in engineering is a concern. The final analysis chapter, Chapter Nine, will examine many of the same themes appearing in Chapter Eight, but will focus on the women I interviewed. Central to this discussion will be participants' perceptions of differences in gendered personalities, structural issues in the balancing of family and work, and the relationship between organizational support of work-life balance and commitment to the profession.

In Chapter Ten I will return to my three research questions, drawing on findings from the substantive chapters to highlight the complexities uncovered at the intersections of the gendered habitus, gendered field, engineering habitus and engineering field. The focus of this concluding chapter will be examining the (mis)matches between habitus and field, in particular: the long hours culture and a strong work ethic; being a linear problem-solver and the desire for innovation;

the dominance of (masculine) technical skills; the quest to make a difference; the emphasis on leaders and teams; and the importance of organizational policies.

Chapter 2: A Review of the Literature and Theoretical Perspectives

In this chapter I will provide an overview of the literature and theoretical perspectives that were central to the conceptualization of this project and the interpretation of the results. The literature review will focus upon gender in engineering, beginning with a brief overview of the extensive work conducted on women's educational experiences in engineering and science fields, particularly in postsecondary education. I will then introduce some of the most influential studies for this project from the extensive literature on gendered organizations, followed by an outline of research on women in the engineering profession. The need to focus on engineering as distinct from scientific careers and to expand our knowledge of engineers' gendered experiences will be highlighted. Past research that examined retention in the field will then be presented, and the argument made that this is an area in need of extensive development. I will then introduce the social constructionist perspective on gender used for this project, which is based on the work of West and Zimmerman (1987), Lorber (1994) and Connell (2002). I will conclude this chapter with a discussion of Bourdieu's (1992, 2004) theoretical approach and an acknowledgement of the tensions – and possibilities – that arise in combining a social constructionist view of gender with Bourdieu's more structuralist approach.

Research on Gender in Engineering

Examining gender within the engineering profession, and how it shapes professional identity and retention, means engaging with a variety of research literatures and identifying existing gaps. Since many of the pivotal articles have been integrated into subsequent chapters, I will focus here on addressing how this project is distinct from, and addresses major gaps in, the existing research. In particular I want to identify that: 1) the majority of past research has focused on educational institutions and experiences, with limited attention to workplace experiences; 2) most studies have grouped engineers with scientists, or have focused upon academic contexts, despite potentially different cultures; 3) research has emphasized the careers of successful individuals, with little data on those who leave the "pipeline"; and 4) lacking in the existing literature are nuanced readings of gender as constructed and impacting men's and women's experiences.

Beyond Education

Much of the research that has examined women in engineering (and science with which it is often grouped) has focused on educational experiences and academic career paths. For example, of the 110 papers published between 2001 and 2005 by the major journal focused upon gender and SET, *Journal of Women and Minorities in Science and Engineering*, 72 (65 percent) were focused on educational or curriculum issues (including three on faculty). Fourteen (13 percent) explored other aspects of the career cycle. Similarly, of the dissertations retrieved on a search of Proquest under the terms "gender and engineering" and "engineering and women" 42 of the 55 relevant theses or dissertations from 2001 to 2006 were focused on education; the majority (28) focused on undergraduate experiences and issues. For the purposes of this study, I will not be reviewing the numerous projects on primary and secondary education, which have emphasized changing curriculum, introducing programs to increase girls' interest in science, and ensuring young women have the prerequisites to pursue sciences and engineering. The emphasis on primary and secondary education can be seen as quite successful, as reflected in COSEPUP's (2006) report (based upon a review of recent studies) that since 1994 girls have been "as likely as boys to have completed advanced mathematics courses" and "more likely than boys to take advanced biology and chemistry" in the United States.

Postsecondary education in engineering, however, continues to reflect strong gender differentials (as reflected in the statistics reported in Chapter One). COSEPUP (2006), on the basis of their review of the literature, concludes that social pressures and influences appear to have a greater impact on motivations and preferences than do underlying abilities (25). These pressures were clearly revealed by Dryburgh (1999) in her ethnographic study of undergraduate women engineering students. Based on this research she argued that engineering is more challenging for women due to: the masculine culture of engineering; the need to act in solidarity with colleagues; demands to present as confident; and a general denial of discrimination (or defining it as exceptional). Similarly Bagilhole (2006), based on data collected from female undergraduates in the UK, concluded that while female students held the same masculine stereotypes of engineering as the general public and expected some gendered hurdles, they anticipated these would be easy to manage. These young women again were reluctant to report discrimination and emphasized the importance of building a reputation for their skills. Coping strategies were focused upon the women themselves, rather than changing gender relations in organizations (p.115). Using data from the same study as Bagilhole (2006), Powell et al. (2004) further argued that while the culture and structure of higher education did not actively deter women, the masculine culture of the profession did permeate the education received. In particular Powell et al. (2004) emphasized that "female students' did not always approve, or feel comfortable with, curriculum content, assessment methods, the volume of work they had, or the emphasis on theory as work" (p.33).

Other research, however, has indicated that changing the curriculum may not be sufficient for challenging the masculine culture of engineering education. Tonso's (1999) study of an engineering program that stressed cooperative learning found that new curriculum was not sufficient in a system in which "women had no culturally accepted ways to be recognized as engineers" (p.396). In spite of the university's desire for change and attempts to create change through altering the style of teaching, the cooperative learning environment was "contributing to reproducing their [female students'] subordinate status in engineering" (Eisenhart and Finkel 1998:122). Tonso's research implicates the systemic nature of discrimination in the field and the unconscious ways in which gender norms are built into the engineering culture – norms that cannot easily be challenged even through explicit attempts and programs.

Studies examining retention in undergraduate SET fields suggested interesting themes to explore in this project (Fencl and Schell 2006; Herzig 2006; Jackson, Gardner and Sullivan 1993; Xie and Shauman 2003). Jackson et al. (1993:243) found that, for females, greater self-confidence in public speaking and engineering-related hobbies predicted persistence; for males, fewer personal problems, self-confidence in writing, and use of support groups predicted persistence. MacLahlan's (2006) research stressed the importance of building networks. Herzig (2006) reports on the importance of adapting to the "sociocultural practices," while Fencl and Schell (2006) write of the impact of classroom climate, teaching quality, self-efficacy and self-confidence. Katz et al. (2006) emphasized family and peer support. Seymour (1995) found that women were significantly more likely than men to report low self-esteem and psychological alienation as reasons for leaving SET studies (cited in Fencl and Schell 2006:287). These themes of individually confronting challenge, self-perception of ability, fitting into the culture, and self-esteem all have critical, but under-explored, roles in professional retention.

In light of the research showing differences between men's and women's postsecondary experiences in S&E fields, and the different factors that impact their retention, it is of interest that in projects where professionals reflect back on their educational experiences few women indicate having felt overt discrimination (Carter and Kirkup 1990a; McIlwee and Robinson 1992). This is not to suggest that no differential treatment in education was reported, but that it was seen by participants in these studies as more moderated in the educational stream than in the workplace, which is of note given that the majority of research and interventions developed have focused upon changes to the education system. Hanson, Schaub and Baker's (1996) comparison of gender stratification in education (secondary and post-secondary) and the workplace in seven countries indeed concludes that "countries with more gender stratification in their education systems have more stratification in their occupation systems; however, factors other than training are clearly playing a role, because gender stratification is far greater in the occupational segment of the science pipeline than in the education segment in each of the countries and the drop-off in female representation is greater in some countries than in others" (Hanson et al. 1996). It is this greater gender stratification within the workplace that my project targets.[5]

Gendered organizations

Before moving into specific discussions of gender in the engineering profession, I want to briefly overview the broader literature on gendered organizations that is critical to this project. Kolb et al. (2003), in their review of literature on gender equity in organizations, identify four key frames: (1)"fix the woman," (2)"celebrate the difference," (3)"creating equal opportunities," and (4) "revise work culture." The first frame emphasizes changing women (e.g., Henning and Jardim's 1977 article *The Managerial Woman*, which emphasized that what woman are - non-competitive, focused on relationships - does not fit into the business world and thus women need to be taught the skills and characteristics required to fit into the masculine world of work). The second, "celebrate the difference," reflects a radical feminist perspective wherein women are seen as having different, perhaps better, contributions to make. As scientists, women are believed to be more "holistic" thinkers (Trescott 1984); as business leaders they are seen to be better communicators, with more cooperative and

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[5] Postsecondary education in engineering will also be briefly discussed in Chapter Four.

democratic ways of leading (Helgesen [1990] 2003). Radical feminist critiques also underscore the patriarchy implicit in contemporary science and business organizations (Hubbard 1984). This approach, while adding an important critique of the masculine subtext of organizations and scientific works, is problematic for its lack of emphasis on the diversity that exists among women and among men. In its reliance on differences, this approach also creates a situation where one gender ideal replaces another without deconstructing either of these ideals.

In contrast, the third frame, "creating equal opportunities", emphasizes bringing women into organizations as a way to change organizations. This perspective includes the highly influential work of Rosabeth Moss Kanter ([1977] 2003; Fletcher & Ely 2003) on gender tokenism and organizations. Kanter's work examines the way in which organizations' "opportunity structures shape behavior in such a way that they confirm their own prophesies" ([1977] 2003: 34). Gender differences therefore continue to exist, but are the result of organizational processes (Fletcher & Ely 2003: 6). Because women are grouped in low-mobility situations, Kanter argues, they are likely to lower their aspirations and career commitment. Although these are "universal *human* responses to blocked opportunities" they are interpreted as a characteristic of women given their "token" status (emphasis in original, Kanter [1977] 2003: 34). Unlike earlier work, this approach takes a critical step away from equity being the responsibility of the individual to examining the power differentials in organizations and how these play out in opportunities and access to resources (Fletcher & Ely, 2003, 5). A shortcoming of this research, however, is its lack of emphasis on changing the informal culture and rules that govern workplace behavior (Kolb et al., 2003, 12) because the gendered nature of organizations and society are not examined (Acker 1990). Furthermore because of the emphasis on structural / legal / policy change, the subjective experiences of individuals are overlooked (McIlwee & Robinson 1992, 15).

The fourth frame, "revise the work culture", is the frame supported by Kolb et al. (2003). This frame works from an understanding of organizations as gendered, a key theoretical notion in the gender, organizations and work literature introduced by Acker (1990). Acker describes this as:

> To say that an organization, or any other analytic unit, is gendered means that advantage and disadvantage, exploitation and control, action and emotion, meaning and identity, are patterned through and in terms of a distinction between male and female, masculine and feminine. Gender is not an addition to ongoing processes, conceived as gender-neutral. Rather, it is an integral part of those processes, which cannot be properly understood without an analysis of gender. (p.146)

Understanding organizations as gendered involves a recognition that male-dominated organizations tend to privilege the work of men, while limiting women's opportunities. In her work Acker identifies the predominant assumption of the male worker: "The worker with 'a job' is the same universal 'individual' who in actual social reality is a man. The concept of a universal worker excludes and marginalizes women who cannot, almost by definition, achieve the qualities of a real worker because to do so is to become like a man" (p.150). Central to Acker's theory is the idea of a "gendered organizational logic" which reflects the ways in which seemingly gender-neutral policies and practices work to maintain gender inequality in organizations (Britton 1997).

Acker's approach to gendered organizations has been used in analyzing a variety of male-dominated contexts including dentistry, prison workers, information technology, law firms, and Wall Street investment firms (Adams

2005; Britton 1997; Demaiter and Adams 2009; Pierce 1995; Roth 2004). Roth (2004), for example, examined the unconscious discrimination that exists in the securities industry - a "culture in which whiteness and maleness confer assumptions of greater competence" (p.208). Reflecting on the benefits to men of being tokens in female-dominated professions, Roth identifies that homophily (or similarity) preferences cannot fully explain women's continued lower success rates in male dominated professions. Rather status expectations must also be examined. Thus interventions must focus on changing the basic work practices and norms (Kolb et al. 2003:13). Poggio's (2000) interviews with men and women in four different occupational fields illustrate how gender in an organization reflects the organization's culture. Poggio concludes that the symbolic order continues, not because it is natural, but because it functions to preserve organizational structures. Thus as "gender emerges as a cultural and organizational construct policies need to be targeted there [organizational structures], not on individuals" (400).

This fourth approach is clearly an improvement over the others because it focuses directly on the organizational culture. The problem is that, in doing so, it overlooks the subjective experiences of individuals. Clearly there are structures that limit women's opportunities within engineering and a masculine culture that leads women to develop strategies to fit in, to fight, or to leave. But a theory that focuses solely on organizational culture does not help us to understand why some women take up different strategies or how they understand the strategies they use. Furthermore, it limits our ability to understand men's gendered experiences, by accepting that they see their masculine approaches as an unproblematic norm. As Britton (2000) writes, "simply assuming, a priori, that organizations are gendered drastically limits the potential of this approach to produce social change, at least in the short term" (p.422).[6] By emphasizing gender as constructed (as detailed below) and using a theoretical approach that incorporates structure and agency (which I will argue Bourdieu's work allows) the *similarities and the variances* in organizations' and individuals' experiences can be explored, and the spaces where more equitable relations are enacted can be examined as reflections of possibilities for change.

Specifying Engineers

In the majority of studies of gender in the SET workforce, engineers are grouped with scientists and/or the focus is on the careers of scientists and engineers in academia (Zuckerman 1991). While this research has identified many relevant issues, it overlooks important differences between engineers and scientists. By focusing on scientists and subsequently applying the findings to engineers, the experiences of the minority are applied to the majority (56% of those working in S&E are engineers, Zuckerman 1991). Furthermore, important gender differences in the cultures of science and engineering professions may be overlooked. This is supported by Ahern and Scott's (1981) research, which proposed that sex disparities vary significantly by discipline:

> …this is particularly interesting because it suggests forcefully that the disadvantages women suffer have little to do with marriage, family responsibilities, or limited geographic mobility – the traditional and widely accepted explanations for women's less satisfactory career

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[6] Britton (2000) also makes a critical point regarding the necessity to differentiate between male-dominated professions or occupations and masculinized organizations. Clearly engineering is a male-dominated profession, but the range of participants' experiences indicate the differing extent to which organizations are masculinized.

> progress… The conclusion that many disadvantages arise from the traditions of the disciplines themselves … seems inescapable. (p.vi)

Furthermore, the values of engineering students have been found to have more in common with the values of business students than science students, who are more similar to humanities students (Hacker 1989:121). Engineering is also different from science due to its status as a profession and its links to the trades. The focus on engineers and scientists in academia is a further concern because the majority of scientists and engineers work in industrial organizational contexts (Evetts 1996:25), which are driven by (theoretically) very different motivators of profit rather than research and learning. These distinctions create a unique field for engineering and lead to particular gendered norms and relations as will be demonstrated in Chapters Three and Four.

That said, studies of gender and engineering within the work context have been undertaken with Carter and Kirkup (1990a, 1990b), Hacker (1989, 1990), McIlwee and Robinson (1992), Evetts (1994a, 1994b, 1996), Kvande (1999), Jorgenson (2002), Miller (2004), Ranson (2003, 2005b), Watts (2007, 2009a), Faulkner (2000a, 2000b, 2007) and Gill et al. (2008) being exemplars of research that uses less deterministic and less functionalist understandings of gender. This is exemplified in Kvande's (1999) discussion of femininities in engineering in six large Norwegian companies (p.310). Drawing on the work of West and Zimmerman (1987), Lorber (1994) and Connell (1987), Kvande illustrates "that by applying a relational understanding of gender the diversity of female graduate engineers' construction of femininities becomes more apparent. The women engineers actively negotiate the meaning of gender by participating in male-dominated work organizations" (p.325). This relational approach, as I will elaborate below, has been critical to my conceptualization of gender.

Early work focusing on engineers that has shaped my project includes that of Carter and Kirkup (1990a, 1990b), Hacker (1981, 1989, 1990), McIlwee and Robinson (1992) and Evetts (1996). Carter and Kirkup's (1990a, 1990b) research began to explore the non-feminist stance of many female engineers and the difficulties women engineers face balancing multiple roles. Sally Hacker's (1981, 1989, 1990) linking of radical and socialist feminist perspectives with a more traditional liberal feminist perspective marks an important contribution to the analysis of engineering careers. Based on an ethnographic study of engineering education, Hacker (1989) argues "[real] engineering was structured to draw and keep students disciplined with a special set of skills, yielding the camaraderie and elitism of in-jokes, private language, and delight in abstraction, complexities, and the elegance of the simple solution" (p.45). Her work opened the door to recognizing how important the culture of engineering is to one's experience of the field. Hacker (1989:48) also presents a perspective of engineering that is often missed in the academic literature - the "delights and fascinations of the field."

The importance of the culture of engineering was reinforced in the work of McIlwee and Robinson (1992) and Evetts (1996). McIlwee and Robinson (1992; see also Robinson and McIlwee 1989) explore the workplace culture of engineering, arguing that "organizational structures and power relations are the most important variables [in an engineering career], but that interaction styles, particularly if they are conceived as resources, play a role as well" (p.143). Thus it is "neither gender behavior nor organization structure alone that shapes the engineering career. It is the interaction of the two, mediated by the culture that prevails in a particular workplace" (McIlwee and Robinson 1992:110). Evetts's (1994b, 1996) model of the dialectical relationship between careers and organizational structures extends the insights found in McIlwee and Robinson's (1992) work by focusing upon the subjective aspects of careers (based on work of Hughes 1937), or one's "career identity." Central connections to my project are Evetts's (1994a) use of Bourdieu and her exploration of the individualistic nature of solutions to contradictions between career and motherhood that participants undertook: "[t]hese women did not expect the organization to have to change to better enable them to combine their public and private work responsibilities" (p.177). These individualistic tendencies in dealing with issues were a very common theme throughout the past literature. Jorgenson (2002), for example, identified that participants in her study worked to identify as a singular individual, at times rejecting the label of "female engineer" and "positioning themselves as efficacious agents rather than as helpless victims, they sometimes also invoked traditional feminine stereotypes to underscore their differences from other women" (p.364). [7]

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[7] The role of the individual, and the expectation that one is individually responsible, also links to the work on individualization of Ulrich Beck (Beck and Beck-Gernsheim 2002; Beck and Willms 2004) and Zygmunt Bauman (2000, 2001). Past findings on women in engineering reflect the individualization thesis, the idea that we are living in a new epoch where risks continue to be produced socially, but it is now the duty of individuals to cope with these risks (Bauman 2001, 47). This is not the neo-liberal anomic form of individualization in which we are each fully self-determining, rather it is an "institutionalized individualism". The individual "is becoming *the social structure of second modern society*" (emphasis in original, Beck & Beck-Gernsheim 2002, xxii). This institutional individualization will also be shown to be an important theme in the present research.

Studies by Ranson (2003, 2005b) and Miller (2004) provide very interesting insights into the gendered nature of engineering and, notably, come from the same context as my study – Alberta, Canada and the dominant Oil and Gas industry.[8] The masculinity of this culture is clearly exemplified in Miller's (2004) study, which she argues is shaped by three primary processes; "Everyday interactions which exclude women; values and beliefs specific to the dominant occupation of engineering which reinforce gender divisions; and a consciousness derived from the powerful symbols of the frontier myth and the romanticized cowboy hero" (p.47). Respondents, she reports, identify a sense of having to prove oneself, of fitting into the organizational culture, and of developing masculine (aggressive, confident) approaches or work styles. As Miller (2004:47) critically argues, these approaches may create short-term individual gains, but they are a long-term failure for they do not challenge the masculine values of industry. A major contribution of Ranson's (2003) project was that she looked beyond gender differences to career paths (organizational, occupational, entrepreneurial) and how these paths were undertaken by men and women (Ranson 2003:26). Similarities between men and between women are explored with an emphasis on the balancing of family and work demands in a highly nuanced way that moves beyond male/female, masculine/feminine binaries.

Two researchers in Britain, Watts (2007a, 2007b, 2009a) and Faulkner (2000a, 2007), have recently published on gendered experiences of engineering.

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[8] While Miller's project focused on the Oil and Gas sector, Ranson's project and my dissertation focus on engineering in the province more broadly. While there are important differences between sectors, and engineers work in many industries, the Oil and Gas sector can be seen as a driving force in the province's economic well-being and general employment levels in the profession.

Watts (2007, 2009a) examined the experiences of female civil engineers working in the construction industry, in particular the "workplace environment and culture, equal opportunities as policy and practice, support networks, work-life balance concerns, professional registration procedures and the changing business base…" (2009a: 44). Central to her analysis was the impact of the long hours and "presenteeism" culture (2009a:45), which measured commitment in terms of availability and willingness to work as long as needed. As reported by Ranson (2003), the transition to motherhood was particularly challenging; "Many suggest that there was reasonably equal treatment of men and women until women become pregnant, with motherhood being seen as a key differential in a way that fatherhood was not" (Watts 2009a:48).[9] Watts (2007b) also explored the conflict-ridden nature of the workforce and the challenges faced by women due to pervasive sexual harassment. Faulkner's (2000a, 2007) work develops an understanding of the two dominant narratives of engineers (technically oriented versus technically and socially oriented) in relation to the masculinity of the profession. Drawing on an ethnographic study of six engineers from two UK engineering consulting firms who were shadowed over five weeks, Faulkner presents an eloquent analysis of the engineering identity and its connections to Connell's notion of hegemonic masculinity. Recently in Australia, Gill et al.

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[9] The impact of motherhood has also been more broadly identified in the gender and work literature. Budig and England (2001), for example, report an average wage penalty (or motherhood penalty) for women of seven percent per child, two-thirds of which remains after controlling for experience and other work related factors (p.204). A special issue of the *Journal of Social Issues* (2004) was dedicated to exploring the continued low wages of working mothers (at approximately 60% of working father's wages) and argued for the notion of a "maternal wall", rather than a glass ceiling (Crosby, Williams and Biernat 2004).

(2008, see also Bastalich et al. 2007) conducted a series of studies with female professional engineers and the identity negotiations required in transitioning from education to the workplace. Central to their findings was a sense held by the majority of participants that they were different and had needed to compromise some aspect of themselves in order to be accepted (p.229). Gill et al. argue: “the taken for granted assumptions that engineering is a masculine domain permeates the workplace leaving no space to be professional engineer and woman at the same time” (p.323).

Each of these projects have influenced my interpretation of my research findings, but given the size of the engineering profession, and its highly unbalanced gender make-up, there remain areas that are still under examined. These studies represent the few in the area of gender in SET that reflect a nuanced and theoretically informed reading of gender in the profession. And, while they do present the experiences of women, little analysis of the gendered experiences of men has been undertaken. Further, the experiences of people leaving the profession have been given very limited attention.

“Leaving” Engineering: Non-traditional/Non-linear career paths

Critical to my project is the inclusion of individuals who leave engineering or use their engineering education in unorthodox ways. As a report by COSEPUP reveals, one of the major issues in investigating those who leave careers is the lack of data. For the engineering faculty, the focus of COSEPUP’s (2006:89) work, the data on attrition that does exist focuses on retirement and provides little information on where people go when they leave. The literature suggests that retention in engineering is a gendered phenomenon, with women being more likely to leave engineering careers at every stage in the pipeline (perhaps with the exception of graduate school). Of the 317 engineering graduates that participated in Ranson's (2003) study 19 percent of women, versus 4 percent of men, had left engineering. Over half of the women who left (10.4 percent) were no longer in paid employment. To date there have been very few studies that have explicitly examined the retention of scientists and engineers, with exceptions being Sonnert and Holton's (1995) study of academic scientists and Preston's (1994, 2004) research on factors impacting individuals' exit from scientific and engineering careers. Sonnert and Holton's work (1995:xii) was based on a survey of 699 former National Science Foundation (NSF) and National Research Council fellows and 200 face-to-face follow-up interviews. Their work identifies important differences by gender in achieving success in academia, such as rates of publication, research topic choices, and the "two-body" problem[10], but because of their focus on academia it is of limited applicability to a non-academic population.

Preston's (1994, 2004) study of women's exit from science and engineering professions was conducted at almost the same time as Sonnert and Holton's work. Preston used the longitudinal Survey of Natural and Social Scientists and Engineers (1982-1989) to model gendered exit and reasons for exit. She reports that more than 20 percent of women who had been working in S&E professions in 1982 had left by 1989, which was almost twice the number of men. Reasons for leaving also varied by gender, with men more likely to leave

[10] The "two-body problem" refers to the issue faced by professional couples in finding two positions in the same location.

due to promotion, whereas women left due to family reasons (3.5 percent), other reasons (2.6 percent) or changes to another line of work (10.4 percent) (p.1447). In 2004, Preston published a broader study of exit from science careers using a combination of NSF data, a quantitative work history survey, and qualitative interviews to examine the likelihood of leaving science careers, what factors influence retention, and what the impacts of non-science career paths are on earnings. Preston (2004:32) identified the key factors differentiating male leavers from stayers as "discontent with income and opportunity in science" and "looking for more interesting work outside of science." For women, the key differentiating factors were "looking for more interesting work outside of science," "lack of mentor or guidance," and "difficulty shouldering familial and career responsibilities." While Preston makes strong arguments for these factors, her emphasis on salary and Human Capital Theory leads to a fairly one-dimensional image of science, and does not examine the culture of the workplace. Additionally, while her sample does include engineers and scientists, differences between the two occupational groups are not drawn out.

Other factors that have been posited in the literature as impacting retention include the kind of work organizations (Carter and Kirkup 1990a; Perrucci 1970), differences in organizational culture (McIlwee and Robinson 1992), and the need to decide between technical or management "ladders" within an organization (Carter and Kirkup 1990a:126). Gill et al. (2008) observed that the women engineers in their study:

> … had to engage in practices of renegotiation of identity despite having been proven as 'able to do the job'. In order to achieve some sort of equilibrium many undertook a range of tactics whereby their femaleness was either virtually denied or accentuated in order to create a persona that could 'get by' in the workplace. For some of those who either could

> not or would not adopt such strategies the workplace became unbearable and a cause of deep dissatisfaction. Not surprisingly they were unlikely to continue with it. (p.234)

Which factors impact retention, however, has not been examined in detail within the engineering context.

Also critical to understanding career paths is deconstructing the idea of a "successful" career. As Rosser (2004) identifies, career paths are widely varied. Thus the ideal of the "pipeline" that everyone enters and must be encouraged to move through and remain within, which has been the dominant model in research on women in S&E (Berryman 1983), is highly problematic, because anyone who leaves this "path", whether due to discrimination, interest, or aptitude, is considered a "loss." As Xie and Shauman (2003) argue, this type of perspective is "the major conceptual limitation in the literature on women in science" (p.7). As Hanson, Schaub and Baker (1996) write, the pipeline model overlooks "the role of other, non-training factors in maintaining gender-stratified science labor markets" (p.287). "Success" as an engineer is further complicated, McIlwee and Robinson (1992) highlight, because it may have more to do with fitting the image of a competent engineer, than with actual merit:

> Competence as an engineer is a function of how well one presents an image of an aggressive, competitive, technically oriented person … *style* … To be taken as an engineer is to look like an engineer, talk like an engineer, and act like an engineer. (P. 21)

Examining the "style" that is connected to success, what is understood as a good career, what factors lead one out of the profession, and the other ways that engineering training can be used, are central to my project. [11]

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[11] The notion of a "pipeline," or a linear career path, can also be seen to limit understanding of careers by reinforcing a false idea of decision-making in a world freed of

Theoretical "Tools"

Bourdieu's Habitus and Field

The primary theoretical perspective used in shaping this project was the work of Pierre Bourdieu. In discussing it, I want to begin by stressing that his theoretical concepts have been taken up in so far as they are useful. My aim is not to conduct a Bourdieuian analysis of the engineering profession, but to use Bourdieu to bring theoretical insight to the topic of gender and professional commitment in engineering. I will attempt, as Phipps (2005:20) wrote, to interweave Bourdieu's ideas with those of others and my own. In this way Bourdieu's work will be used, as Jenkins (1992) describes it, as "good to think with" (p.176).

Field

For Bourdieu, the field is a "network, or a configuration, or objective relations between positions" (Bourdieu and Wacquant 1992:97). Fields are spaces of conflict or struggle that are always made up of positions occupied by the dominant and dominated (Phipps 2005:22). They are also always relational, contingent and changing (Everett 2002:60). Society is understood as made up of

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non-career concerns. From early on in research on career decision-making, it has been shown that individuals make choices in light of many other factors and often in "irrational" ways. The choice of engineering, for example, is often a passive or haphazard choice (Carter and Kirkup 1990a; McIlwee and Robinson 1992). This non-linearity has been taken up within the educational psychology literature in models including Super's (1990) theory of different phases within the career cycle, Mainiero and Sullivan's (2005) "Model of Kaleidoscope Careers," and Nash and Stevenson's (2004) "kaleidoscope strategy." In each of these perspectives, careers are understood as processes, with different issues coming to prominence at different periods in the career cycle. These models reflect that career-decisions are not a one-time event. Rather than *a* decision that is made and followed through, as the pipeline model suggests, career decisions are made and revised throughout the life course and are impacted by a variety of work and non-work experiences (Madill et al. 2007).

numerous fields, each defined by what is at stake – be that housing, education, power (politics), cultural goods – and each is governed by a different logic (Jenkins 1992:84). The positions that agents or institutions occupy within a field are defined by the distribution of capital (power) specific to that field. In this way a field can be compared with a "game." Although a field is not deliberately "started" nor are the rules explicit, like in a game "players are taken in by the game, they oppose one another, sometimes with ferocity … [and] players agree … that the game is worth playing" (Bourdieu and Wacquant 1992:98). Like players in a game, each individual has cards with a variety of values – some trump others – and the relative value of the cards each player holds within a game determines their position in the game and the strategies they will use (Bourdieu and Wacquant 1992:99). Over time as we play the game / participate in the field and master its logic we acquire a "feel for the game" (Jenkins 1992:70; Phipps 2005: 21), which is critical both to our acceptance of the game as worth playing and our own ability to "win."

A field that is pertinent to my study is the "scientific field," which Bourdieu (1975) saw as organized around a competitive struggle over scientific authority or scientific competence. Refuting Merton's conception of the scientific community as "functional," Bourdieu (1975:22) stresses that science is not a disinterested field, but rather that it is governed by a specific form of interest – recognition by one's scientific peers – that leads to a maximization of scientific capital (elaborated in Bourdieu 1991). In studying the scientific field the relationships between labs and researchers, and who holds what position within the field, must be examined (Bourdieu 2004). Furthermore the field is understood as subject to pressures from other fields (Bourdieu 2004:47).

Capital

The concept of capital "refers to the positions, attributes, and properties (material or symbolic) that distinguish between agents in the field" (Phipps 2005:22). Continuing the analogy of "a game," capital can be seen as the cards used, with each card representing a different form of capital. And while "there are cards that are valid, efficacious in all fields … their relative value as trump is determined by each field" (Bourdieu and Wacquant 1992:98). Bourdieu and Wacquant (1992:119) identify three "fundamental species" of capital: economic, cultural and social. *Economic* capital, the most self-explanatory, contains monetary and material wealth (e.g., land ownership, commodity holdings). It is "distinctively material" (Everett 2002:62) and can exist independently of any particular field in which it is used (Phipps 2005:22). *Cultural* capital moves from the material to knowledge, skills, lifestyles and qualifications (Bourdieu and Wacquant 1992:119). *Social* capital "is the sum of the resources, actual or virtual, that accrue to an individual or a group by virtue of possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition" (Bourdieu and Wacquant 1992:119).

Each of these three species of capital can act as *symbolic* capital if it is recognized within the field as legitimate, or when the "arbitrariness of its possession and accumulation" are misrecognized as meaningful or natural (Bourdieu and Wacquant 1992:119; Everett 2002:63). Bourdieu also theorizes additional forms of field-specific capital, such as scientific capital. Scientific capital is a capital based on "acts of knowledge and recognition performed by agents engaged in the scientific field and therefore endowed with the specific categories of perception that enable them to make the pertinent distinctions"

(Bourdieu 2004:55). Scientific capital thus functions as a form of symbolic capital (Bourdieu 2004:34) because it exists through the perception of agents within the field, confers status, and is held as legitimate. Notably scientific capital (as symbolic capital) can be converted into other forms of capital (particularly economic). Further "symbolic capital flows to symbolic capital," thus individuals with capital (the "big names") gain the most profit from their work and have greater power of "closure" on issues (Bourdieu 2004:56).

Habitus

In Bourdieu's theoretical framework, habitus functions to ground agents' practices and strategies within a sociocultural context, rather than explaining them in terms of grand narratives (e.g. of psychoanalysis, mode of production or structuralism).

> Habitus can be understood as, on the one hand, the historical and cultural production of individual practices – since contexts, laws, rules and ideologies all speak through individuals who are never entirely aware that this is happening – and, on the other hand, the individual production of practices – since the individual always acts from self-interest (Webb et al. 2002:15).

The habitus can be understood as an individual's "feel for the game" (Bourdieu and Wacquant 1992:21), the power of which is derived from its functioning at the sub-conscious level through habits and routines, rather than the conscious following of rules and decision making (Jenkins 1992:76). Common sense, or what Bourdieu (2001) describes as "doxa," is thus a critical aspect of habitus.

Habitus functions by inscribing structures and power relations onto the body and individuals' dispositions (Phipps 2005:23). As Chambers (2005:331) identifies, habitus is reflected in the ways we carry out actions without apparent conscious awareness or choice. For example, Bourdieu identifies the smaller steps taken by women, learned through wearing high heels and skirts, but continued when out of this attire, as a reflection of the internalization of a gendered habitus (as cited in Fowler 2003:472). These “small steps” are simultaneously a physical gesture and a reflection of mental structures.

Two important aspects of the habitus are its ability to be modified and its dialectical relationship with the surrounding field. First our dispositions, knowledge, and values (all of which are constructed through the habitus) are always potentially changeable. Rather than being passively inscribed, if the narratives or explanations of our habitus no longer “make sense” the habitus may be shifted (Webb et al. 2002:41). That said, the trend for conservation and reinforcement is generally stronger, as our habitus stays with us across contexts and shapes our interactions with multiple fields (Webb et al. 2002:36-7). Secondly, the habitus is understood both as the creation of social relations and as shaping these relations (Phipps 2005:23). The relation between habitus and field is, on the one hand “conditioning: the field structures the habitus… On the other side, it is a relation of knowledge or *cognitive construction*. Habitus contributes to constituting the field as a meaningful world, a world endowed with sense and value, in which it is worth investing one’s energy” (emphasis in original Bourdieu and Wacquant 1992:127). The field presents the limits and structures the habitus; the habitus structures how the field is perceived (Bourdieu, as cited in Everett 2002:65).

It is in terms of the field and habitus that the research questions outlined in Chapter One were developed, in particular the third: *How does a (mis)match between the dispositions of an engineer and the structures of the engineering field influence an individual’s commitment to the engineering profession?* This question was constructed from Bourdieu's conceptualization that with the matching of field and habitus there will be the "illusion" of immediate understanding, there will be no need to question the basis of the structures of the field or its conditions, rather we have a 'doxic experience' of the field (Bourdieu, as cited in Jenkins 1992:70). Without a good match, however, individuals will 1) be unable to "function" and not see the potentialities of the field, and/or 2) become conscious of the arbitrary nature of the rules that exist and of their dispositions. A third option that may come from this mismatch is the possibility of new potentials. For women in non-traditional spheres this could create two possibilities: 1) bodies enacting different gender identities; or 2) undoing existent norms to create new ones that have "greater livability" (Powell et al. 2009). Because of this close connection between habitus and field, many of the themes that are addressed as part of one will have a corollary in the other. For example, technical innovations are key to the engineering field and the parallel, technical expertise and interest, are central to the engineering habitus.

Gender as constructed

As argued above, much of the work on gender in SET fields has taken a fairly traditional view of gender and emphasized differences between men and women. My project, following Kvande's (1999), Ranson (2003, 2005b) and Faulkner (2000a, 2007), instead conceptualizes gender as constructed and includes both men's and women's experiences. The attention to women in the majority of studies examining gender and SET is understandable, given the extent to which women have been the outsiders in these male-dominated fields. Through their entry into these occupations, women have brought into focus gendered assumptions that have historically been invisible. The problem with this approach, as Ranson (2003) highlights, is that it leads to an emphasis solely on differences and leaves the diversity within men's experiences and women's experiences unexamined. It must be recognized that not all engineers, nor all men, nor all women, are alike (Hacker 1989: 38). As Ranson (2003) writes of the participants in her research:

> [Many] women seemed to experience particular disadvantages compared to [many] men, particularly when it came to balancing their paid work with family responsibilities. But while it was politically important to tell this story, it was not the whole story. In short, the women were not all alike, and nor were the men, and in some cases women and men were more alike than different. It seemed important to tell this part of the story also. (P.23)

This is further reflected in Tonso's (1999:387) work, which illustrates the complexity of gender constructions in her study of undergraduate engineering students. Here she exemplifies that there were no monolithic man/woman divisions among her participants, but many different ways of viewing and interacting with the other gender that were based on power distributions and cultural pasts.

The perspective I am taking on gender stems from the work of West and Zimmerman (1987), Lorber (1994), and Connell (2002) who all frame gender as constructed. From West and Zimmerman (1987), I have used the idea that gender is not a set of traits that reside in bodies, fixed to physiology, but instead is "a routine, methodical, and recurring accomplishment" (p.92). This accomplishment occurs within a gendered world where "actions are often designed with an eye to their accountability, that is, how they might look and how they might be categorized" (p.98). As social beings we are aware that others will comment, and so we self-regulate to ensure that we align with the gender norms into which we have been socialized. Additionally, West and Zimmerman (1987:98) show that because society is partitioned into male and female and placement into one sex category or the other is enforced, "doing gender is unavoidable." In other words, so long as we are identified as male or female (placed in a sex category) our actions will be judged in relation to that category. And while the "doing" of gender is the product of individual human action, it is "a situated doing, carried out in the virtual or real presence of others who are presumed to be oriented to its production" (West and Zimmerman 1987:92).

Building on West and Zimmerman (1987), Lorber's (1994) "The Social Construction of Gender" explains gender as three-fold: as process, as stratification, and as structure. Gender, as process, stresses the ways in which, through social interactions, we learn what is expected of us as "men" or "women" and enact the appropriate roles. Very much in line with the idea of "doing gender," gender as process, emphasizes action, the reinforcement of appropriate behaviors through reactions of others, and the possibilities of resistance. Lorber (1994) also emphasizes the power differentials: "as a part of a *stratification* system, gender ranks men above women of the same race and class" (p.32). In contemporary Western society what is the normal, the "dominant" is "man", leaving "woman" as the other. This can be seen in the social sciences, as Hearn and Collinson (1994) explain, where masculinity is usually "*implicit* but *central/centered*: They [men] are at the center of discourses" (p.97). Gender also functions as a *structure* as it "divides work in the home and in economic production, legitimates those in authority, and organizes sexuality and emotional life" (Hearn and Collinson 1994:116; See also Connell 1987).

Central to a social constructionist perspective on gender is recognition that because gender is "done" it can be "done" in different ways. Critical for understanding this has been Connell's work on gender, in particular masculinities. Beginning with the article, "Towards a New Sociology of Masculinity" (Carrigan, Connell, and Lee 1985), Connell has worked to develop and refine a theory of multiple masculinities and power relations (Connell and Messerschmidt 2005). Key to this work is recognizing the diversity in masculinities, that masculinity is negotiated and contested daily (Barrett 1996:131), and the relations between forms of masculinity, or that "[t]here is a gender politics within masculinity" (Connell 2005:37). In her writing Connell (1987:183) outlines four positions, the most commonly discussed, and the idealized form, being hegemonic masculinity. Hegemonic masculinity exists in "relation to various subordinated masculinities as well as in relation to women." While not the most common, "[i]t embodied the currently most honored way of being a man, it required all other men to position themselves in relation to it, and it ideologically legitimated the global subordination of women to men" (Connell and Messerschmidt 2005:833). Connell (1987:183) argues there is no parallel hegemonic femininity, but does argue for the existence of an "emphasized femininity." These idealized forms are, critically, not to be understood as static, but rather as changing over time.

While Connell's work emphasizes the enacted and multiple elements of gender she also, as is found in West and Zimmerman's (1987) and Lorber's (1994) writing, recognizes the important connections and patterns – what she calls the "gender order" of a society (2002: 3). The study of gender, according to Connell, should not focus on difference, nor accept that gender is "natural", but rather be focused on relations. Gender is a social structure, insofar as structures are understood as “enduring or extensive patterns among social relations” (p.9). Within organizations these structures are further formalized – creating “a pattern in gender arrangements” that she terms “the *gender regime* of an institution” (p.53, italics in original). Gender regimes identify who takes on what role in an organization, what social divisions exist, how emotional relations are conducted, and how institutions are related to one another. These gender regimes – and the broader gender order – direct behavior but do not enforce it. Again it is up to the individual to enact.

Aligning Bourdieu with Social Constructionist views of Gender

My study, in taking up both Bourdieu’s ideas of field and habitus and social constructionist views of gender, works to combine two approaches that might be seen as conflicting. In particular, Bourdieu has been critiqued for overlooking feminist research, leading to questioning of the appropriateness of using Bourdieu for conducting feminist analysis (Skeggs 2004). However, numerous scholars have attempted to interpret how gender can be understood within Bourdieu’s theoretical framework. Lovell (2000) argues for describing gender as capital (as cited in Chambers 2005:332). Moi (1999) proposes that gender is a general social field that is dispersed across and influences every field (as cited in Adkins 2004:6). Chambers (2005) conceptualizes gender as a habitus that functions across fields: “The gendered body is a prime example of one ordered by norms, or discipline: women and men hold and use their bodies differently in ways that cannot be explained by biological difference alone” (p.332). Without delving into the nuances of where “gender” fits, I am comfortable understanding gender as both habitus and field. As habitus, the embodiment of gender and its impacts on behaviors, styles of work, individual trajectories, and aspirations can be understood. By seeing gender as a general social field that infiltrates other fields, such as engineering, one can conceptualize how the gendered habitus is shaped and reinforced. Gender, like social class, ethnicity, and economic capital, plays a role in each field (Adkins 2004:6; Chambers 2005:333). The extent to which gender plays a role may differ, but in each field there are rules about appropriate gender behavior, and thus an individual's gendered habitus develops in relation to both the overarching social field of gender norms and the particular field(s) with which they come into contact. Engineers, with a gendered habitus that is already shaped, approach their training and careers in a field that has its own "rules" about gender. Their families, education, and social class will have shaped their gendered habitus; in engineering this habitus will be reinforced or challenged.

In attempting to work with both Bourdieu's general social theory and a social constructionist approach to gender, one is faced with an important difference in the view of individual agency. Major criticisms of Bourdieu's work include that it is tautological (Everett 2002; Jenkins 1992), deterministic, and restricts agency (Chambers 2005; Everett 2002; Fowler 2003; Jenkins 1992; Phipps 2005). The criticism of tautology is related to his conceptualization of agents as guided by an unconscious habitus that cannot be proven or falsified (Everett 2002, 76). Jenkins (1992), further argues that the relationship of the habitus to the field and the reproduction of relations that this is seen to create is "a celebration of (literally) mindless conformity" (97).

> What this suggests is that the charge of determinism is, in Bourdieu's case, justified. In the 'subjective expectation of objective probability', the appearance of meaningful practice is actually the reality of a self-fulfilling prophecy. Social structure and history produce the habitus. This, in turn, generates practices which serve, in the absence of external factors, to reproduce social structure. As a consequence, history tends to repeat itself. (Jenkins 1992, 97).

That Bourdieu's work lacks agency is a legitimate critique and is, to some extent, even accepted by Bourdieu who acknowledges that he holds the field to be primary (Bourdieu and Wacquant 1992, 107). Further, Connell has critiqued Bourdieu's ideas of gender as tending towards functionalism (Connell and Messerschmidt 2005:844). That said, Bourdieu also stated that he does not accept that individuals within fields are merely mindlessly conforming. "They exist as agents… who are socially constituted as active and acting in the field under consideration… And it is knowledge of the field itself in which they evolve that allows us best to grasp the roots of their singularity, their *point of view* or position (in a field) from which their particular vision of the world (and of the field itself) is constructed" (Bourdieu and Wacquant 1992, 107). This is clearly a limited agency (perhaps more limited than theorists such as Connell would be comfortable with): individuals are not free and unfettered. But I see in this understanding a very important recognition of the strength of external and internal social barriers. Indeed these limitations can be seen to mirror the notion of gender order that Connell (2002) articulates. This is a view that, I believe, may help us to understand why women are not succeeding in non-traditional and leadership positions. As Wacquant notes of Bourdieu's work on structural limits, "The rigid determinisms he highlights are for him observable facts that he has to report no matter how much he may dislike them" (Bourdieu and Wacquant 1992, 80). Similarly for this project, as much as I may desire that women hold an equal number of positions of power to men, there are factors that limit this becoming reality. Ignoring these factors and stressing individuals' opportunities is what, I would argue, has hampered past research. Indeed, as McNay (1999) has argued, I hold that the value of Bourdieu's work is the extent to which he shows the difficulty of change (cited in Chambers 2005, 333).

Thus I do not see Connell's and Bourdieu's perspectives as irreconcilable. Rather, what Bourdieu provides is a framework for understanding the continuation of gender through the ways that particular gendered habituses fit in a particular gendered field. That said, Connell's critique of Bourdieu as describing gender in an overly deterministic way does have grounding, for Bourdieu does limit the role of agency. But Bourdieu does not preclude change. Rather he emphasizes its improbability and difficulty. I see Bourdieu as highlighting the power of gendered norms – the role of hegemonic ideals in shaping the actions and lives of both men and women. Connell's work, in turn, reminds us that one is not trapped, that there are options.

Conclusion

In this chapter I have outlined some of the past research that was critical to undertaking this project and contextualizing the findings. As described, a substantial proportion of the past research on gender in engineering has focused on the educational experiences of women in SET fields. The themes uncovered by this research, particularly expectations of individual responsibility, experiences of being outside the culture, and questions of self-esteem and confidence will be shown to resonate with professionals' gendered experiences. In addition to moving beyond educational experiences, I also argue for the need to differentiate between engineers and scientists, and for the need to go beyond "pipeline" models of careers in order to understand non-traditional career paths – and the experiences of those who have left the engineering profession - which have been largely unexplored.

In exploring gender in engineering the literature on gender and work has been critical. In the brief outline of this literature I have aimed to show my recognition of the importance of a perspective that acknowledges the gendered nature of organizations (Acker 1990), but that also calls for attention to the subjective elements of individuals' gendered experiences in organizations. This desire to include both the organizational and the subjective elements parallels my choice to combine an understanding of gender as socially constructed with the more "functionalist" works of Bourdieu. In both instances I am attempting to balance the objectivist with the subjectivist. I am working from an understanding of meanings as constructed and changing, but still limited by the surrounding structures.

In the next chapter I will take up the first research question: *What is the shape of the engineering field and how does it intersect with the broader social field of gender?* Here I will work to develop a profile of the engineering field using the first two (of three) steps articulated by Bourdieu as required in studying a field. The first of these is examining the relation between the engineering field and other fields (Bourdieu & Wacquant 1992, 104-105) and the extent to which engineering is autonomous. The second necessary element for studying a field is mapping out the relations between agents and institutions that are competing for the form of authority, or capital, legitimated within the field (Bourdieu & Wacquant 1992, 104-5). In addressing this I will examine the role of the professional association and question the power relations implicit in the field's dominant values.

Chapter 3: Engineering Field

The history of engineering in Canada begins in the 1850s with thirty-five men who "dared to call themselves 'engineers'" (Gingras 1990:144). During the second half of the 19th century the numbers of civil engineers grew rapidly (prior to this engineers were military engineers) (Ball n.d.), climbing to 719 in 1881 (Gingras 1990:144). Initially engineers were British or American, but in the 1870s engineering schools were set up in Toronto and Montreal. In 1887 the Canadian Society of Civil Engineers (CSCE) was formed in an attempt to develop standards for the profession; this was the first step in professionalization and setting up the current rigid standards for practice (Ball n.d.). In the latter part of the century the profession grew and specialized, with the beginnings of sub-disciplines in electrical, mining, mechanical, chemical, and petroleum engineering. In 1918 the society became the Engineering Institute of Canada (EIC), with the CSCE continuing but focused upon civil engineering. Notably no definitive histories of engineering in Canada have been compiled and little academic work on the topic has been undertaken (EIC n.d.; Guedon 1989).

In Alberta the profession finds its origins in the building of the Canadian Pacific Railway in the 1880s. The influence of engineers continued as the railways expanded, irrigation systems and urban utilities were put in place, and coal and petroleum resources developed (Mulder 2007). From its foundation in 1908 the University of Alberta has housed a Faculty of Engineering (Mulder 2007). The Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGGA) has regulated the practice of engineering in the province since 1920. As of October 29, 2008 there were 42,894 engineers who were members of the

Alberta professional association. This was made up of 38,082 males (both holders of the professional status and engineers in training) and 4,811 females (11.2 percent, both holders of the professional status and engineers in training) (email communication with APEGGA research assistant dated October 29, 2008).

In this chapter I will be exploring my observations of the engineering field in a very particular time and location.[12] To gain a sense of the engineering culture in Alberta in 2007 and 2008 I will emphasize the presentation of the profession found in materials produced by APEGGA, the Consulting Engineers Association (CEA), the engineering alumni association at the Universities of Alberta, and the Schulich School of Engineering at the University of Calgary from the 2007 and 2008 period.[13] As these are publications of professional, academic and alumni groups, it is important to emphasize that the rhetoric presented is far from

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[12] In this chapter, and throughout, it is important to note that the conceptualization of the field is provisional. Engineering in Alberta, as will be detailed, is not controlled to the same extent as other professions (e.g., medical doctors). While APEGGA attempts to regulate the profession there are people who undertake what is essentially engineering work without being licensed by APEGGA and have others who are registered review and "stamp" their work. Furthermore engineering encompasses a broad array of roles, disciplines and industries: from design to management, from civil to mechanical to environmental engineering, and from natural resource extraction to manufacturing to public infrastructure. Thus while I am describing engineering as *a* field, its breadth means that the constituent parts (e.g., disciplines, industries) could potentially also be analyzed as independent fields. That said, the interconnection between disciplines and the existence of *a* professional association that the majority of individuals are licensed under does support my conceptualization of field. The commonalities found in the responses provided by participants from a variety of industries and disciplines that are the subject of upcoming chapters further support that my conceptualization of engineering as a field is legitimate.

[13] Details on the publications selected and limitations in their representation of the field are provided in Appendix A.

critical of the field. Reflections of participants will be used to incorporate a complementary, and sometimes more critical, perspective. The discussion will show that although there is not a singular narrative of the engineering profession there exist themes – elements of the culture of engineering that multiple participants and texts discussed. In exploring engineering as a field, I will begin by describing the extent to which the profession is interconnected with the broader socio-cultural context - or the degree of the field's autonomy. Following this I will consider the ethical regulations that all Alberta engineers are guided by, before asking what dominant norms and values of the profession are reflected in the symbolic, textual and narrative materials examined. The chapter will conclude with a discussion of the structural patterns that can be found in the field in terms of locations of work, organizational hierarchies, work teams, and leadership and management.

Autonomy of the engineering field

Following Bourdieu, the first step in studying a field is examining the autonomy of the field.[14] Understanding the degree of connection between the

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[14] This discussion of autonomy is distinct from analyses of the extent to which professional associations are autonomous based on whether the profession regulates education or holds examinations for entry (rather than having these controlled by the state) (e.g., Adams 2009). In this context I am emphasizing the extent to which the employment and careers of individuals within the field are impacted by broader forces, including the economy and regulations for practice. Notably in this way engineering is similar to many other fields that are oriented towards providing services to other industries (e.g., accounting professionals). While limitations on autonomy due to market factors are not unique to engineering they are important in distinguishing engineers from scientists (particularly academic scientists) with whom they are frequently grouped in social research.

field of interest and other fields is critical (Bourdieu and Wacquant 1992:104-105). In the case of engineering, many of the products engineers develop are specialized and meant for other members of the profession rather than the public at large (e.g., a widget for a train engine or a chemical compound for decomposing waste from the oil sands), thus increasing the degree of autonomy of the field. That said, most engineers are clearly linked to corporate interests and are compensated in largely non-field-specific indicators (e.g., earnings). One of the greatest impacts on the profession in Alberta, is the profitability of the oil and gas sector. Other impacts to be examined are trends in management, as Kunda's (2006) work suggests, and government policies that impact the industries where engineering is conducted.

Given that the majority of engineering occurs within the private sector[15] it is not surprising that profits and corporate growth are important to most engineers and engineering organizations, which in turn means that the existing economic climate has a critical impact on the field. As a resource dependent region, particularly reliant on the oil and gas sector, the economic climate in Alberta can be seen as more volatile than other regions. From the early 1970s, for nearly a decade, the Alberta economy grew at unprecedented rate until the recession of 1982 to 1983. By the 1990s, with increasing oil prices, employment

[15] Finding detailed percents here has been difficult. The best estimate I have is based on the most recent (2009) salary survey. Of the 10,607 engineers whose salaries were reported (about 25 percent of the total engineers in May 2009) only 674 (6.4 percent) were in the "service-not for profit" category, which "includes governments and their controlled R & D organizations, regulatory agencies, educational and health care organizations, and Crown corporations" (p.22).

and growth in the province again increased (Stamp n.d.). The peak of this growth was reached in 2007, with unemployment falling to 3.6 percent in 2008 (Government of Canada n.d.). This boom was followed by an economic contraction, which saw unemployment rise to 7.5 percent in March of 2010 (Statistics Canada 2010) and the largest provincial budget deficit ever of $4.7 billion projected for 2010 (CBC News 2010). When I was conducting my research in 2008, the recession of 2009 was unforeseen and the province was in a period of unprecedented growth. This is reflected in the CEA yearly magazine, *Alberta Innovators* (Spring 2007). The cover story of the publication, "Boom Studies: Alberta's educational institutions embody rapid change in our industry" emphasized the growth in consulting engineering and that "the boom should keep everyone working for some time" (Messenger 2007:13). Also in the *Alberta Innovators* (p.15) the article "Young but Busy" emphasized the very high demand for new engineers, such that people were hired before they graduated and university training programs were increasing enrollment numbers to meet demands. A third article in the issue "Cold Facts in a Hot Economy: Infrastructure across Alberta is feeling the heat" detailed the growth in the province's cities and the infrastructure pressures the boom was creating (Kerpinsky 2007:50-53). This pressure was clearly felt by the participants in my study, many of whom reflected on the very heavy demands they were facing at work, the great availability of positions, and the pressures to return early from maternity leaves. The boom was also seen as a potential moment to positively transform the field, as this high demand could create opportunities for increased diversity, because organizations had to be open to hiring women and ethnic minorities.

This impact of the economic climate reflects the relative lack of autonomy of the engineering field. As a profession it is largely reliant on demand from other industries and sectors. This interconnection is particularly evident in the oil and gas sector in Alberta. Older participants reflected on the early 1980s and the downturn in the economy, in particular the impact of the National Energy Program on the oil and gas sector. Kim, who graduated in the late 1980s when oil prices were low, reported purposefully selecting another sector in order to work in a more stable and steady industry.

Limitations on autonomy in engineering can be seen at both the professional association and organizational level. Adams (2009) identifies the impacts of industry on professionalization in Ontario, where the mining industry worked to slow and alter the legislation governing engineering, and in Saskatchewan, where licensing was opposed by farmers fearing the loss of their ability to erect small-scale structures (p.209, citing Girard and Bauder 2007, and Millard 1998). The limitations on organizations' autonomy can most clearly be seen in the consulting engineering industry.[16] Consulting firms survive by bidding for projects and having the highest possible number of billable hours. These firms emphasize making profit and providing reliable service to one's clients. Consulting firms are at the mercy of the companies and industries that hire them. Consequently, they push people to get as much out of them as possible. Eric described that "an underlying pressure in the industry is to be very, very billable." He later continued:

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[16] Consulting firms also reflect many of the characteristics of professional service firms (PSFs) through their focus on providing advice, being knowledge intensive, and made up of professionals (Greenwood, Suddaby and McDougald 2006).

> I have a major problem in the profession because invariably, a lot of times, a project is, “we need that project. The only way we are going to get that project is to cut the budget or cut the plan-log, we’ll just make a plan afterwards.” When the project comes in it goes to somebody else who goes [*pretends to be reading over project*] “this is ridiculous, who put this together? Oh well, we’ll just have to get it done.” And some poor sucker’s going to get his butt flogged trying to get that thing done. Weekends and he’s going to have family yelling at him and wife threatening to leave him and kids don’t see him for three weeks because somebody put the budget together to get the project. It happens a lot and to me that’s just where the profession, all you’re doing is driving people away.

In contrast to consulting, the public sector, while not autonomous (as corporate pressures clearly influence the standards set and public opinion motivates priorities), can be seen to have different pressures and objectives. As Emma stated:

> Industry is bottom-line, “we want to make money.” With government their bottom line, if it’s environment, is environmental outcomes, so it’s a very different bottom-line. I mean individually the person working in government maybe their bottom-line is I want to make money by promoting environmental outcomes. But it’s yeah, a different, they have a different focus which is why we have multiple, multi-stakeholder groups where we try and do these consensus based approaches.

The lack of autonomy of the profession can also be seen, although to a much smaller extent, in the impacts of management trends. In discussing the leadership at his organization William explained that management was influenced by writers who came out with the new “it” approach: “…every once in a while, you get a guru like Michael Porter, and then people just hand out the books, and everybody absorbs it, even the big-headed engineers! *[laughs]* ‘This is the technique.’” Governmental and public policy can also be seen to have a notable impact on the field, as reflected in the earlier comments on the National Energy Program. Most of the engineers I spoke with presented as having limited respect for Government (either Federal or Provincial). Government departments were seen as developing and forcing policies on engineers without the scientific knowledge needed:

> Unfortunately it's my opinion that the problem we have our - the politicians are politicians, they're not technically sound anybodies and they are hardly what you'd call far-thinking or proactive and when they are proactive it's "put more cops on the street that'll stop crime" type of – very simplistic thinking.... Ethanol blended gasoline? It's a zero-sum game. You're taking arable land – and I'm sure you've heard this before – you're taking arable land which means the cost of food goes up ... It's still gasoline, it's just slightly better. (John)

This resistance to state involvement can also be seen as an indication of professional fears of a loss of power, for the self-regulatory nature of engineering can be seen as critical to the profession's continued status. Eric identified a final limitation to the autonomy of the profession -the socio-political environment. Beyond the direct impact that rules and policies play in shaping engineering work and products, engineering designs need to fit the cultural and social needs of the audience they are created for. He reflected on developmental work he had done and the recognition that they had "good engineering solutions, but not suitable for the socio-political environment into which they were going." Eric continued, "so that's when I started to say 'well okay, engineering's not just engineering, there's much more to it'." Notably this reflection by Eric was the only moment when a participant in my study discussed the socio-political implications of the products of engineering work.

Professional Ethics

> Our profession's ethics stem instead from the British sentiments expressed in the Ritual Calling of an Engineer. Through the Iron Ring we become conscious of the catastrophic failings of which we are capable; wearing it is an expression of humility. But are we too humble for our good or for the good of society? ... Individuals are expected to honour their moral and legal responsibilities or face prosecution and censorship.

> But given the pressures from superiors, all the way up to company directors and shareholders, the individual may face a serious dilemma. (Lock 2007:19).[17]

A critical element that sets the engineering profession in Canada apart from other fields is the existence and centrality of professional ethical regulatory boards. Thus while engineering is typically conducted on a for-profit basis within privately owned corporations, as a profession, like medicine or education, practioners are held (at least by themselves) to a high standard of ethical behavior.

The code of professional ethics that regulates engineers can be seen as "...central to advising individual engineers how to conduct themselves, to judging their conduct, and ultimately to understanding engineering as a profession" (Davis 1991:151). Davis (1991) argues that although ethics codes for engineers are frequently seen as "self-serving, unrealistic, inconsistent, mere guides for novices, too vague, or unnecessary" they fulfill an important function by creating standards or, in his words, "rules of the game." Using the example of the Challenger disaster, Davis (1991) argues for the necessity of codes of ethics: "Just as we must know the rules of baseball to know what to do with the ball, so we must know engineering ethics to know, for example, whether, as engineers, we should merely weigh safety against the wishes of our employer or instead give safety preference over those wishes" (p.155). With professional codes of ethics

[17] Although written by British author Rudyard Kipling, the Ritual Calling of an Engineer cannot really be considered British as it was written at the request of H.E.T. Haultain on behalf of seven past-presidents of the Engineering Institute of Canada (The Iron Ring n.d.). The Ritual of the Calling of an Engineer is not an oath nor does it designate having achieved a professional status. Rather it is a stated obligation to maintain profession ethical standards and undertake diligent practice (Jesweit n.d.).

one can know what is expected and if one can object to an unsafe practice as a professional - as an engineer - rather than merely as an individual (p.158).

While a few of the participants in this study did express negative sentiments about the limitations of the professional association, these were considerably less prevalent than positive sentiments.[18] In Alberta the code of ethics regulating the profession is the Engineering, Geological and Geophysical Professions Act (*EGGP Act*) and is made up of five "Rules of Conduct." (APEGGA n.d.). These rules include that professionals "hold paramount the health, safety and welfare of the public and have regard for the environment"; "undertake only work that they are competent to perform"; "conduct themselves with integrity, honesty, fairness and objectivity in their professional activities"; "comply with applicable statutes, regulations and bylaws in their professional practices"; and "uphold and enhance the honor, dignity and reputation of their professions and thus the ability of the professions to serve the public interest." As the professional association, APEGGA is an independent corporate body delegated by the Government of Alberta with the responsibility of enforcing the *EGGP Act*.

This responsibility is clearly reflected in APEGGA's monthly newsletter, *The PEGG*. Each issue containes a "Professional Practice and Ethics Corner" column written by Ray Chopiuk, the Director of Professional Practice, in which he answered questions submitted by APEGGA members about complying with ethical guidelines. The October 2007 issue, for example, responds to a question

[18] This may be a reflection of the fact that many of my participants were recruited through advertisements in one of the professional association publications, indicating that I may be representing the voices of people more accepting of the code of ethics than engineers in general.

regarding the need to sign and stamp copies of drawings. Each issue also includes a "Compliance" section. Typically, this section identifies violations of the code that have been reported (by either individuals or companies) and what decisions are made on the cases. Many of the violations reported involve using a restricted title when not licensed, for example "APEGGA Examinee candidate using engineering designation and Civil Engineer in title in e-mail signature" (*PEGG* 2007a:4). Other frequently reported issues are companies that do engineering (or geological or geophysical) work without a permit or whose permit has lapsed.[19] A third issue is ensuring that all indications of engineering are removed from materials when they are not (or no longer) permit holders.

An interesting example of the emphasis on professional ethics and the ramifications of not complying was the publication in the January 2008 *PEGG* of a three-page report (in a 36 page newsletter) of an APEGGA Discipline Committee Decision. The case examined whether a report prepared by a member was "deficient and misleading," with the major issue being that the engineer's report did not indicate that it was a summary and should not be used in investment decisions. The article details the professional Rules of Conduct that were broken and the sanctions set, which included a $5000.00 fine to be paid to APEGGA, a requirement to re-do the professional practice exam within six months, having the results of the meeting published with the individual's name mentioned, and paying the cost of proceedings ($12,981) within 6 months. The publication of these findings indicate the extent to which APEGGA does uphold

[19] Companies must also have a permit to practice if undertaking any independent engineering work.

ethical standards but, interestingly, no details were provided on why this was brought to council and what, if any, negative outcomes arose from the member's actions. While clearly this engineer was in error, this case and many of the others discussed in the Compliance section seem more focused upon the use of professional titles and representations of work, than on issues of ensuring safety, responsibility to the environment and serving the (non-corporate) public interest, as I will address below.

The intersection of corporate interests and being ethical can also be seen in the advertisements found in the APEGGA and CEA materials. Most salient was a focus on "integrity," particularly in recruitment materials. An advertisement in the *PEGG* by Suncor (July 2007) reads, "When you join Suncor, you enter a working environment where how you get the job done is as important as the goals you achieve. You'll be part of a company that's guided by strong values and beliefs; that demands a high standard of safety, integrity, responsibility and always strives to exceed expectations..." (p.25). Similarly a professional service advertisement from the CEA *Alberta Innovators* magazine (Spring, 2007) by ISL Engineering identifies this notion of integrity: "ISL Engineering and Land Services Ltd. provides excellence in design and consulting with a commitment to professional integrity, quality work and client satisfaction" (p.26).

The concern with safety and integrity was also reflected in the words of study participants. Kim, for example, described the values of her organization as "... respect for people, integrity, sustainability...". A number of the interview participants also identified safety, and importance of integrity and ethical practice, as something as central to engineering due to the potentially devastating nature of an error. Nick stated this most forcibly:

> … Realistically, it's [engineering] one of the largest influences on society as a whole. There are very few things in the world that cannot trace at least some part of them back to an engineer some place, whether it was on the design or with the execution. We do have a very wide-ranging impact on the world around us. There's an awful lot of responsibility that goes with that, of course. If an engineer messes up, it's not like a doctor where you might kill the patient; it's you could kill the town or the city. So that's one of the big things about engineering, is that it has such wide-ranging impacts.

One of the most dramatic examples of the ramifications of engineers' actions is the BP Gulf well blowout. Although the actual cause awaits a detailed investigation, media reports and testimony to Congress suggest that senior drilling engineers, confronted with a "nightmare well" that was behind schedule and sharply over budget, authorized several shortcuts from established practice which contributed to the blowout (King Jr. and Gold 2010).

In discussing their work practices, ethics also came up in relation to liability. For Kevin and Daniel, both men who continued to work in engineering, liability as a professional engineer was presented as a source of stress. Kevin discussed an aspect of his work which involved inspecting machines on site: "A lot of the inspection is done of equipment that is dirty and greasy and grimy, and I found I was always left with the nagging suspicion, 'Have I inspected it closely enough? Have I been thorough enough? Is there something I missed?… it may not even fail at the point where we were looking at the damage — but the history's all called into question." Daniel also reflected this concern:

> … I don't know whether it's a sign of age or being in the job too long, but the further along you go, the number of signatures you make, you start thinking about the cumulative liability that you've created *[laughs]* … "Okay, I've been here 20 years, I've signed so many certificates." We're hoping and praying that we've done everything we're supposed to have done, and nothing's going to happen on those issues, nothing will come back to haunt us by a smoking hole in the ground and bodies splashed everywhere.…

This worry over liability was, however, not shared by all of the active engineers. Matthew, in contrast, stated, “I think that’s where most engineers run scared; they’re always trying to avoid being sued. No, we’re not avoiding being sued. If we build stuff that works, why would we ever get sued? . . . And all of our insurance and their whole industry is based on the idea of how not to get caught.”

It is this sense of “getting caught” and of an ethics motivated by fears of being sued and liability that highlights the tension between the “bottom line” pushed by corporations and the role of ethics in the culture of engineering. Two of the participants reported having worked with companies where they felt corporate pressures were leading to ethically questionable standards of work. Both had left these organizations. But beyond quitting one’s job, is it one’s responsibility as a professional to report on one’s organization – to act as a whistleblower? This was the topic of a question in the Professional Practice and Ethics Corner in the July 2007 *PEGG*: “I’m a professional engineer working at a municipal drinking water facility. It has come to my attention that water quality testing, submitted to Alberta Environment, has been falsified. I asked my boss about it, but he just shrugged his shoulders. What should I do?” The member is advised that their “duty to the public is paramount” and therefore they should advise their employer of the threat. If this is ignored they should inform the employer they are ethically bound to present the information to the authorities, and then should disclose it to authorities to protect public safety. A second question asks about protection for whistleblowers. It is here that, despite the rhetoric of integrity and public safety, the power of APEGGA to protect engineers when they follow the rules is seen to be negligible: “There is no whistleblower protection legislation in Alberta, per se. … However, if you followed the

Guidelines for Ethical Practice … you have fulfilled your ethical obligation. Should your employer retaliate against you, you can file a complaint of unprofessional conduct against your employer" (Chopiuk 2007:4). The article goes on to suggest reporting the activity to Crime Stoppers. As a letter published in the following issue (*The PEGG,* September 2007*)* highlights, the hypothetical member is on the one hand required ethically to report, but then provided virtually no protection by the professional association. As the letter's author continues, "APEGGA's mandate is to protect the public, but it fails the public and its members by failing to protect its professionals when they are acting ethically in the public good" (Ferguson 2007:13).

This lack of organizational support, and individualizing of responsibility for upholding ethical standards, is further exemplified in the "President's Notebook" (a monthly editorial column in T*he PEGG* by APEGGA President John McLeod) from June 2007. Here McLeod writes of "personalizing professionalism" as the new philosophy for the association:

> When you perform your duties in an ethical, profession and responsible manner, you are personalizing professionalism. When you make sure your professional designation appears on your business card, you are personalizing professionalism. When you stand up for the public's interest and safety in the face of economic and other pressures, you are personalizing professionalism. (p.5)

Yet real support for individuals doing this seems unavailable. This "personalizing professionalism" also reflects the increasing individualization of society (Bauman 2001) as the risks that are produced as the outcome of corporate strategies and decisions (e.g., the BP Oil well blowout), become explicitly labeled as the responsibility of individuals to address.

Furthermore, broader ethical and moral issues are rarely addressed in the professional association documents. One exception to this is an article in *The* PEGG from October 2007 which raises the question of creating a curriculum that teaches engineering students to ask not only if something *can* be done but also if it *should* be done. This is one of the few instances where the implications of engineering are raised: "Applied science cannot claim to be amoral. … Imagine students and practitioners alike who were dedicated to the art and science of 'technosophy' – the wise use of engineering. Think of where this would lead the profession and society" (Lock 2007:19).

That said, one issue where the impacts – and responsibility - of engineering are being actively questioned is global warming. In the 2007 issues of *The PEGG,* discussions of the professional association's responsibility to address and be involved in environmental policymaking were prominent, particularly in the letters published. In the June 2007 issue, the cover story states that "APEGGA and its membership have roles to play in a planned provincial action plan" and that APEGGA has taken up a membership consultation to seek opinions on the science of climate change, its impact on the profession, and the association's responsibility in informing policy (Lee, 1). A second article in the issue reports on the general public's views on climate change and that the majority believe action needs to be taken (*PEGG* 2007b:3).

In September 2007 four letters were published in response to the above articles in the June issue. One letter argued that the responsibility of engineers is to find the facts and that "there is political evidence that the global warming theory was developed as a population control policy by anti-humanists who hate the idea of the creativity of the human mind" (Bohdan 2007: 12). A second concluded that "the most important job for an environmental committee of

APEGGA to do is to question why Alberta is spending all this effort on CO_2 emissions, which are actually beneficial for the environment, and ignoring the real pollution issues associated with fossil fuels…" (Kalmanovitch 2007:12). The third reflected support for APEGGA's aim to understand the phenomena more, while the fourth focused on the need for engineers to be more involved in public debate (Faulder 2007:13; Phelps 2007:13). The fourth letter makes the particularly important point that engineers are faced with balancing demands for cost effectiveness with public safety, yet the longer range questions of whether projects should be undertaken, and their social and environmental implications, typically remain beyond the scope of "ethics" as it is understood in the profession, namely, that engineers should not directly challenge the corporate interests for which the majority of engineering work is conducted. Furthermore, the value stance of a substantial number of engineers, as reflected in the first two letters remains one in support of the status quo.

Dominant Values in Engineering: Bottom Line, Efficiency, Innovation & Making a Difference

Throughout the textual materials, a core set of values for engineering as a profession were frequently referenced: a profitable bottom-line; efficiency; innovation; scientific objectivity; and improving the world.[20] While the latter three can be seen to fit with notions of ethical professional practice, the focus on *the bottom line* stands in contrast. Yet it was critical to the organizations and

[20] These five terms should be read as representing broader trends. The emphasis on the bottom-line, for example, is closely aligned with the "long hours culture" that will be addressed in future chapters. Aligned with science is a very strongly held belief in the rationality and objectivity of the scientific method.

industries in which engineering took place. As Angela observed, at the large oil and gas company where she works, the emphasis is on "increasing their production and reducing impact on the environment … it's about *[pause]* well, dollars…". Even in companies that are not completely focused on the bottom line, in Joseph's words, "numbers *always* matter. It's a numbers industry." While engineers pride themselves on finding creative solutions to problems, this creativity gains its worth when translated into dollars and earnings. The University of Calgary magazine, *Schulich Engineer*, reflects this in the Spring 2008 article "Commercializing Creativity: When ideas turn into products in the marketplace" (p.5). The story reports on a partnership between the National Alpine Ski Team and the Schulich School of Engineering led by Dr. Gerard Lachapelle. He describes the project – and engineering work generally: "We start thinking how our knowledge and technology – very often with modification – can be applied. This leads to new fields of application, new technology and results in better cost effectiveness" (Weir 2008:5).

Kevin provides another example of this financial focus, describing how little downtime there is in his office. You bill clients by the hour so you are working every minute of the hour. This has lead to what has been termed the "long hours culture" (Bacik and Drew 2006; Watts 2009a). In this culture the model of work is based on extreme commitment to work that is expressed through being present, rather than quantity or quality of work. Aligned with this, as Watts (2009a) found in civil engineering in the UK, are expectations of complete flexibility to work long hours, being available at all times, and being willing to travel at short notice; expectations that were experienced by some as very stressful. This "long hours culture" can also be seen to exemplify the idea that the companies engineers worked for are “greedy organizations”. The notion of greedy organizations was adapted from Coser’s (1974) concept of “greedy institutions”: institutions that “seek exclusive and undivided loyalty” (p.4) from their members. Organizations can, in turn, be seen as “greedy” through the extraordinary demands they place on their members, pressures put by the organization on the individual to weaken ties to other institutions (e.g., family), and attempts to influence members so that their identity is in line with the organization (Franzway 2000; Burchielle, Bartram and Thanacoody 2008).

The emphasis on the bottom line indeed seems to be becoming increasingly important for engineering. According to Anthony, the oldest participant in the study:

> Everybody looks at the bottom line as being the right answer, but making money seems to be more what people want, than success in what they do. ... nowadays, a lot of the aspects are — because a lot of the companies are publicly owned, they’ve got a duty to the shareholders, and the shareholders demanding that they make money, so the bottom line, I think, is much more important than it used to be, yes. Unfortunately.

This impact of shareholders, and their influence on what organizations focused on, was repeated during a number of interviews. John, for example, described how an industry will be described as being in a downturn when, in reality, profits have increased over the year before, just not as much more as anticipated, “It’s not that it didn’t make as much, it actually made more, but it didn’t make as more as they wanted it to and therefore the world is coming to an end right, you see that.” Expectations continue to expand seemingly without recognition that growth cannot increase indefinitely. [21]

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[21] Notably these interviews were completed in the peak of the oil and gas boom, so it may be that some of the engineers’ reflections would be somewhat less optimistic today.

A critical outcome of this bottom line mentality is that people, quality of work, and creativity can only ever be secondary. For Jack, this focus on the bottom line, something he described as being part of the maturing of a company, pushed the focus away from intangible elements like people towards a "focus on project delivery, lowest operating cost." This shift, he observed, might be the right one for the company but it does not ensure workers' potential is reached and makes retention of workers problematic. Tied to the bottom line focus is also a concern that it leads to a decrease in the quality of work, as identified by Anthony above. Results are promised for a certain cost and on a specific timeline that may not be feasible. People overwork, burn out and make errors.

Tied to the bottom line nature of engineering was a consistent theme of *efficiency*. This was expressed in three ways: by organizations selling their skills on the basis of their efficiency (often combined with expertise and innovation); by conferences or processes being sold to help increase efficiency; and by praise for individuals who are efficient. An example of corporate use of efficiency as a selling feature was an ad published by Autodesk Topobase in the *Alberta Innovators* magazine (2007: 6): "Spend less time searching for customer information and more time getting things done." An advertisement by Colt Engineering (in *The PEGG* October 2007:20) relied on similar notions of speed, alongside accuracy and reduced cost. The importance of efficiency is emphasized as a necessity brought on by the "boom" the industry is facing. This is reflected in advertisements for two conferences: Construction FORUM 2007 and Construct Calgary. The advertisement for the latter reads:

> It is not news that Calgary is undergoing major transformation. The economy is booming and as a result, along with every other industry professional, engineers, architects and other construction professionals are

> busier than ever. Every minute counts! Taking this into consideration, the eighth annual Construct Calgary Conference and Exposition has paid special attention in creating an event that will be worth every penny and every minute of your time. (CEA *Bullet* October 2007).

It is understood, indeed expected, that as an engineer in this "booming" economy you will be overworked and needing solutions as quickly as possible.

The back cover of the July *PEGG* (2007) presents an ad for APEGGA that draws upon three other prominent themes in the textual materials examined: *innovation, science,* and *making a difference*. The advertisement shows a compact florescent light bulb followed by "Proudly brought to you by Professionals in Engineering and Geoscience" in a very large font. The text continues below, in a slightly smaller font, "Since 1920, Members of APEGGA, The Association of Professional Engineers, Geologists and Geophysicists of Alberta, *have made a difference in the daily lives of millions of Albertans by bringing science and innovation to life*" (italics added). A similar sentiment is reflected in the message from the Assistant Dean of External Relations, David Petis, in the *U of A Engineer* magazine (the University of Alberta's Alumni magazine) (Petis 2007): "Fostering innovation. Transforming technology. Applying science. These are the roles and goals of the Faculty of Engineering" (p.2). Awards, such as "The Alberta Ingenuity Fund Research Excellence Award" also reflect these interconnected ideals: "The award recognizing professionals in academia or industry who have conducted innovative research in engineering, geology or geophysics that has been successfully applied to improve our economic and social well-being" (*PEGG* July 2007:16). These themes resonate throughout the textual materials. Engineers are innovators – they use their technical skills to create new and important things. Engineers are scientists – their work is objective and grounded in rationality. Engineers are making a difference – they are people with the ability and responsibility to change the world. While innovation, science and making a difference are themes frequently used alongside each other, when used independently innovation tended to be aligned with entrepreneurialism and creativity; science with objective and concrete problem-solving; and making a difference with leadership and professional development.

In the documents, *innovation* can be seen aligned with business interests and entrepreneurialism through profiles, advertisements for professional services, and recruitment ads. A profile in the Fall 2007 issue of the *U of A Engineer* of Art Price reflects this. In describing his successful business ventures, the author draws upon Price as an entrepreneur and innovator whose achievements: "reflects the ongoing success of the enterprising Price family of Acme, Alberta. It's also a testament to innovative thinking – a strength Art Price (Mechanical '73) comes by naturally" (Gravelines 2007:27). The importance of innovation is also reflected in a "Message from the Premier of Alberta", Ed Stelmach, in the *Alberta Innovators* magazine (2007):

> The CEA is setting a great example for industry in its promotion of best practices in engineering, particularly in these prosperous times. 'Unleashing Innovation' is one of four pillars of government's business plan, which goes hand-in-hand with addressing the requirements of Alberta's current economy… Congratulations on receiving a record number of submissions for this year's Showcase Awards, further evidence that Alberta's engineering community is both inventive and entrepreneurial. (p.7)

Innovation and being innovative were also frequently used in advertisements by engineering firms for their professional services. An ad for EBA engineers, a consulting engineering and sciences company, in the *Alberta Innovators* magazine (2007) reads: "We innovate" in a large font against a background of an industrial worksite with a forest in the background and a young Caucasian female named Shauna (by the name on her overalls) in the foreground. Dressed in safety gear, with pigtails tucked under her hardhat, "Shauna" appears to potentially be another "innovation." Innovation was also used, although less frequently, in recruitment advertisements. A McElhanney advertisement used innovation to describe their organizational culture: "We also foster a culture of innovation, with an established reward program for exceptionally creative solutions." (*PEGG* January 2008:35). This link with creativity that the McElhanney advertisement includes can also be found in an ad by TWD technologies (October 2007:25). In this ad for an Engineering Manager, the organization stresses its small size, emphasis on teamwork and flexibility, and describes its members as, "an innovative creative bunch with a focus on work life balance." The organization's small, creative and relaxed atmosphere is highlighted in the advertisement's header: a photograph of children in a movie theatre in 3-D glasses. This emphasis on the innovative solutions of engineers, their use of technical expertise in solving problems, will be a critical theme throughout this dissertation.

Related to the emphasis on innovation are frequent discussions of engineering as a "*science*." Given the types of work and methods used in engineering this connection is far from surprising, yet the extent to which it is a particular side of science – the applied and technical side – is of note. This is reflected in the message from the editor in the Spring 2007 issue of the *U of A Engineer*: "U of A Engineers have been part of many scientific and technical breakthroughs in history" (Steele:4). This emphasis on the technical is also displayed in event listings which involve technical competitions in two issues of the monthly CEA *Bullet*. The November 2007 issue has a listing for an upcoming dinner meeting of The Canadian Society for Civil Engineers that begins with a "Popsicle Stick Bridge Competition." A listing for National Engineering and Geoscience Week 2008 in the January 2008 issue describes that events will include "Kicking off the week, on February 21, are two APEGGA corporate challenge events where teams will compete in a mystery event that will test their skills." This technical orientation is also critical to the (masculine) engineering identity, as will be explored in much more detail in later chapters.[22]

The final related theme was the emphasis on *making a difference* or improving the world. As reflected in the "Rules of Conduct," an overarching goal of the profession is to "hold paramount the health, safety and welfare of the public and have regard for the profession." A desire to make a difference was also emphasized by many interview participants, particularly the women, who viewed having an impact as critical to their personal success (this will be described further in Chapter Nine). In the documents analyzed repeated references were made to how engineering was important because it "made a difference." A request for donations to the Faculty of Engineering at the University of Alberta

[22] An interesting juxtaposition to engineering as science were two articles emphasizing the importance of the arts to engineering. The first article, "The Future of Science is… Art?" in which Lehrer (2008) argues that in order for science to get past the current limits, "Science needs the arts. … The current constraints of science make it clear that the breach between our two cultures is not merely an academic problem that stifles conversation at cocktail parties. Rather, it is a practical problem, and it holds back science's theories" (p.24). The second article overviews the work of Dr. Alan Lightman a theoretical physicist and novelist scheduled to speak at the APEGGA Annual Conference (2008). The article relates Lightman's focus on "ways of knowing the world, different approaches to truth, and different patterns of creativity" (Toth 2008:10).

for the 100th anniversary in the Winter 2008 *U of A Engineer* magazine reflects this:

> This year, as we celebrate 100 years of engineering education at the University of Alberta, the 20,000th U of A Engineer will graduate... while the campus, the tools, and the technology may have changed, today's engineers share a common goal with their predecessors: to use human creativity and imagination, along with an understanding of natural phenomena, to solve the problems of society. (p.36).

Awards frequently include making a difference as a criterion. The Canadian Engineering Leader Award, for example, seeks nominations "for candidates who are models through their uncommon vision, sound common sense, commitment to the community and recognition as a leader" (*Schulich Engineer* Spring 2008:4). One of APEGGA's yearly awards is targeted specifically towards people who have made a difference: The Community Service Summit Award (*The PEGG* July 2007: 15). Helping others and giving back are also routinely emphasized by APEGGA in calls for volunteers and profiles of companies.

The idea of making a difference was also used by corporations to sell their services and recruit employees. UMA AECOM used this form of rhetoric repeatedly in its advertisements for professional services: "Through the combined efforts of over 28,000 people, AECOM offers a unique blend of global reach, local knowledge and technical excellence, creating a better world in which to work and live" (*Alberta Innovators* 2007:4; See also *The PEGG* July 2007:27). More frequently the ability to make a difference was used by companies in recruitment materials. McElhanney Engineering, for example, presents four images from Cambodia, one of temples and four of engineers working in the field, with the caption "Land Administration in Mine Contaminated Areas, Cambodia" (*PEGG* September 2007:41). Although the ad does not state, "make a difference" these images clearly call upon this type of desire. An advertisement for Earth Tech makes this call even more explicit. With an image of a young white woman surrounded by computer models, the advertisement includes the quote: "You must be the change you want to see in the world. Mahatma Gandhi." The text continues, "At Earth Tech, we focus on change. Change to improve the quality of life, to make operations efficient, and to build infrastructure to meet today's needs and tomorrow's challenges. All around the world, our clients look to Earth Tech for engineering solutions to deal with change. Earth Tech delivers solutions to help make a better tomorrow possible" (*PEGG* November 2007:26). Here the engineer is defined by a desire to "make a difference," a strategy that is probably highly effective based on its salience among my interview participants – particularly the women. That this call is made by a company that at the time was owned by Tyco International, a publicly traded company on the New York Stock Exchange with revenues of $1.3 billion in the 2007 fiscal year, suggests it may be more strategy than reality ("AECOM to Acquire Earth Tech from Tyco." 2008). The authenticity of the desire to improve the world versus the use of this notion as a powerful rhetorical tool, therefore, comes into question. As will be argued in Chapter Nine in relation to a number of the female engineers' experiences, while this rhetoric does indeed draw individuals to the profession, when it was found to be hollow they were left with little to keep them in the profession.

Practices of the Engineering Profession

In describing the engineering field it is critical to note that the profession is practiced in a wide array of organizations, from large public sector institutions, to multinational engineering firms, to corporations where engineers make up a small department or section of a department, to being practiced by independent contractors. However within this array of organizational forms and sizes, a number of very consistent work practices were found in texts and participants' experiences including: the two dominant locations of work ("the field" versus "the office"), the hierarchical structures of engineering organizations, the emphasis on teams and teamwork, and the forms of leadership idealized.[23]

Locations of Work: High pressure and negativity

Engineers undertake the majority of their work in one of two contexts, out in the field or in an office setting. These two locations lead to very different work cultures. The engineering profession, unlike other professions, retains very strong connections (both physically and metaphorically) with the trades and technical fields. These ties remain important to the daily work of engineers, as is reflected in the images of the profession presented in the textual materials analyzed. In the 68 page *Alberta Innovators* magazine (2007), the dominant image of engineering work is one of being "in the field" with the majority of photographs presenting industrial facilities, construction projects, and drilling sites. Engineers are frequently shown outdoors or on industrial sites wearing hard hats and coveralls. On the shop floor, or out in the field, the engineer's work focuses on the technical elements and the production of engineering solutions, which appealed to a number of participants. However, working in the field also

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[23] Other organizational elements that may also play an important role in shaping organizational culture, but were beyond the scope of this project due to the variance found in the experiences of this small sample, are organizational size, industry, whether engineers worked primarily with other engineers or with non-engineers, and the ownership structure of the organization (e.g., partners, publically traded or public sector).

typically meant working with non-engineers, which involved its own distinct culture. This was a culture in which an engineer often had to supervise or direct trades people who could be very senior in age and experience. It also meant a culture that was more aggressive and confrontational.

Working in the field typically meant long hours, isolation, and difficult physical conditions. Laura, recalling an early position, described:

> I was out in the field and what I discovered was for me was very challenging was to connect with other people because I could show up on Monday and work would say, "you're out in the field for the rest of the week". …the isolation and inability to connect with other people, build a community, that I eventually decided, "I'm going to leave this position."

The time demands of working in the field were felt by Kevin:

> …the [name] division is 24 hours a day, so it's just a game of keeping up with the jobs as they phone in any time day or night, and then managing to get sleep often enough, and enough to stay legal to drive to the next job … always on call…

More difficult for Kevin was what he called the "harsh environment" in the field:

> When we pull on to a site, it's demanded that we be there early — not just on time; that we be there, ready to go. And typically, most of the *[pause]* I'll call them *staff* — the crews on drilling rigs tend to be a rude, grumpy bunch. The drilling foreman on-site is responsible for everything, but the rig runs 24 hours a day, so he sleeps when he can … so you get a lot of people that are grumpy, and especially if they finish drilling at a certain time, and they need us to be there, it might be 3:00 in the morning. … So we've got to wake somebody up at 3:00 in the morning, and he only went to bed at 1:00. So again, that's part of that harshness. It's not a happy, friendly — there are no Wal-Mart greeters at drilling rigs. *[both laugh]* It's, "What the rr-rr are you doing?" You know the whole rig-pig phrase? It exists for a reason; these are generally not a cooperative teamwork type of a group of people. The lease hand, who's the lowest guy on the totem pole, gets abused by the guy above him, because when he was a lease hand, *he* got all the crap jobs and bossed around and called names and ridiculed, so when he moves a step up, he ridicules the guy below him. And it happens all the way up the chain. There were a few rigs that had a group of guys that were a bit nicer, worked together with a little more teamwork attitude, but typically, it's antagonistic.

The field was also a very gendered site:

> … when you show up with a female trainee engineer on-site, it goes one of two ways: one is, the chauvinists figure she doesn't belong there, and they're rude and dismissive; and the other way is, if she steps out of the truck to help lift the heavy tools out to the catwalk, to the drilling rig, immediately, there's a swarm of guys that want to come carry tools. … (Kevin)

The other context in which engineering occurs is an office setting. This was the predominant work setting of participants in this study. In describing the office environment, the social environment and the opportunities for personal development that were available were emphasized, rather than physical challenge and dealing with trades people. In participants' comments and in textual materials the form of culture that was presented as most desirable was fun, young and interesting. Urban Systems, which regularly ran recruitment ads in *The PEGG*, reflected this: "At Urban Systems, you'll work with some of the best minds in the business in a climate that emphasizes passion, excellence, growth and fun" (January 2008: 33). Another recruitment advertisement by Suncor worked to sell employment with the company in a similar manner "You want positive feedback for your ideas. At Suncor Energy, we offer a collaborative environment and a friendly, supportive workplace where colleagues and supervisors respect and encourage your ideas and innovation. … At Suncor, you'll work in an exceptional workplace culture – one that develops personal accountability and self-sufficiency and breeds a passion for achieving goals" (*PEGG* November 2007:24). Participants reflected these ideals of busy, friendly cultures in their descriptions of work cultures they had most enjoyed:

> … I like to work in a team environment that is project-based stuff, where there's a lot of activity and a lot of variety in the day, where there's meetings and phone calls and bits of things to calculate and people to get back to … (Michelle)

> … the group I'm with is really quite young and so I made some good friends and stuff right away… I felt like I was given some freedom and flexibility to kind of do some things on my own … (Tracy)

> I'd say it's pretty casual. These guys are all comfortable with each other … I don't think there's any yelling; I don't think I've ever heard anyone yell here. … We try to understand why it happens if something happens, and resolve it in the best manner possible. (Christopher)

Corporate environments, however, often did not meet these ideals. One of the frequent criticisms of the corporate cultures, which connects with the emphasis on the bottom-line and efficiency described above, was that employees were pushed to do too much too quickly, leading to poor quality and high levels of stress. Karen described her corporate experience as:

> …Very fast-paced; everything was deadline-driven and budget-driven as well. … So it was very intense. There was no time for learning; you just had to pick it up and run and go with it. So it was very intense, very stressful, people were under a lot of stress. Not a lot of camaraderie, a lot of complaining that went on. But some people feed off of that stress and that intensity.

A number of participants, particularly women, identified the office environments they worked in as very stressful. Emma related that her former workplace was "High stress, they were very high stress." Julie described a former organization as "high in pressure" with employees motivated by a feeling that organizational success depended on each deal made. She continued later: "it was a very aggressive environment there were more people burning out than – than saying 'I enjoy, I am happy with my work-life balance,' I don't think anyone would have said that. But also it's an environment where people choose to put in that time. So no one says [*hand slapping against desk*], it just ends up…" The impacts of this stress were clear in Tracy's description of her office:

> I think it's a pretty highly, like, sort of a high stress type of thing that gets fast-paced and there's pressure from our clients and stuff to get things

> done in a certain amount of time and, um, I'm noticing it more, there's been in our office alone in the last year, like, four men who've had heart attacks and they're not like over 50 years old, two are really young and it's just – so I don't think that's a coincidence, so I think it is kind of a, I don't think people relax enough.

Although extreme, Tracy's story reflects the high pressure nature of work in engineering in Alberta at the time of the study. And, while this culture was broadly recognized, little appeared to be being done to challenge it. Rather as Eric relates, it could be seen to work in the interest of those in higher positions: "The worst is that nobody in senior management has gone to anybody and said 'okay, we're working too hard' because [*pause*] it suits them to have a workforce that is just like blowing the socks off everything. But it's not just alright, or equitable, or reasonable to work someone like that."

A second theme was that the corporate environment could be hostile and negative. A number of the participants, all of whom were female, critiqued the use of yelling in the workplace. Jennifer stated, "Yelling. That's, like, the number one tool that people have in their toolbox at [company]: they yell at you. I've been yelled at. I've never been yelled at in any other job in my life." The extent to which this becomes an accepted aspect of an organizational culture was reflected in Erin's description of moving to a new organization where yelling was not the norm:

> ...Like managers yelling and screaming and swearing at their subordinates in front of others, so like just downright abuse. Um, and just a lot of like game playing crap. Very manipulative, um, it was just um, it was exhausting actually. So, um, I mean that's another thing that I would find satisfying about [company B] it's very professional, it's very quiet, first week I walked around and I was shell-shocked because no one was yelling. Everyone was polite. No one was swearing, I mean it was the weirdest thing. It was just so bizarre.

Negativity was not always as overt as the above examples; in other workplaces a complaining and apathetic culture dominated. Karen, whom I quote above describing the intense pressure of her workplace, expressed:

> … I was shocked with just how apathetic people are. This is generalizations, too; there are some very motivated individuals that really enjoy their jobs. I was shocked at how many people don't like their work, and if you don't like your work, it's very hard to do a good job, because if you're not motivated, how are you going to do a good job? So that's what I found shocking — and probably incredibly naïve of me until I went out there — is just so many people out there don't like what they do; they're just doing it for the money, for the paycheque … So when you manage people like that, it's *very* hard, because they're unhappy, and it's how to motivate them and inspire them when they don't really even enjoy it. It's a tough one.

Rigidity, hierarchy & order

In the organizations in which engineering occurs hierarchies predominate, even when the organizational culture is such as to deny these hierarchies existence (Kunda 2006:30). That engineering careers and engineering firms remain very hierarchical is reflected in the yearly *APPEGA* salary survey, which includes a detailed "job evaluation guide." An individual's score based on this guide, which breaks down one's position into 9 parts (e.g., duties, education, years experience, supervision, leadership), is used to determine one's job description and level of responsibility. This job description can then be used to compare one's salary to others with a similar level of responsibility. Levels of responsibility range from Engineer-in-Training and Jr. Design Engineer (level A), through Project Engineer (level D), to Engineering Manager (level F).[24]

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[24] The median total cash compensation for each of these groups in 2009 based on the survey for engineers in all industries was: Level A: $67,824, Level D: $118,590, Level F: $180,340. (APEGGA 2009:28)

For a number of participants, all of whom were critical of the profession, engineering's structured nature was one of its most problematic elements. Jennifer described the industry she was in as "very old school … very hierarchical in the management style." Ben, who had left engineering, described the field as "too structured and too quantitative." Critiques of engineering based on its rigid structure related both to the nature of the work and the dominant career path. Karen described having found a position in an area that was open and creative, in comparison to the "very rigid, scientific background" she had gained through her engineering training. The impact of the hierarchical nature of engineering on one's career path was noted by Jack, who described leaving engineering as getting "off the escalator and got into a boat":

> I know people that plan their careers out by stages: "In 2 years, I'm going to be VP of this, and then I'll be EVP of that," or whatever it is — and they're on this escalator, and the walls and the sides of that escalator are really high, so they only see one future for themselves. … So you get in your boat, and you've got this ocean in front of you, and you're going, "Oh, my gosh, the wind is blowing me over here today, and over there, somewhere else." From an engineering perspective, very different kind of world than the planned, ordered, organized, focused, outcome-oriented world.

This ocean can be a scary one, where the future is not clear, where one cannot plan out their path until age 90. And it is a path much different from the world Jack had inhabited while in the profession.

Notably, as Kunda (2006) describes in his study of an information technology firm, this hierarchical structure is at times "hidden" by a discursive emphasis on an idealized unstructured organization. Jack, for example, in an earlier part of our discussion described the merger of a company he worked for with another as "the cultural clash of the teddy bears and the GI Joes." The company Jack was with was the "GI Joes": "'the free-wheeling, everybody-does-what-they want type thing – that's why it was so great." This embrace of a "free-wheeling" organizational style reflects Miller's (2004) description of the dominant images in the oil and gas industry in Alberta of the frontier and rancher. Yet, despite this rhetoric of the idealized "free-wheeling" organization, there was little to suggest a non-hierarchical organizational structure was actually common.

Teams

> …it's the last class on a Friday afternoon, 2 o'clock, and of course you end up developing friendships because people need help. I don't know what it's like in – when you were in university – but the first two weeks you start looking for – if you don't have friends that you go to school with you start establishing relationships because you can't do it by yourself. *Engineering is not about a single individual, it never is*. (John)

> The idea of an engineer working as a solitary person is gone … Now virtually every engineer works in a team with other engineers and professionals in other disciplines … and now that engineering and science are global activities, engineers need to be able to function in multicultural groups and communicate well. (Dr. Maria Klawe, President of Harvey Mudd College, quoted by Cook 2008, p.12).

Of the prevalent notions of what engineering is, or how engineers work, one of the most dominant is that engineers work in – and should work in – teams. This notion is reflected in the words of John above, and others, who discuss the importance of working in groups to surviving their undergraduate training. For instance Patricia related that, "I think you pretty quickly figure out that you have to become part of a team in order to succeed. There were very few people who'd go through engineering by just doing it on their own."

In discussing their work experiences the majority of the interview participants brought up the team-oriented nature of their work and the ways in which it was beneficial: "I have certain knowledge that I bring to a team, and everybody else contributes their little bit, whether it's technical ability — being right out of school and a totally different technical ability than I have … Teamwork is exciting, it can be nice" (Don). What teams allow for is a bringing together of different perspectives and areas of expertise, thus the best teams, as Lisa relates, are those with the greatest diversity: "… I've seen it in teamwork over and over. That the more diversity you have in a group – not male, female – diversity in terms of thought process and thinking off the wall, etc., the better solutions you come up with."

That teams are advantageous was further reflected in the rhetoric of the profession. Organizations, for example, emphasized their team-based approach as a way to sell their services. A short article reprinted in the September 2007 issue of the CEA newsletter reflected this, advising consulting firms on how "to sell the value of your *team* to clients" (italics added). It is not the skill of an individual engineer that is emphasized, but the combined skills and project orientation of "the team." In recruiting, employers frequently listed "team player" among the desired attributes of a future employee. An AECON advertisement for example read: "If you are a dynamic team player willing to drive success and uphold our high safety standards in a fast paced environment we want to hear from you!" (*The PEGG* October 2007:27). Organizations also used their teams to attract employees: "…we offer co-operative team environment, access to senior management, open communication styles and an emphasis on our clients" (Klohn, Crippen, and Berger in *The PEGG* September 2007:42).

Leading and Managing Engineers[25]

In the engineering profession, movement into leadership positions is the typical promotional path and developing strong leaders is of clear concern to the professional association and programs that train engineers. APPEGGA gives yearly awards, such as "The Centennial Leadership Award," to "recognize leadership and excellence … and the contribution of APEGGA professionals to the economy and their communities" (*The PEGG* July 2007:14). Regularly *The PEGG* includes advertisements for professional development seminars, which emphasized leadership, such as "Coaching for Commitment" (October 2007:10). *Schulich Engineer* devoted its Fall 2007 issue to leadership with articles describing engineering leadership in a global economy (Fripp 2007), women as leaders (L'Abbe 2007), student experiences as leaders, profiles of leading engineers (Hayden 2007; St-Denis 2007), and announcements of the winners of the 2007 Canadian Engineering Leadership Award and the 2007 Dean's Award for Corporate Leadership.

Throughout these textual materials, and the interviews, a range of descriptions of what a leader should and should not do were presented. The most common critique of leaders, identified by a number of the younger participants, was that they did not lead. Jacob, an EIT, reflected a perceived lack of guidance: "I just think there should be more peer review and more closer emphasis placed on actually signing off on things, you know." For Joseph poor leadership as a young engineer had meant not being pushed hard enough: "I have left because of

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[25] Some engineers work under managers who are not engineers. However, I'm focusing on engineers as leaders in this discussion.

poor management, or because I felt — let's say I considered myself almost like a race horse, and I felt like 'I'm not being utilized here. I'm not being driven. They're holding me back, or they're not pushing me enough,'…". Senior engineers criticized a lack of overall organizational control leading to different departments or teams being led differently and creating organizational conflict. They also were concerned that leadership had come to mean compliance with standards (e.g., performance reviews) rather than with actual guidance and development.

More frequently emphasized, both in interviews and textual materials, was what made one a good or strong leader. One of the clearest statements of this came from Joseph who, as quoted above, saw a bad manager as not pushing him. When asked to describe a successful engineer he responded in terms of a good leader (who was also "naturally" male):

> It would be a very good leader, a strong leader. He'd be very diplomatic in what he says. He'd be extremely calm. He would be generous with his knowledge. He would be forthright and honest, and will have worked on a — that would be his personal qualities. In terms of his job credentials, I'd say he's someone who's seen — who's had quite a lot of experience, who's worked on different volumes of projects, different scales of projects, small projects and large projects, and someone who's good with words, someone who can explain complex ideas in really straightforward language without using highfaluting words.

Terms used to describe good leaders included devotion, originality, inventiveness, courage, vision, motivation, love of the profession, results focused, curious, hardnosed and decisive. Sansone and Schreiber-Abshire (2006) argue that specific criteria for leaders in SET should include:

> Sense of purpose; confidence in making an impact; assertiveness; receptivity to feedback; long-range view of the organization; ability to engage others in a compelling vision; propensity to architect operational systems and design effective strategies; strong need for continuous learning, for rigorous process, and for the production of substantive

> information; internal motivation for competency; orientation toward working with others (p.41-42).

They go on to note that while these traits are typical for good leaders, they are often not highly valued in SET work environments where emphasis is on knowledge and technical mastery. Indeed while having technical expertise was recognized by my interview participants as signifying leadership, moving into leadership positions typically coincides with a move away from the technical. Jack, who had reached a senior engineering position before leaving the profession, described this movement using a particularly illustrative metaphor:

> … I used to liken it to the thickness of the gloves you had to wear. As a do-work employee, you actually got to touch the tools, but when you become a leader, you put on the snow mitts, and then if you're a leader of leaders, you'd better have boxing gloves on, 'cause you're that far removed from the machinery.'

This tension between the interpersonal skills of an idealized leader and the technical skills of an engineer will be critical in later chapters in explaining the professional identity and commitment of engineers.

From the perspective of the field, leaders also play a critical role in shaping overall organizational cultures. Leaders are the people who, in Bourdieu's terms, hold capital that is accepted as symbolic of power in the field. As in any organization, working under a particular leader or manager can greatly impact one's experience. This was reflected by Alex who described how positive his experience at one company was in comparison with colleagues working under another supervisor at the same company who had much less freedom. Both Jack and Eric, who had achieved management positions but were critical of the profession, emphasized the need for changes in how management and leadership was conducted in engineering. Beyond the day-to-day, leaders also play a critical role in shaping the organizational culture (Sansone and Schreiber-Abshire 2006). Erin, in reflecting upon a past work experience, presented a clear example of how much impact leadership can have on an organization:

> I was hired on by [name] who was an amazing, amazing, amazing leader. Wonderful. Wonderful, wonderful. And um, as a CEO he was like visionary, absolutely visionary. And, um, about a year and a half before I left [name] became CEO and he's … militaristic, top-down, hierarchy, do as you're told. So again, um, the culture at [A] had been quite amazing up until the last couple of years, in which case it was just – reverted 20 years, just like that, instantaneously … when he retires I mean there could be some change, but again I think it's contingent on the leadership and the leadership style. A large part. So, if you've got a leadership that's supportive of balance, say, and allowing folks to self-define and um, great, but if you don't then you're lost, you're sunk.

Conclusion

In this chapter I have addressed the first two steps outlined by Bourdieu as necessary for understanding a field: examining the links between this field and others (or the autonomy of the field) and beginning to explore the dominant values and structures of the profession (Bourdieu & Wacquant 1992, 104-105). Both the textual materials studied and participants' reflections on the culture and values of the profession have been critical to developing this analysis of the field. In examining the autonomy of the profession it was argued that the engineering profession is closely linked with other fields through the impacts of economic climate, policy initiatives, management trends and socio-cultural needs. Of particular importance to the profession in Alberta is the Oil and Gas sector, which at the time of the interviews was in a period of growth that greatly influenced participant's sense of opportunity, as will be explored in upcoming chapters. Because of this resource dependency, however, the profession in Alberta also faces downturns and a general dislike of government policies that regulate these industries, insofar as policies may negatively impact the profitability of the industries (such as the Federal National Energy Program in 1980 and Alberta's decision to increase royalty rates in 2008).[26]

Moving from the links between the field and other fields, attention was turned to the critical elements that define the profession. In doing so, I add to the existing literature on the engineering profession, including Kunda's ([1992] 2006) *Engineering Culture: Control and Commitment in a High-Tech Corporation* and Kidder's (1981) *The Soul of a New Machine*. The culture revealed in these texts was built around engineers who were:

> Addicted to their work, living from vending machines, and often (it is said) perilously close to "burnout", they have survived what is called (with only some irony) "life in the trenches": hard work, ambiguous responsibilities and roles, a confusingly complex organizational structure, a decentralized "bottom-up" decision-making process, high levels of disagreement and confrontation, all coupled with a general sense of employment security and a belief in the intrinsic value of the products. (Kunda [1992] 2006: 28).

Many of the trends reflected in Kunda and Kidder's work were also reflected in the words of my participants and the textual materials produced by the profession. Engineering in Alberta at the time of the study was presented as under critical pressure to be efficient and was seen to idealize long work hours. Confrontation, yelling and hostility, as I explored, were also addressed by many

[26] The contextual factors of resource dependency and availability of employment reinforce that the field examined for this study should not be taken as representative of the profession generally. While this context does allow for interesting premises to be held (in particular what it means for retention that one could find work if one wanted it) this is certainly a particular moment. That said, the unique confluence of factors at any moment or location render the same cross-sectional limitations. To address this, as I will discuss in the Concluding chapter, comparative studies in different economic and industrial contexts are needed.

participants as central to the work culture. And technical products were seen as the key contribution of engineering – indeed even making the world a better place.

In addition to reinforcing the existence of many of the themes Kunda reports, the current research also points to an important tension that exists in the field between the "bottom-line" pressures of private industry and the ethical principles of a profession. The professional association, as seen in the "Rules of Conduct" and publication of compliance issues to remind professionals of their obligations, reflects a strong emphasis on integrity and upholding public safety. That said, little support is given by the association for upholding these standards. Integrity is used as a selling point, but putting it into practice is up to the individual as they "personalize professionalism".

This tension between the financial and ethical can also be seen in the values of the profession. On the one hand engineering is dominated by private firms (either consulting or larger industrial firms) where the bottom-line and efficiency are key goals. On the other hand, ideals of innovation and making a difference resonate throughout the materials and reflect an ethical impetus. In examining these values it appears that the ethical is important – so long as it does not mean negative ramifications for corporate interests. Indeed while "making a difference" is an important talking point, little attention is paid to how products can be developed that would actually better the world or whether products should be made (rather than can they). As will be described in upcoming chapters this tension between the corporate and the ethical also aligns with professional identity and gender.

The structures of engineering - where it is located, the hierarchy of positions, the importance of teams and the desired traits of leaders - reflect further tensions. On the one hand leaders with good interpersonal skills and teamwork are stressed, yet on the other participants relate the negativity and hostility of actual interpersonal relations in the workplace. While the profession can be seen as structured in a hierarchical manner, many participants stressed the importance of fun and social work environments. Work was presented as stressful and high pressure, yet some still felt they were not being pushed hard enough. Thus the field, particularly as it was interpreted through the eyes of people working in it, was experienced in very diverse ways. This diversity will remain important throughout the upcoming chapters as it helps to contextualize the differences between individuals' experiences. In the next chapter I will continue to develop a picture of the engineering field, emphasizing that although diversity (both gender and racial) in the field has increased, and that this diversity is generally well represented in representations of the field, the values of the engineering field remain traditional and conservative.

Chapter 4: Diversity in the Profession

> *Interviewer:* I'm interested in diversity within the engineering profession.
> *Lisa*: Narrow. Very, very narrow! [*laughs*]

> It is a white male profession. Absolutely. Not only is it a white male profession, it's a white male conservative profession, so you're getting — and very rural, too, I'd say; you're getting a lot of kids from farming communities that come into engineering as well. Nothing wrong with that, but it's just it's a very — here at U of A ... Oh, my gosh, it's a white male farm boy community in engineering. Absolutely. (Karen)

> They say electrical engineering's about 10% female – I always used to joke that of that 10% I couldn't even tell which one's were the females. I'm a little mean, but anyways. And then when I got, in chemical engineering I think they say it's about 30 percent female, so that was that was kind of nice, there were girls that looked like girls in chemical engineering. And – this is so stereotyping but I'll do it anyways – there's a lot of the brown guys go into chemical engineering and they are just a lot of fun. They like to party and they kind of, they have a good vibe to them. Very stereotyping – electrical engineering tended to be a bit more of like the Asian population and they would talk to each other in Chinese, so if you were kind of like a white female, you were sitting there like, I have no friends, I have no one to talk to, I don't fit in. (Emma)

The dominant image of the engineering profession is that of a politically conservative field with little diversity. It is seen to be, as Karen states above, white, male, conservative and rural. The conservative nature of the field can be seen, for example, on the cover of *The PEGG* from January of 2008 which features a Christmas tree ornament with text that reads: "Merry Christmas & Happy New Year! From the Staff, Council & Executive Committee of APEGGA." Despite general cultural shifts towards inclusiveness, APEGGA's seasonal greeting makes no attempt at incorporating diversity, choosing to remain rooted in an assumption of Christian dominance. That said, as Emma's words reflect, ethnic diversity – at least on a numerical basis – can be seen to increasingly be the "reality" of the profession.

In this chapter I will be exploring increases in diversity, both in relation to gender and race, and how these differences are represented and understood in the profession. I will begin by exploring the extent to which the profession is male dominated, starting with representations of engineers from the textual materials and moving into the ways in which engineering reflects a masculine culture. In discussing the culture of engineering I will emphasize the ways in which the norms of engineering, such as scientific objectivity, technical skills, and the bottom line emphasis described in Chapter Three, reinforce a masculine culture. The impacts of this culture on women, and the need for continued encouragement to recruit and retain women, will then be addressed in the chapter. Although not the focus of the research, in this chapter I will also explore racial diversity in the profession, examining representations of the field as racially diverse and then engineers' awareness of, and concerns with, diversity in the profession. Throughout this chapter I will argue that, while numbers of women and visible minorities in engineering may be increasing, the engineering field remains dominated by and reflective of a traditional and conservative set of racialized and gendered values.

The Engineering Field as Gendered[27]

The most obvious way in which engineering is gendered, unsurprisingly, is the numerical dominance of males within the profession. Engineering, like other professions that gained professional status in the late nineteenth century was "created by middle-class white men" and can be seen to be defined by "middle-class white men, for middle-class white men" (Adams 2000:4). As of October 2009, as reported earlier, only 11.2 percent of the individuals registered in Alberta as engineers were female. The low proportion of engineers who are female was reflected in participants' experiences. Don, one of the older participants, reported having very little contact with females as engineers throughout his education and professional life:

> … In my classes, there was probably only two or three females … I interviewed one girl that was quite clever, but not a tinkerer… But the only other time I've been in proximity to women in engineering was — and certainly, you get the odd engineer consultants — is my daughter, when she went into engineering.

Another example came from Jennifer who described being at a conference and "everyone was saying, 'Oh, who are you married to?' I'm, 'No, I'm not. I'm married, but I'm actually a designer here.' It was kind of funny."

To explore the gendered nature of the field, I will begin by examining images of the field, both in terms of representations of men and women and the dominant themes presented in the textual materials. (See Appendix A for an overview of the materials and analytic strategy). I will then discuss how a

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[27] Given the focus of this dissertation on gender, and the need to develop the gendered aspects of the field in setting the stage for upcoming chapters, this section will be developed in much more depth than was the discussion on visible minorities.

number of the dominant norms of the profession reflect gendered (masculine) norms, such as the emphasis on rationality and "hard" skills. The discussion of the gendered culture of engineering will conclude with some observations about the negative impacts of the masculinity of the engineering culture for women: lack of support; "joking" as an interaction style; and overt sexist treatment.

Representations of a masculine profession

The images in the documents clearly revealed that engineering is a male dominated profession. (See Appendix A for details on the publications selected, the data collected from the texts, and the forms of analysis undertaken). The University of Calgary materials, perhaps because the faculty has a female dean (Dr. Elizabeth Cannon), had the highest proportion of females imaged. In the three issues examined, 38 percent of people imaged were females. In the CEA *Alberta Innovators* magazine (2007), 25 percent of people imaged were females. On average 32.8 percent of images in issues of *The PEGG* were of females (from a low of 15 percent in October 2007 to a high of 46.8 percent in July 2007). The publication with the fewest images of females was the *U of A Engineer* (University of Alberta engineering alumni magazine), with an average of only 7 percent of the people imaged per issue being female, and with one issue having zero representations of women.

Based on this count, it appears that these publications, with the exception of the *U of A Engineer*, are imaging a profession that is more demographically equitable than the current reality. A straight numerical comparison, however, does not take into account the role in which the individual was imaged. In two of *The PEGG* issues, for example, there were large group shots of women who are members of the engineers' wives clubs. Women were also frequently imaged in relation to stories on human resources and programs that encourage women to enter engineering. The men, in contrast, were never imaged as husbands. Additionally, when profiles of successful engineers were presented they were overwhelmingly male.

As part of the textual analysis I also examined these publications for latent themes (see Appendix A for details on qualitative analysis of text and images) and found four interesting symbolic frames: the rough and ready explorer; the competitive sports player; the composed businessman; and the technical worker. These frames, which were reflected throughout the publications, were particularly salient in advertisements. Given the focus on succinct messages in ads this is not surprising, but it also indicates the extent to which these frames are positively perceived.

The *explorer* image, a predominant image of the engineer identified in the work of Miller (2004), was common in the symbolism that advertisers drew upon. An advertisement by *Colt Geomatics*, a division of the largest engineering, procurement, construction and management company in Canada, reflects this frontiers*man* image. Placed in the July 2007 issue of the *PEGG* this advertisement images an "idealistic" Albertan landscape. It is winter in the forest. A logging road runs through the trees, with a pipeline following it. No people are shown, yet the ruggedness (and masculinity) of the scene is clear. Here the engineer has allowed us to harness nature; to use and develop its bounty. The company's logo (which is reflected throughout Colt's materials) of a horse running free, reinforces this Wild West image. Yet the text of the ad - "when experience counts" - indicates that this is not an unbridled world.

Experience and expertise (which set the engineer apart from the tradesman) are reinforced.[28]

A second metaphor that was drawn upon is that of the *competitive sports player*. This can be seen in an advertisement by *The Mergis Group*, a large headhunting organization. In this ad, which targets engineers, they write:

> You deserve the best. You are among the top Oil and Gas professionals in your field, and considering taking your career to the next level. When you're ready, we're ready! You deserve Mergis representation. … We work like sports agents, but for Canada's business professionals. (*The PEGG* June 2007:31)

This linking of the oil and gas industry "players" with athletes reinforces the implicit dominance of masculinity – and a particular form of masculinity. This is a competitive, individualistic masculinity. The engineer in the oil and gas industry is thus more oil man – more rough and ready, competitive and strong – than the "nerd" of the Dilbert engineering world. The importance of sports analogies was also reported by Duerden Comeau and Kemp (2007), who identified the role of these metaphors in normalizing masculinity, youthfulness and technical ability among workers in small information technology firms.

A third way in which engineers were portrayed was through the image of a *successful "businessman."* Interestingly, while this frame dominated the actual content of the publications, it was much less common in the advertisements, particularly those presented by engineering firms. When the successful business*man* image was drawn upon in engineering advertisements, it was

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[28] Throughout the interviews, a need to differentiate themselves as engineers from people trained in trades was evident, perhaps indicating a professional insecurity stemming from the early trade-oriented nature of engineering.

almost always in combination with images and/or references to the technical. *Emerson Process Management*, an international process automation firm that is a subdivision of the larger firm *Emerson*, ran a recruitment advertisement in the October 2007 issue of *The PEGG*. The text of the advertisement asks the reader "Who builds monuments to ingenuity that are the beating heart of efficiency and bottom line productivity? You will – if you work for Emerson" and emphasizes the corporate success that the individual will gain as an employee: "Work and learn with the best minds and technology in the business. Imagine your possibilities and your growth – in 85 countries around the world, Emerson's 120,000 employees lead the way." The masculinity of this combined corporate and technical ideal is reflected in the image, which shows a white male in a dress shirt and pants facing away from the camera. In his hands he holds a conceptual sketch, signifying his engineering identity. On the wall in front of him is a reflection of a much larger male figure, flexing his biceps. This reflection appears to represent the engineer's inner-strength, his physical prowess. An interesting aspect of this advertisement is that it was also published in the January 2008 *PEGG* (p.34) with two changes: while all of the text remained identical, the person imaged was changed to a woman of color (again in dress clothes) and the reflection was now of a non-gendered person holding up a large sphere. In parallel these ads suggest that personal success, technical achievement, and strength are norms accepted by *Emerson* – as things any employee would want whether they are male or female. The masculinity of these norms, however, becomes invisible - gender-neutral - when the engineer identified is female.

As reflected in the text of the *Emerson* advertisement, the *technical* continues to play a major role in creating and selling the image of an engineer, particularly in the advertisements to recruit employees. A recruitment advertisement by *Shell* (*The PEGG* September 2007:43), for example, shows three “engineers” against a bright blue background with computer graphics of machinery. All are people of color, two are male and one is female. One of the men sits in front of a drafting board; a page of diagrams rolled and held over his shoulder by a perfectly manicured hand. In a background inset, the second male and the female stand smiling broadly and looking up into the distance following the second man’s pointing hand. Dressed in coveralls, safety glasses and hardhats, they reflect the emphasis on safety and diversity that the text describes. The ad calls to “engineers and scientists who are confident communicators and decision makers, analytical thinkers and enthusiastic team-players all wrapped up in one.” Apparently the image that best portrays this direct call to an engineer is one that emphasizes the design elements of the profession.

In all of the publications, in addition to details on upcoming meetings, seminars and policy changes (both by the associations and relevant government departments), profiles of successful engineers and engineering firms were presented. One issue of the *U of A Engineer* (Spring 2007) contained seven such profiles. These profiles clearly reflect the dense masculinity of the profession. Each of these seven profiles is about a white male. This in itself is telling, but of more interest are the aspects of each person’s biography and achievements that are described.

For example, Neil Camarta, a senior vice president of Petro-Canada, is interviewed about the oil sands projects in Northern Alberta and the importance of communication. The author quotes Camarta as crediting his abilities to his "upbringing as an Alberta farm boy, the grandson of Italian immigrants lured to the Edson area by free land" (White 2007a:10). The article concludes stating:

> Camarta isn't the only Alberta farm boy to make an impact as an engineer in the oil business. As a farmer, Camarta explains, you're a handyman—always fixing things and working with equipment—so, before you even arrive at university you have a good preparation for engineering. "Guess what engineers do their whole career? They always fix stuff. That's what I do all day long. It's not always engineering things—it's some problem that I have to step into and help people fix."

Other "Alberta farm boys" profiled in this issue of the *U of A Engineer* (Spring, 2007) are Dr. Jerry Sovka, a nuclear engineer whose parents immigrated from the Czech Republic, and Ron Bullen, a mechanical engineer and businessman. Dr. Carl Laird, a process systems engineer, was raised in Bonnyville. Rob Gliddon came to university from Edson. In each of the articles the technical developments of the individual are outlined and the desire to "fix things" drawn upon. The men profiled are businessmen, such as Ron Bullen whose profile emphasizes his tenacity and risk-taking in developing businesses and working in the Soviet Union in the mid 1980s. They are committed employees, such as Don Lougheed (former Alberta Premier Peter Lougheed's older brother) whose "Imperial Career" with Imperial Oil involved "the nomadic life of a young oil explorer in the early 1950s" (p.31) which he and his family lived. They are dedicated employees, whose sole focus in life appears to be engineering – and perhaps a desire to make a difference through their engineering – a dedication shown by the military service of Rob Gliddon in Afghanistan who is quoted as stating, "…training in engineering gave me an analytical approach to problems. … By using the same logical, sequential approach you would see in a design project or any big engineering endeavor, you can throw together a plan for an operation"

(Betkowski 2007:22). They are calm, rational and unemotional men, like Sovka who "displays a ready smile and a warm sense of humor. And he doesn't betray a hint of stress at work – a talent he says somewhat cryptically that he had to learn the hard way" (White 2007b: 17). Through these profiles the masculinity of the engineering culture is relayed – a culture that becomes very clear in the reflections of participants on the profession and their organizations.

Elements of a masculine culture

The *numerical dominance* of men was reflected in the culture of the profession. Karen, for example, explained: "Especially in engineering, because it's a very — you're constantly reminded, even though you're accustomed to being in a very male-dominated profession, you — just, you interact differently, men interact differently." This notion of engineering being a male profession because it was dominated by men – who are naturally different from women – is fairly frequently used as can be seen in the widely critiqued comments of Harvard President Lawrence Summers in 2005 on women's under-representation in science and engineering careers. Summers, in his address at a National Bureau for Economic Research conference, hypothesized that the gender difference in representation in SET fields was due to "availability of aptitude at the high end." He also suggested that men's and women's brains are wired differently, a difference that enables more men to excel in science and engineering (as cited in Frehill, Javurek-Huming and Jeser-Cannavale 2005). While the engineers in this project all held that women could be excellent engineers, Summers' comments and the masculine conceptualization of rationality were reflected in a number of men's comments. John articulated this most directly, describing to me that, in comparison to men (who all deal with logic problems in the same way), "Ladies, in my opinion, always approached them in an oblique way." While this way was not inherently inferior it was not the norm. He continues:

> … the fact is that a lot of industries whatever profession it is, and I know this is going to sound strange, is a game being played by men. Not a man's game. But a game being played by men and I think there's a real difference. … It's like, well, it's a bunch of men playing a game and because they're men they play it like men. And it's not a – shit we got together and collectively came up with this set of rules to make it harder for women. It's just how we all approach rules. If you had a bunch of men playing a game of Monopoly and you watched a bunch of women playing the same game, so it's the same game but two different types of people, you'd see a different way of doing it.

From John's perspective, due to the dominance of males, the profession necessarily reflects the values and interests of men. So long as men are numerically dominant the field will be masculine. That said, participants indicated that overall the division between the genders has improved:

> I think more [women] are taking engineering as a career and making it to the higher levels within that career. I mean right now for example, in [organization] our senior VP [department] is a woman, there's one on the [group] that's a woman, and it's quite likely that when our senior executive director of [department] leaves he'll be replaced by the GM, so it's making progress. And that's a conscious change… (Ryan)

> I think a lot of it's happened already. There was more issues when I graduated 22 years ago than there is now. I think that engineering week used to be a little bit disorientating for some of the women in it, and I think that a lot of those things have changed; the really, really gross parts of it have disappeared or gone underground. Within work environments, I just think — and it's not just engineering, it's just the work culture in general — there's sort of a lack of tolerance for demeaning behavior, for sexual rude remarks at work, for the kind of jokes that make people turn red and turn away. I just think our society has become a little more genteel, which is a good thing, engineering and other… (Michelle)

As Ryan and Michelle's words reflect, there is a sense that within the profession gender equity has improved in terms of women's increased representation and movement into decision-making positions, and cultural changes that challenge the traditional male dominance and overt sexism in the field. I will argue, however, that the culture of the profession continues to reflect strongly masculine norms and values through the climate of engineering education, the emphasis on rationality and technical skills, an emphasis on traditional family values, and a perception of diversity as beneficial because of what it adds to the profession.

The introduction to engineering for most individuals is through *post-secondary training*, which has been extensively studied and found to have a masculine and 'chilly climate' (Mills and Ayre 2003). This climate includes assumptions of tinkering experience, issues of a lack of relevance in the curriculum content, teaching methods appropriate to very limited learning styles, and uncomfortable classroom atmospheres (Mills and Ayre 2003; Powell et al. 2004; Bagilhole 2006). An element of the "chilly" educational climate is the "weed out" system, which Etzkowitz, Kemelgor and Uzzi (2000:52; See also Hacker 1989, 1990) discuss as sifting out students by a seemingly meritocratic process that simultaneously removes individuals without the "desired" (or dominant) social, cultural and economic characteristics. Central to this weeding out is "challenge," a masculine motivational strategy that tests one's ability to withstand stress, pain, or humiliation and that requires the individual to meet "challenges" individually (54).

The influence of masculinity of the engineering field on engineering education has been explored by Dryburgh (1999) and Powell et al. (2004). Dryburgh (1999), in her exploration of the professionalization process of engineers, argued:

> that it is more difficult and demanding to be a woman than a man in this profession [engineering] because of the adjustments required of women with regard to the occupational culture, impression management, and

> solidarity with others in the profession. In each case, women have to work harder than men, and they face obstacles not there for men of similar ability. Women not only have to adjust to the occupational culture but also to the masculinity of that culture. They not only have to portray themselves as competent to their employers and clients but also to male colleagues. Finally, women have to prove their solidarity to others in the profession, a more difficult task for women than men, given engineering's masculine identity. (p. 666)

That young women are facing these difficulties with the engineering culture this early in their career suggests that the culture of engineering may be particularly hostile to women and that the impacts of this hostility will have long term ramifications on their careers. Powell et al. (2004) examined the experiences of second year female students in the UK, and found that "while women are not deterred from pursuing their chosen engineering career, the culture and structure of the engineering education system has been designed for a male audience" (p. 21). In line with this COSEPUP (2006:25), on the basis of their review of the literature, has concluded that social pressures and influences appear to have a greater impact on motivations and preferences for pursing study in SET areas than do underlying abilities.

In light of the research showing differences between men's and women's postsecondary experiences in SET fields it is of interest that in projects where professionals reflect back on their educational experiences, few report overt discrimination during their studies (Carter and Kirkup 1990a; McIlwee and Robinson 1992). Among the 18 women interviewed for this project this was reflected. Although all of the participants were asked about their educational experiences none emphasized difficulties they had due to gender in going through engineering training. (See Appendix C for the interview protocol). Indeed, in the majority of interviews there were no comments made in relation to gender during their undergraduate training. In line with previous research a number reflected on how gender was less of an issue in their undergraduate studies than in the workforce. When I asked Kelly, who was very seriously considering leaving her engineering position to take up a new career, about whether her career would have been different as a male, she responded:

> …like you don't see the issues in school, the discrimination isn't in school. I mean there might be the odd professor that's a bit of a git, but I mean, on the whole, or the odd student who's a really git, but it's mostly in industry that you face problems and you face difficulties because of the old school. Not all of them certainly, but the ones that are quite against it [women as engineers], they're still there. They're still working. And unfortunately they're too valuable to their companies to – so you either deal or you move on.

The masculine culture of engineering, beyond the numerical dominance of men, can also be understood through the links between gender and notions of *rationality* and *objectivity*, which impact both engineering and other science and technology fields. Keller (1978) in her formative work described the study of "gender and science" as examining "the historically pervasive association between masculine and objective, more specifically between masculine and scientific" (as cited in Keller 2004:187). Central to these associations are symbolic connections and polarized understandings of male and female. Phipps (2007) in an examination of the "Women in SET" discourse articulates the extent to which male/female binaries continue even within organizations oriented towards increasing the inclusion of women in science and engineering fields. This discourse, she identifies, continues to be based on and reinforce "a binary between femininity and masculinity in which women are domestic, passive, and emotional while men are rational, individualistic, competitive, confident, and technically skilled" (p.780-781). This continued understanding of girls and women as more cautious, illogical, and interested in applications, stands in opposition to Western notions of science and engineering, as "synonymous with abstract rationality" (Phipps 2007:782).

An element of this, as feminist scholars of science have explored (Merchant 1980), is science's role in achieving control over nature, a nature that Lloyd (1984) states has been associated with the irrational feminine since the Greek philosophers (as cited in Ross-Smith and Kornberger 2004). Coming from the perspective of organizational theory, Ross-Smith and Kornberger (2004) developed a detailed analysis of the link between masculinity and rationality, which is central to both management and scientific discourses. In this work they argue "that the concept of rationality that is elaborated in western society from Descartes to Kant and Weber and enacted in organizational discourses and which informs practices is, at its core, masculine, despite appearing gender-neutral." (p. 282).[29] It is at the intersection of a masculine rationality of science and masculine organizational discourses that the engineering profession exists. As past research supports, the "culture of engineering," which consists of the norms and values of "correct engineering," has been defined by male engineers in line with masculinist notions of rationality and objectivity as 'hard' and in opposition to

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[29] Ross-Smith and Kornberger (2004) develop this, identifying that while Descartes can be seen as responsible for the notion of the "rational man," Francis Bacon's development of the empiricist tradition of "unbiased analysis of concrete data, inductive reasoning and empirically supported conclusions" (p.284), secured a conceptualization in which nature remains female but becomes knowable and controllable. They follow the connection of rationality and masculinity through Weberian Rationalism, Taylor's Scientific Management, the development of the field of Human Relations, Parson's Structural Functionalism, into contemporary management and organizational discourses, concluding: "The link between these two concepts was also found to be resilient, durable and capable of reinventing itself such that it still dominates organizational discourse" (p. 296).

‘feminized’ approaches that emphasize sociability, caring, and are ‘soft’ (Bastalich et al. 2007; Burack and Franks 2004; de Pillis and de Pillis 2008; Dryburgh 1999; McIlwee and Robinson 1992; Miller 2004). Burack and Franks (2004) identify the way in which this division is reflected in the language used within the profession, in particular the way that engineers consistently differentiate their use of “hard” and “soft” skills. These hard skills include the technical, mathematical, and scientific elements; the soft skills are communicative and interpersonal. And while both are seen as “needed,” Burack and Franks (2004) underscore that their usage reveals a hierarchy with “hard skills” ranking more highly:

> These uses of the modifiers hard and soft have no obvious connection to the skills they denote in engineering. … However, connections between masculinity, virility, male sexuality, and hardness are culturally engrained, have unconscious emotional resonance, and are widely and immediately understood. Likewise, the connection of softness with femininity is a cultural signifier with both conscious and unconscious meaning. (p.84)

It is these unconscious meanings, which pervade both engineering and culture more broadly, that work to reinforce the masculine culture of engineering.

The gendered and conservative nature of the engineering field can also be seen in the idealization of “*traditional family values*.” Recruitment ads draw on organizations as families, and appeal to possible employees as both engineers and “family men.” An ad from Progressive Engineering in the June 2007 issue of *The PEGG* for instance reads, “Progressive Engineering provides opportunities for career advancement, a stimulating family oriented work environment, with competitive wages and fringe benefits program.” Focus Engineering displays the prototypical “family man” in another recruitment ad, using an image of a younger male with a little boy on his shoulders standing outside both wearing t-shirts with the organizational logo and smiling, and labels being "people-first" as an organizational value. The positive rhetoric around family is also reflected in images of award winners published in the newsletter, which frequently show family members (wives in particular), and occasional articles included in *The PEGG*.

The masculine nature of the engineering culture can also be seen in the *good for business* rationale for having more women in the profession, such that calls for greater representation of women are often based on arguments that the profession needs to have the "best and the brightest" minds. If women make up half the population then it is logical that if women are not half the profession that there are "good" minds that are not being utilized (Emerson 2005; Fox 1998; Frehill, et al. 2006; Herzig 2006). Numerous programs have been put in place over the past thirty years, such as Women in Scholarship, Engineering, Science and Technology (WISEST) at the University of Alberta and Women in Science and Engineering (WISE) at the University of Calgary, to encourage women to enter science and engineering fields. That these programs continue to run and new funding and programs are developed, such as a $550,000 investment by Imperial Oil on a program to recruit young women into engineering (*Schulich Engineer* Spring 2008:34), indicates that the desire for increased recruitment of women continues. Notably this goal of increased recruitment appears to reflect more an interest in economic goals, through increasing the pool of engineers and having more "diverse ideas," than changing the culture.

This is further reflected in the words of the men interviewed for this project who spoke of women's different perspectives as broadening the field and its solutions. Women were also seen to soften the field. Daniel, for example, stated that women engineers are "… qualified, they're smart, they perhaps bring a woman's perspective, if you will, which is different from a man's perspective in certain kinds of projects. I say good, that's what we need." Anthony emphasized women's ability to change the professional culture: "I think women make great engineers, and they soften the engineering people." While positive in their construction of what it is women will do for the profession, this discourse of women as bringing new perspectives to engineering inadvertently reinforces the masculine culture of the field. It serves to remind that women's ways and women's knowledge, remains other. They bring new insights because of their outsider status. They soften the field because they are not men.

Impacts of the Masculine Culture

As the above section describes, the masculinity of the engineering profession is more than just that men numerically dominate in the field, it is also the way in which the engineering culture is structured such that what is the "norm" is also that which is typically aligned with men and masculinity. Women remain the other in this realm of rationality, technical skills, and "traditional family values"; this otherness is reflected in the "diversity" women are expected to bring to the field. While experiences of working within a masculine culture and the impact of this culture on the retention of women in the profession will be elaborated in later chapters, it is useful at this point to outline three negative impacts of the male dominance of the engineering field on women's experiences: 1) a lack of role models, support systems, and networks as a female engineer; 2) males' "teasing" style of interaction with women in the profession; and 3) dilemmas in dealing with exclusion and sexual harassment.

Lack of social connections

The lack of networks was seen as an issue for women who, because their numbers are so limited, were *unable to establish social connections*. Danielle, for example, reflected on the isolation of her co-op placements as a young female, which lead her to socialize with the administrative staff and not develop mentoring relationships with engineers. This lack of role models was critical for a number of the women. Heather, for example, described her impressions of being a woman in engineering:

> … I think in mechanical engineering in particular, there are very, very few role models. There was one lady … But she left after one year because she was miserable. She was the first female faculty member, and the message that sent to me wasn't a terribly positive one.

When asked if things would have been different had she been a male student, she emphasized the prevalence of role models: "I'd have lots of role models. Yeah, I think for me, it's important to have an idea where I *could* wind up. Not that I want to do any one thing, but that I *could* do any of those things if I felt I wanted to." When we spoke, Heather had left engineering and was pursing education in a health-related field with many female role models. Role models were also critical for Karen who had actively sought a female supervisor with children for her graduate studies "because that's something I had aspired to in my life as well. I *really* wanted to surround myself with people who had achieved what I had in similar - or what I was hoping to achieve, I guess, and how they did it and how they survived, etc." [30]

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[30] The importance of role models has been reported in numerous earlier studies as an element that, when it is not available, is perceived to negatively impact women's

Being able to connect was critical to enjoying one's work for many of the women, perhaps due to their outsider status. Heather did not like research work, as it was too distant from people; Angela spoke negatively of one work location where she was isolated from her coworkers in a separate building; Veronica and Amy both related being more social than was the norm in the profession. Veronica, for example, stated:

> I mean, the people, for the most part, from what I remember, were really great. The environment, a little bit, because it's very much the cubicle classic Dilbert world, right? … I remember sitting in my cubicle for 3 hours doing drawings on the ACAD or the CAD or whatever it was called, and being, like, "Oh, my God"; like, "Can we talk? Is anybody out there?" *[laughs]* We could do stuff, and we had social stuff, but it certainly wasn't a very interactive environment.

For Angela, a good social environment was essential to a positive workplace. A good work environment, she described, "includes also a relaxed environment, so social aspects, getting to know people, not necessarily in technical meetings; so it should have a good social network where you can see people in ways that you would not normally see them." Similarly Emma described, "I made friends at [org B]. Like there's girls that I'm happy to go for a coffee with on the weekends. Yeah, there's definitely, there's an atmosphere to it. Well every place has atmosphere, but it was an atmosphere that I actually could take to." The overwhelming male dominance of the culture seemingly made this need for connections that much more salient among the women. Ryan noted this in his thoughts on why women may be more likely to leave the profession than men:

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recruitment into non-traditional fields and reduce their likelihood of being retained (Blickenstaff 2005; Cory and Rezaie 2008; COSEPUP 2006; Demaiter and Adams 2009).

> I wonder if it, if there's a critical mass where that doesn't make a difference, because I notice at work that once we get to more than a certain number of female engineers then they congregate and they have, their own networks, their own activities and everything else and their enjoyment of the workplace I am assuming is improved. Because there are things that you want to do with your gender and things that you don't want to do with the other gender, so I think maybe it's a matter of do you have enough of both that you can actually choose your interaction at work.

"Teasing" interaction style

This impact of not having women to work with was also discussed by a number of women in relation to the difficulties of cross-gender socializing, particularly a perception of men's emphasis on "*joking*." Here Jennifer reflects the challenges of connecting with men on a social level:

> I think men are uncomfortable around women, too; I don't think they know how to act, they don't know how to treat them. They don't swear, or they try not to; they go, "Oh, sorry, sorry." I'm, like, "Oh, c'mon." I think it's easier for men to be around men, because that's what they're used to, especially the older guys. Throw a girl into the mix, and it changes the dynamic.

The idea that men needed to control their behavior, particularly their use of foul language, due to the presence of a "lady" came up in a number of interviews. As Jennifer relates, although some decorum may be nice this controlled interaction reinforces the sense that women are not "normal" or part of the group. This ties to the perception that males and females have a different style of interaction, particularly in relation to joking, which excludes women from the dominant workplace culture:

> … men tease all the time in the workplace, I find — joke and tease — where I find, my experience is women like to sit down and actually talk and discuss and have meaningful interactions — I guess not that teasing's not meaningful, but it's just different. So I found it exhausting. So I think I realized fairly early on that, even though that's fun — I think it's fun for 15 minutes, not for the whole day — that it was really important to try to find people that I would connect with and have support. Women, I think,

> understand when you do have children, how much more - what's going on at home a bit more and what the pressures are… (Karen)

Although the women did not "complain" about the teasing and joking, there seemed to be an underlying sense that they felt that in some instances this "joking" was tied to their gender and reflected a questioning of their abilities. An example of this came from Patricia who, when I asked if anything about her career would have been different as a man, immediately responded with "Nobody would be calling me *kiddo* [*laughs*]. That happens a lot…"[31]

This "joking" thus serves two functions – it excludes women from the dominant engineering culture and indirectly reinforces that women lack the necessary skills. As such it can be seen as an example of "boundary heightening" (Kanter 1977): "actions by the majority to emphasize their group characteristics to make the newcomer feel as different and 'outside' as possible" (cited in Watts 2009b). Crude language, sexual jokes, even conversations that emphasize 'male' interests such as sports, can be seen to work to enforce women's position as outsider. Cohn (2000), furthers the analysis of boundary heightening, arguing that these behaviors are intended to test the resilience of the minority individual and their willingness to conform. This "joking" has also be reported in past research by Powell et al. (2004) in the context of engineering education. Here the students Powell et al. interviewed reported being treated justly and fairly. Even when there were inequities and sexist banter these were dismissed as 'jokes.' Within the educational context this joking "intimates that if individuals want to

[31] One of the most insightful questions from the interviews was asking participants if they thought their career would have been different if they were of the opposite sex (see Appendix C). Responses to this question will be particularly important in Chapters Eight and Nine.

achieve in the sector they must conform to existing masculine norms and attitudes" (Powell et al. 2004:34). The issue, however, is when after years the 'jokes' begin to affect the recipient: "A cascade of affirming experiences serve to amplify a string of positive effects, until there is a short-circuit and the process is reversed … what had the potential for a cumulative positive cascade of experience becomes short-circuited by negative experiences" (Etzkowitz, Kemelgor and Uzzi 2000:133).

Discrimination and sexual harassment

A number of incidents were also described by the participants that went beyond joking to *gender discrimination and harassment*. Negative interactions ranged from being talked down to and having one's abilities questioned to having to deal with sexual comments. Jennifer related her experience with the stereotype that women were unable to be electrical engineers in an early work experience:

> I was working and doing a presentation, one of the older gentlemen, a scientist, said, "I didn't know girls could do electronics." And I was so stunned, I had nothing to say 'cause it seemed absurd to me. And my boss said, "Oh, she doesn't design them, she cleans them." So he kind of made light of it, and we all laughed, and carried on. But from that moment on, I thought, "Oh!" And also I noticed — my husband's also in electrical engineering, and when we tell people what we do, and he tells them what he does, they're, like, "Oh, okay. Cool." And when I do it, they're, like, "Oh? Wow! Really?" — you know, so surprised, and I think, "Why are you so surprised?"…

Part of what is so troubling about this experience, in addition to the discriminatory assumption of the scientist, is that her boss did not stand up for her. Rather this "joking" style of male interaction came into play as a way to diffuse tension and reassure everyone present that the status quo can be upheld. Discriminatory practices can also be seen in the discussion of the "penalization" that both Kelly and Erin faced upon returning from their maternity leaves, which will be elaborated on in later chapters. Karen, discussing how she felt her career was impacted by being female, described having a supervisor who made a sexual comment to her: "Nice. Like, how brutal is that? Just crap like that, you kind of go, '*Ridiculous*!'"

Eric and Anthony both related that as a female one would have to face sexual comments and innuendo, however the impact of this behavior and the challenges of working in this type of environment were not really understood. Eric, for example, stated:

> I had to smile the other day, this one young lady, she's quite buxom and she's a very sweet girl. And a couple of guys are a bit crude with her, but man she can play her womanly whiles on them and I can see the guys are like, they're getting a tad flustered, and she's working them up a little bit and then she walks out. ... But it's not fair that she's got to work out how to deal with them, she shouldn't even have to. I mean she said to me the other day, she's actually thought of laying a – a gender harassment charge. So I thought "um, that's serious." Then she thought, "oh, I'll just work his case." And that's fine, but I think she does at some stage at least go and talk to the boss and say "look, I'm not happy with this."

His words reflect a difficult tension between recognizing that these men's behavior is inappropriate, while at the same time placing some of the responsibility in the hands of the woman who is being harassed. Eric realizes how serious the men's actions are, based on the woman's statement that she is thinking of laying a harassment charge. Yet it seems that without this threat he was willing to see it as humorous or an interaction the woman could handle.

As Eric's words reveal, even among the most sympathetic of men in the engineering profession the real implications of discriminatory and sexualized treatment were not understood. This was reinforced by the questioning of a few men of the need for programs that support women. John, stated that "The women in science program in my opinion is actually a – it's really – you know there's nothing stopping you from getting a degree and anybody who says there is, well it's BS, you can't sell me on the idea that people should be getting special help." To establish the validity of his opinion he described a female student who worked for him:

> She had a real, real problem with the whole affirmative woman's action sort of thing. As far as she was concerned it was a bunch of lazy ladies trying to use their sex to further themselves rather than their own efforts… It diminished what she had accomplished by associating her sex with it as opposed to what she had done herself. And I thought, isn't that an interesting, and there you go. Point of view is everything, right.

A critique of programs supporting women in engineering was also leveled by Kevin:

> I'm all in favor of more women in engineering, though. In general, because being around guys all the time, all day, all guys, gets boring or old; because most guys talk about and want to be around more women, so why wouldn't you just want to work with more. So I'm in favor of that. This is branching off-topic maybe a bit now, but while I would like to have more female colleagues, I'm not in favor of universities favoring women to try to push more women in and through the program. You know, equal opportunity: not trying to generate equal numbers on the outcoming end, but just equal opportunity going in, and go from there.

Kevin and John's comments both reflect a lack of understanding of what programs supporting women and visible minorities in the profession are meant to do and the cultural and systemic barriers that those not in the majority face entering these fields. Women and visible minorities are welcome to work in the field – even desired as the need for engineers and new ideas is great - but they are to fit into the culture as it stands rather than reshaping the culture or even requesting support in "fitting in." [32]

[32] Notably the acceptance of women and visible minorities into the profession and recognition that overtly discriminatory treatment is inappropriate does reflect that the engineering profession can, and is, changing.

Visible minorities in engineering

Students of color, particularly of certain ethnic backgrounds, make up an increasingly substantial proportion of students in science, engineering, and technology (SET) fields. In the U.K., a recent report to the British Royal Society (Jones and Elias, 2005) found that:

> Chinese and Indian populations are the highest participators in SET. They are much more likely than other ethnic groups, including whites, to take three SET-based A levels; they are over-represented relative to the their population size at all levels of higher education, through to academic staff grades; and they are more likely to have a SET occupation than other ethnic groups. At the other end of the spectrum, black Caribbean and Bangladeshi populations have low participation rates. (p.29)

In the USA while participation remains dominated by whites, it is also increasingly diverse. Undergraduate enrollment in engineering programs in the U.S.A. in 2007 indicates that 68.8 percent of students are white, 10.9 percent Asian, 5.5 percent black, and 8.8 percent Hispanic (National Science Foundation 2007: Table B-10); in comparison the figures for employed engineers in 2006 in the U.S.A. indicate that 74.8 percent were white, 14.5 percent were Asian, 3.2 percent were black, and 5.4 percent were Hispanic (total of 1,621,000 engineers) (National Science Foundation 2007: Table H-6). Statistics for Canada have been very difficult to find, but figures from 1990 indicate that 21.1 percent of graduates from engineering programs in Canada were visible minorities, which was the highest rate of any of the fields of study examined by the National Graduates Survey of 1992 (Wannell and Caron 1994:9). Of Canadian engineers aged 32 to 54 in 2001, 20 percent were visible minorities (Statistics Canada 2007).

Related are the numbers of foreign-born, versus domestically-born, engineers. The data available indicate that foreign-born scientists are becoming an increasingly large proportion of SET students and graduates. For example, Preston (2004:9) reported that 50 percent of graduate students in engineering, mathematics, and computer science in the United States were foreign-born in 1999, up from approximately one third in the early 1980s. Furthermore she cites a study by the National Science Board (2002) that reports that 19 percent of the scientific workforce in the U.S. was foreign born in 2000, up from 11 percent in 1980. In Canada, of engineers between ages 32 and 54 in 2001, 37 percent were foreign-born and approximately one-quarter of trained engineers in this age range had immigrated to Canada as adults (Boyd & Schellenberg 2007). Based upon these figures, engineering is clearly not a racially homogeneous profession.

Images of Race in Engineering Texts

While noting that this is a problematic measure, as it is based purely on whether or not the person appeared to be of color or Caucasian, it is unquestionable that the vast majority of images in the materials examined for this study (publications from APEGGA, CEA, the engineering alumni association at the Universities of Alberta, and the Schulich School of Engineering at the University of Calgary from the 2007 and 2008 period) were of Caucasian people, with 83.2 percent of the 679 images of people where race could be estimated being white. In the images analyzed for this project, the extent to which visible minorities were presented varies by the publication. In the six University based magazines examined 20.9 percent of the people imaged were visible minorities, which is slightly lower than the actual proportion in the profession (based on US estimates and expectations that in Canada percentages of visible minorities have increased over the past 20 years). The numbers, interestingly, were again quite different between the two schools with the three University of Calgary publications having an average of 26.5 percent visible minorities per issue (Fall 2007, 22.9 percent; Spring 2007, 24 percent; Spring 2008, 29.7 percent), while the University of Alberta had an average of 15 percent of people imaged in each issue being a visible minority (Spring 2007, 14 percent; Fall 2007, 20 percent; Winter 2008, 9 percent). The professional associations overall had lower presentations of visible minorities: only 9.6 percent of the people shown in the CEA yearly *Alberta Innovators* magazine were visible minorities and on average 15 percent of the images in the six *PEGG* issues were of visible minorities (from a low in July 2007 of 6.5 percent to a high of 21 percent in November 2007). These numbers suggest that the images chosen to represent the profession – both to the outside world and to its members – are likely to under-represent the diversity that exists and continue an image of the profession as dominated by whites. Overall, the roles in which visible minorities were portrayed did not differ from how whites were shown. The majority were presented as corporate workers, a few in the field, some as students, a few as scientists.

Reflections on Race[33]

When participants in this study were asked to reflect on the racial diversity of the profession, many indicated it was not something they had contemplated and/or was not something they believed was a real concern. When I asked Tracy, for example, if there was "a need for more diversity or is there quite a bit of diversity" she responded, "I guess I've never really thought about it." She continued by suggesting that perhaps immigrant engineers, although very important, may not be paid equally and may have difficulty being recognized by APEGGA. As for education, "in my classes in school there's quite a variety of people from different countries and stuff [*pause*] so yeah." Both James and Alex reflected a sense of not being aware because of a lack of personal experience – in particular being a white male. In response to being questioned about the need for more diversity[34] James responded:

> …to be honest, I've been pretty thick to that, in the sense that it just doesn't come up. I like to think that I act and behave professionally, and expect the same from others, so I don't see very often that type of thing happening, good or bad, because probably I'm just naïve to it all. I'm sure it's had an impact on the culture, but I have to admit I don't think I have any personal experience that I could relate.

This lack of personal experience was also related by Alex:

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[33] Despite initial intentions to examine the role of race within the profession, once in the field interviewing this became a very small piece of my discussions with participants, in part because of the overwhelmingly Caucasian and Canadian-born demographics of my sample. However, I believe that racial diversity in the profession and the experiences of immigrant and visible minority engineers is of critical importance and vastly understudied.

[34] As detailed in Appendix C, participants were directly asked about diversity, including their definition of the term and whether it was important for the engineering profession.

> I think in engineering, we could probably use more women, but ethnic doesn't seem to be — not that I'm aware of, but I'm a white guy *[laughs]* so I might be oblivious to some of those — I'm aware I'm oblivious to some of those things.

The lack of reflection on the impact of racial diversity on the profession and whether racial discrimination exists in the profession is perhaps unsurprising, given that the majority of participants were Caucasian.[35] Those who did identify inequitable treatment of visible minorities were Joseph and Vince, both of whom were South Asian. Joseph, who grew up and was educated in Canada, identified that in his experience certain organizations – and certain fields of engineering – were more or less likely to have visible minorities. Much like the women, Joseph often found himself as the exception:

> When I started out, my boss was Indian, too — my first boss. We'd walk into a room and he'd be the only colored guy there. To this day, it's probably fairly close to that — colored guy, I mean. Yeah, he may not be the only minority — Oriental people have been here for quite a long time, so they're there … when I first started there [a different organization], the first month, I couldn't place my finger on something. I'd go, 'Something's different about this place,' and then I realized that on our floor of about 100 people, I was the only *[chuckles]* non-white male engineer. I thought, 'That's odd.'

At the smaller and mid-size organization that had employed Joseph the owners were also visible minorities, so he "blended in," but in the larger companies "it became more stark." He stressed that for foreign-born engineers the experience was far more difficult:

> …foreign-born engineers, so they were usually my senior, usually 10 to 15 years ahead of me, but they were under me because of their foreign

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[35] Despite increases in international outsourcing of engineering work, very few references were made to this trend in the data collected. Only one reference in a text was found (in an advertisement for business consulting firm) and two brief mentions during interviews by younger participants noting how engineering was changing.

> qualifications. Oh, they had *hard* times. I did not envy — I totally respect what they went through just to get even where they are, just to get their foot in the door of an engineering company … I told myself I'm going to do my best to steer them right: 'Here's what you need to do to survive in this industry with your background. Do this. Don't try to be everything to everybody. That's going to kill your résumé right then and there.'

Vince, a foreign-trained engineer who had immigrated to Canada to work a few years earlier, discussed at length his difficulties finding employment in Alberta. He had spent time working in the field in technical roles and had taken the professional exam to gain his P.Eng. But after acquiring the designation he lost his position because the organization could not pay him as a P.Eng. Since then he had been unable to get a new position. Frustrated, Vince questioned why he was unable to work in an economy that purportedly had so many jobs. He was willing to work at a junior level – he just wanted a chance, but without Canadian experience getting work was seemingly impossible.

More generally, when participants did discuss diversity it was generally in relation to how diversity could bring something positive to the profession or an organization – rather than as something that one should strive for on the basis of social justice. Kelly, for example, described the importance of diversity as people "bringing something from a completely different viewpoint, sometimes, different ideas, different backgrounds." These different perspectives, according to Patricia, allowed a team of engineers to look at problems in different ways. Michelle reflected on how working in a more multi-cultural organization allowed one to "learn more about other cultures" and her observations that immigrants are "*very* hard-working. They've come here to make a better life for themselves, they have a fantastic work ethic. They often are working below their capacity because they've had to come to another country and their skills haven't been fully recognized yet. So I think you get some fantastic workers that way." Jack, reflecting upon being a manager and hiring engineers, highlights the benefits one gets from diversity in the following comments, in which he begins by talking about gender and then expands to ethnicity as part of his "diversity strategy":

> I know when I was in the director role, I made a point of hiring females, and not out of any false sense of societal injustice, but because I fundamentally valued the diversity, and diversity of not just their intellect, but also of their experience. I think, again, way too many leaders look for the easy answer: "We'll hire a whole bunch of people that think just like I do. It'll be really efficient." I think that's stupid. Hire people that are your opposites, and yeah, it'll be challenging, and there might be lots of conflict and communication issues, but if you're a leader, work through that and enjoy the rich tapestry that is the product of having people from different backgrounds. Even when I was in plant engineering, I had the opportunity to create a team of leaders, and *[laughs]* I brought in a young Vietnamese guy from China that worked for [company H], and that just blew people away: "He doesn't know the [type of] business." "That's okay. He's capable of learning." *[laughs]* I brought in a Chilean lawyer, *[laughs]* I brought in a female engineer who's an Indian — not an Aboriginal, but from India; another female engineer; and then we had two more typical male white-bread cracker types. We had a lot of fun. Oh, I hired in another Asian gentleman, too. *[laughs]* It was just a potpourri; it was just like a chef's salad! *[laughs]*

For Jack embracing diversity was clearly a leadership strategy, but it had nothing to do with ensuring equity. Rather his interests in diversity were based on a somewhat romanticized notion of the "other" and what they could do for him and his organization.

While the above comments all reflect a general support for diversity, not all of the participants looked so favorably upon diversity, in particular hiring immigrant engineers. A concern voiced a couple of times centered on language barriers faced when working with immigrant engineers. Kevin for example stated:

> I hear discussion of people, like, through *The PEGG*, of bringing in foreign engineers to work on Fort McMurray oil sands projects or something, 'cause we don't have enough local engineers, we don't have enough

> Canadian engineers, we've got to bring in more. And I find it frustrating working with people who don't speak English well, just because the communication is the key to getting a good solution in a timely manner, and sometimes I have had to deal with people where they speak very little English, and it's difficult…

More problematic were comments by John, which reflected a distrust of the professional credentials and skills of foreign trained engineers:

> I personally, and I know this will sound bad, but again I'm going to go back to, it's an issue I have in no uncertain terms. Remember I was saying, one of my problems with my profession is the dilution of the skills. Well that's happening at a rapid rate right now and if you listen on the radio at least once, twice a week there'll be some newscast about some guy from god-knows-where who got a degree from some university nobody's ever heard of that's driving a cab. Well I'm going to tell you, my own personal experience is these people, the people we're talking about the imported help, are largely incapable of driving a cab let alone acting as a responsible professional. The ones with – one exception, and I do mean a single human being – everyone of them has comported himself terribly. They are unskilled, devious in some cases, just generally speaking most of them aren't qualified to be an engineer.

Although he was far more blunt than any of the other participants, that John was willing to say this in an interview setting suggests that it is probably not an entirely uncommon or unacceptable view. Others may not have been willing to directly state it in an interview, but given the difficulties faced by foreign-born engineers such as Vince in getting employment - even when professional status has been attained - it seems likely that distrust of foreign-trained engineers is relatively frequent.

A final theme in relation to racial diversity centers on a questioning of the need for equity-oriented policies and actions. A clear example of this can be seen in the *PEGG*, which during the 2007 to 2008 period ran a series of "Aboriginal awareness columns" written by Robert Laboucane. In these columns Laboucane, president of Ripple-Fx, a Calgary-based Aboriginal awareness company, wrote of issues facing Aboriginal Canadians. In June 2007a (*PEGG)*, he wrote on treaties and the rights of First Nations people (p.21). In July (2007b:20) and September (2007c:29) he wrote on the impacts of residential schools. The November article critiqued federal government laws and policies (2007d:13). These articles were among the longest in each issue and were intended to help meet an APEGGA Business Plan goal of increased Aboriginal representation. In the articles Laboucane uses an interesting rhetorical technique of aligning with "Canadians" (e.g., the reader) against the federal government's equity policies. He writes: "It is important to me that non-Aboriginal Canadians see me as their equal under the law, not their 'more equal'. I choose not to exercise any of my Aboriginal rights, so I can be as equal a Canadian as the rest of you" (2007a:21). The Business Plan goal of increasing Aboriginal representation is also reflected in an overview of a session from the APEGGA mentoring conference which reports on the growing Aboriginal population, low levels of secondary and post-secondary completion among Aboriginal peoples, and the limited participation of Aboriginals in the profession: "The estimate of national enrolment of Aboriginal students in accredited engineering programs is perhaps 100 to 150. In Alberta, the exact number of Aboriginal professionals is unknown but very likely under 100 of our 50,000 members. In Canada, the number is estimated at 300 to 500 of 170,000 engineers. If the Aboriginal presence in engineering was representative, 5,500 Canadian engineers would be Aboriginal." (Lack 2007:6).

These articles, which indicate a concerted effort on the part of the profession to address racial inequalities as they pertain to Aboriginal peoples, led to a very interesting set of letters published in the monthly section "Readers Forum." Some of the letters were very positive and supportive of the series. A letter published in July 2007 written by Brad Howe thanks APEGGA for publishing the articles and states “These articles seem to be exactly what I’ve been looking for” (*The PEGG* July 2007:22). The articles, Howe writes, create awareness which will allow engineers as “problem-solvers… an opportunity to do something now” (p.22). Others letters, however, were far less supportive. A letter in the September 2007 issue argues that the columns don’t belong: “APEGGA members have no control over what happened to Aboriginals in Canada over the past several hundred years. Nor are we responsible. Your columnist appears to be using *The PEGG* as a tool to vent frustrations” (Dolynny, *The PEGG* September 2007:12). A letter in the January issue, written in support of the Dolynny’s letter, states “any program that singles out Aboriginals is a form of racism. This program places special emphasis on one group of Canadian citizens over another, and APEGGA should distance itself from racism rather than be involved in it… APEGGA has no business being involved in racism, unless it is attempting to stop it” (Bohdan *The PEGG* January 2008:36).

This belief that programs to create equality are, in fact, discriminatory, connects with the idea of reverse racism, that in attempting to create equality we are reinforcing inequality or difference. John, whose views on immigrant engineers I quoted above, reflected this: “There’s a certain amount of resentment to – I have personally is that I’ve never been, I’ve always been told that I’m the most privileged person. ‘Oh you’re male, and you’re white, you don’t need nothing, and you’re middle class, you don’t need help from anybody, you’ve got it all already’.” In John’s eyes this perception placed him at a disadvantage and created a situation in which he was the victim. This resentment of efforts to create equality, alongside critiques of the skills of immigrant workers, reflects the extent to which the profession remains dominated by white norms. Visible minorities were useful for the "diversity" – the "flavor" and hard work – they bring to the profession. But the challenges and systemic racism faced by minorities, particularly foreign-trained engineers, was virtually unacknowledged. That said, that APEGGA, despite its overwhelmingly White board and generally conservative approach, has chosen to make increased Aboriginal participation in the profession one of its Business Plan goals does suggest that change is occurring. The blowback received from professional members, as reflected in the letters, suggests that this change will be far from "easy."

Conclusion

In this chapter I have described the gendered and racialized nature of the engineering field. While the profession is becoming increasingly demographically diverse, I have argued that the culture continues to emphasize white, male and conservative values. Given that the focus of this project is on gender in the profession, more emphasis was placed in this chapter on examining the ways in which the engineering field is gendered. Women are statistically over-represented in the images presented in engineering magazines, however they are much more likely than men to be presented in gendered roles (as spouses or discussing professional development). Furthermore, the dominant themes idealized and used in advertising, and the careers profiled in textual materials, reflect masculine norms. The conservative nature of the profession is even more apparent in the under-representation of racial diversity in the images presented in publications.[36]

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[36] I say "appears" because it is difficult to assess the actual proportion of the profession in Alberta that is a visible minority. The statistics that are available are based on Canada

An assumed male norm, I then argued, pervades the culture of engineering. Indeed participants revealed an implicit understanding of this, articulating that because males are the largest group, and men and women are "naturally" different, the culture is "obviously" masculine. Elements of this culture included a "chilly climate" within engineering education, the emphasis on rationality and objectivity, and the framing of "traditional family values" as positive. The impacts on the experiences of women working in the field of this male-dominated culture were then examined. These included exclusion from social networks, different interpersonal styles, the nature of "joking," and the continued existence of discrimination and harassment.

A critical theme linking these impacts was the sense that dealing with these challenges was the responsibility of the individual, not something that required support programs or systemic change, reflecting the broader social trend reflected in the individualization thesis (Bauman 2002; Beck and Beck-Gernshiem 2002). A lack of support for programs to enhance racial diversity was also discussed, with an emphasis on the extent to which few participants in this study had contemplated the topic, and even fewer felt that racial diversity in the profession was an issue. Only the individuals of color whom I interviewed emphasized that issues of exclusion do exist. Resistance to programs which support either racial or gender diversity reflect the tentative nature of the continued status quo in the profession. For those who benefit from the status quo, change means a potential loss of power and the emergence of a system that

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wide data – and other countries – but it is possible that the rates are lower in Alberta, which is the source of all the publications analyzed.

no longer “naturally” fits. By keeping diversity as something framed as “good for the organization,” by framing it in terms of what the profession or organization has deemed important (the bottom line), new bodies and minds can be brought in but kept in a position of continued “otherness” such that norms, values, and practices are maintained.

In this and the previous chapter I worked to set out the engineering field, as it existed for this study. As noted in the first and third chapters, the period of this study was characterized by a “boom”. Given the period of high employment, where “insufficient workers” was a dominant discourse, opportunities for equity should, arguably, be at their peak. If workers are needed, then organization should be more open in recruitment. Further, if diversity is seen as a way to ensure better solutions then organizations should want variety in their employees. That the field remains dominated by a norm of white masculinity in this period of growth suggests that maintenance of the status quo is stronger than “the bottom line”. The interconnections between engineering and other fields, the tensions between professional ethics and the bottom line, and the norms of rationality, innovation and making a difference were described in Chapter Three. In this chapter I have built upon these elements, describing the ways in which they are gendered and racialized. The impacts of these norms on the work experiences of women are also introduced. In the next chapter I will move to the next stage of a Bourdieuian analysis: the habitus. In Chapter Five I will outline the conceptualization of commitment in this project and introduce the widely accepted idea among participants of “naturally” being an engineer before moving to detail elements of the habitus in Chapters Six and Seven.

Chapter 5: Commitment to Engineering

"… me and my brother were talking about making these wicked fast dune buggies [*laughs*] and I can see … I'd love to be living out in the Okanagan, building wicked fast dune buggies."

- Jacob

"… 'cause a family is really important to me, and that's something I struggled with … I don't want to have my children raised totally in daycare from when they're 6 months old or whatever. So I'd probably do something like work part-time … So I don't think my interest areas would change; I think I'd have more options. Like, if I had tons of money, then maybe I could open a clinic …"

- Veronica

"Five years from now, if you won the lottery and money was no concern, what would you love to be doing?" This was one of the questions that I asked each of the participants in my study (see Appendix C for the interview protocol). Some, like Jacob, emphasized opportunities to do tasks that could traditionally be categorized as 'engineering' oriented. Even if money were not the motivation, he would continue to pursue technically-oriented interests and hobbies. He would make things, build things, design things. Individuals like Jacob who are technically-oriented were also likely to be highly committed to being an engineer. Others, like Veronica, reflected interests that did not emphasize the design side of engineering. Some of these individuals focused on family, some on economic success, some on self-fulfillment, some on making a difference. These individuals were much more likely to be disillusioned with engineering and they often did not frame who they were in terms of "being an engineer".

In this chapter I will begin by defining "commitment", as it has been used in this project, and argue that the extent of one's self-identification as an engineer and commitment to the profession reflects the extent to which a (mis)match of the field and habitus has been found. Rather than a traditional notion of retention, I will argue for examining commitment as a way to overcome notions of being "lost" from a profession and as leading to a more productive understanding of the diverse gendered experiences of individuals trained in engineering by emphasizing the subjective understandings of the participant over a professional status or workplace. I will then examine the concept of a habitus as it is reflected in participants' beliefs that people have "natural aptitudes" and that one needs to find the profession that "fits". Focusing on participants' choices of engineering over other professions, I will conclude the chapter by examining the way in which habitus and field intersect in this early decision-making and in turn shape one's long-term commitment to the profession.

Commitment

Of the 36 individuals trained as engineers who were interviewed for this study, 23 continued to work (or look for work) in engineering[37] and 13 identified that they no longer worked in engineering.[38] Upon beginning this research I had anticipated gender and retention (defined as continuing to work in an engineering position) to be the main differentiating factors; I had expected clear differences in the experiences and opinions of men and women and between those of people working in engineering and those who were not working as

[37] Three of these individuals were on parental leave at the time of the interview.

[38] This categorization is based on the participant's self-report on question 17 of the demographic survey (see Appendix B). Of those no longer working in engineering, five identified as students studying in non-engineering fields. These 13 individuals are referred to elsewhere in this chapter as people who have "left" the profession.

engineers. I assumed that I would recruit two groups of people: those who continued to use their engineering training and work as engineers, and those who were no longer working in an engineering related position (see description of recruitment process in Appendix A). Quickly I came to realize that individuals' links to engineering were not that clear-cut. Simple ideas of retention (e.g., maintaining a practicing professional status or being employed to do "engineering" work) did not capture how my participants understood their careers.

Thus operationalizing the notion of who was "in" engineering versus who had "left" became a challenge. And, as Tancred (1999) explains in a paper on women in architecture and engineering, how the profession is defined has important gender ramifications. Tancred (1999:36-38) identifies four ways engineering professionals can be defined: 1) as members of professional associations; 2) as individuals who report undertaking work and duties of the kind associated with this profession, as is done by statistical reports; 3) as all current and former members of professional associations, such that they have all the necessary qualifications but no longer pay fees; and 4) as those with the relevant level of tertiary education. When trying to understand retention in the profession for this study, none of these ways of defining an engineer was particularly useful. An individual might be working as an engineer, but not have their professional status; rather they would have someone stamp their work for them. Another individual could continue to be a "practicing professional engineer," but maintain their status through involvement in seminars and not actually be doing design work. Was the first more an engineer or the second? What about an academic who does very technical work, but is not a member of the professional association? Or a senior manager with a government department or corporation who has become a non-practicing professional engineer? Are these individuals engineers? Creating a rigid definition of what was or was not an engineer seemed too arbitrary.

At first I coded my participants into three groups: those who were "engineers" (e.g., were practicing professionals and did engineering work), those who had "left" (e.g., did not work in engineering and/or was training in a new field), and those who were "grey". This "grey" group was composed of all the individuals I was not quite sure how to deal with. Some continued to hold their professional status, but were non-practicing and no longer did what they considered "engineering". Others maintained a practicing P.Eng. status, but worked in a different field or had moved fully into management. This "grey" group re-affirmed to me that an "in" versus "out" notion of retention was insufficient because so many individuals did not fit into one of my pre-determined categories. This was further complicated by the fact that during the interview, when I asked people about their occupation today and/or if they saw themselves as an engineer, it at times did not align with the categories that I had "put" them into based on the pre-screening (see Appendix A for details).

As I analyzed the data I began to experiment with the idea of categorizing engineers into being either "hegemonic" or "non-hegemonic" engineers. Adapting Connell's (2005) understanding of hegemonic masculinity and other, subordinated, forms of masculinity, I hypothesized a hegemonic (or legitimated) way of being an engineer, versus non-hegemonic ways of enacting "engineer". But yet again I ran into issues. Stipulating a hegemonic way of being an engineer meant determining *the* way to be an engineer – and if measured in terms of traditional notions of success in the profession this would mean management (and moving away from the technical). This "hegemonic" notion thus conflated being an engineer with a very narrow way of being an engineer that moved one away from what a number of participants saw as "real" engineers – the people who love the technical. Further, it missed what in reading the transcripts came through – and clearly spoke to the notion of a (mis)match between habitus and field - the level of an individual's self-identification with, and love of, the profession.

I then began to ask "what if, rather than in and out, hegemonic and non-hegemonic, I conceptualized 'being an engineer' in terms of one's identification in terms of, and commitment to, being an engineer?" While this did not put every participant neatly into *a* category, it did allow me to understand commitment along a continuum and identify some important patterns. I returned to each transcript and contact summary form (see Appendix D for the template), asking "Did this person embrace an engineering identity or distance themselves from it? Did they emphasize fulfilling their goals within the profession or were their goals seen to be only attainable from outside the profession?" Two dominant frames emerged, one of highly committed individuals, the other of individuals who expressed disillusionment.[39] In making this distinction it is important to

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[39] My use of the term commitment in this project should be seen as something that stemmed from the analysis, rather than as based in the broader literature on career, organizational or professional commitment (Morrow 1983). Rather than work from this literature, which attempts to measure commitment, dimensions of commitments, and behaviors that indicate commitment (Singh and Vinnicombe 2000), commitment in this project arose as a way to understand participants' experiences. That said, as conceptualized here "professional commitment" does intersect with Kerr, Von Glinow and Schriesheim's (1977) notion of professional commitment as "identification with the

emphasize that these two positions are not determinate or impermeable. Rather they exist on a continuum, with individuals potentially fitting different positions at different times in their life course and in different situations.[40]

It is important to note that the two positions, of committed and non-committed engineer, do not indicate the individual's current employment status, type of work (e.g., design or management), or professional engineering designation. This can be seen in the case of James who I initially categorized as "grey", but on reflection placed within my committed category. James had left engineering to work as a business consultant early in his career, yet expressed a strong commitment to the engineering profession. Despite not working as an engineer, he defined himself as an engineer, and saw the profession as reflecting his personality. He stated that he "realized that the discipline, the science, the math, the discipline of learning the scientific approach, or let's say the engineering approach, which is applying scientific theory — they all kind of fit

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profession and fellow professionals, ethics, collegial maintenance of standards, commitment to work and the profession, autonomy and expertise" (cited in Singh and Vinnicombe 2000:4). My operationalization of the term, however, placed more emphasis on subjective elements of enjoyment, having personal goals that were achievable within the profession, and self-definition in relation to the profession. It de-emphasized the employment element of traditional notions of commitment.

[40] Notably, as the discussion of Tancred's (1999) work above and the discussion in Chapter Three of the multiple industries and disciplines in which engineering occurs highlight, this categorization of commitment must be recognized as based in part on the participant's understanding of "engineer". How a participant defines "engineering" varies and whether they identify as an engineer is inherently tied to this definition. Clearly this limits the generalizability of this conceptualization of commitment /retention. That said, given my interest in the alignment of habitus and field, this understanding allows for an analysis that takes into account the range of participants' experiences in the profession and acknowledges that part of the reason individuals do or do not find a fit is because of the characteristics of the particular place in the field they are in, rather than purely individual or subjective factors.

with my personality, with my style, and, like you said, it became part of how I identify myself, what I identify with." In contrast was Danielle (who I had also initially categorized as "grey"). Danielle had recently returned to working as an engineer due to economic pressures and the availability of work. Reflecting on this return, she recounted thinking: "I don't want to go [back] into engineering, engineering's not for me, I take it too seriously, I can't handle the, I know I don't like design work, design work is not - I hated detailed design. I hated, hated, hated, hate, hate, hated it." While one is working as an engineer, and the other is not, it was apparent that their professional title did not necessarily indicate their commitment to, or identification with, engineering.

The category of committed engineers is made up of 14 interview participants: 10 men and four women.[41] The majority of these participants were working in engineering. The others were a foreign-trained engineer who was unemployed but seeking an engineering job; an engineer who had completed an MBA and worked in a non-engineering consulting role; and an individual who was working with a non-profit organization in an engineering-related area. All of these individuals continued to hold a P.Eng. and only one was non-practicing.

In comparison, I categorized 22 of the participants (eight men and 14 women) as non-committed engineers. In addition to individuals who clearly self-identified as "not an engineer", a person was categorized as non-committed if they reported disillusionment with the profession; were only continuing to work

[41] This proportion (39 percent of the sample) is not meant to be representative of the profession. Given the focus of the project on retention in the profession, individuals who were no longer employed as engineers, or were considering leaving, were purposefully oversampled. A broader study of self-identification of those trained in engineering would be necessary in order to examine the representativeness of this sample.

as an engineer because of finances or work availability; and/or anticipated leaving the profession to pursue other interests. The extent of this non-commitment was more a continuum than an either/or in the lived experiences of these individuals. One young woman, for example, was working as an engineer and planned to do so unless something came along in another field that was "better". While she was not deeply critical of engineering, her responses were very pragmatic and her commitment much more to her goals than engineering. Another individual, who I grappled with categorizing, was Lisa. Here was a woman who had been very successful as an engineer, identified with many of the characteristics of a "hegemonic" engineer, yet described that she was now leaving the profession because she could not contribute to the world in the way she wanted from within. Engineering had allowed her to meet her financial goals, but now she was leaving to pursue her personal goals. Could she be seen as a committed engineer? Yes, in many ways she could. But I have categorized her as non-committed because her personal goals, her sense of what she wants to contribute, lead her away from the profession. This need to move out of the profession in order to fulfill her interests set Lisa apart from the committed engineers, for whom fulfillment could be found in the profession. In describing this, my hope is that the reader can recognize these categorizations are based upon a conversation with a participant and my reading of our words. These categories are not the "truth". But that said, I would hold that my categorization is no less legitimate than another's for any reading (or making) of data is shaped by its creators' subjectivity.

In examining these two broad groups of participants I explored a range of factors that I believed might be related to the participant's levels of commitment. Overall the basic demographics were very similar, with the only significant difference between committed and non-committed engineers being a gender imbalance – men were significantly more likely to be committed than women (X^2=4.208, p<.05). There was not a statistically significant difference in the ages of the committed and non-committed engineers, although this appears to be due to the fact that the youngest and oldest men in the study were both committed. In contrast, the committed women were on average considerably older (42 years) than the non-committed women (33 years). Additionally, similar proportions of both the committed and non-committed groups were married and had children.

I also examined family background in terms of father's and mother's profession. These did not, for this sample, provide any explanatory value. Having a parent in engineering could theoretically have a great impact on retention, as one should "know" what the field involves, but while two committed engineers had fathers who had worked as engineers, three of the non-committed engineers also had engineer fathers. Committed and non-committed engineers were also equally likely to have parents in other professions. In both groups, individuals from a range of sub-disciplines were represented, indicating that commitment is not an issue stemming from a particular sub-field of the discipline.[42] Similarly degree of "success" in the profession, in terms of

[42] The exceptions may be for individuals with undergraduate degrees in electrical engineering, all of whom (n=4) were non-committed, and those with degrees in small sub-specialties (e.g., mining, environmental) all of whom were also non-committed. In chemical, civil, and mechanical engineering the numbers for committed versus non-committed were: chemical: 5 committed, 3 non-committed; civil: 4 committed, 7 non-

managerial experience and title, did not appear related to commitment. While those who owned or were partners in engineering firms were all committed, among those in engineering management and project management there were slightly more non-committed engineers. Thus socio-economic and basic demographic features (with the exception of gender) do not appear to explain the difference between the two groups in this sample.

The concept of commitment also serves an important theoretical function in this project: it reflects the degree of match/mismatch between an individual's habitus and the engineering field. As described in previous chapters, the engineering field reflects clear cultural norms and values. According to Bourdieu, the habitus functions as the sub-conscious internalization of the field. It can be understood as an individual's "feel for the game" (Bourdieu and Wacquant 1992:21), which performs by inscribing structures and power relations onto the body and an individual's dispositions (Phipps 2005:23). In mapping both field and habitus we can, Bourdieu (2004) argues, forecast "the probable behaviours of agents occupying different positions within that distribution" (p.58). For with a habitus adapted to a field, a range of options will be perceived for action – "*a space of possibles*" (Bourdieu 2004:59). "When apprehended by a well constituted habitus, the various positions that are realized are so many 'possibles', so many possible ways of doing what the agents who perceives them does (such as physics or biology)... A field contains potentialities, a probable

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committed; mechanical: 4 committed, 5 non-committed. Overall, given the very low numbers I am very hesitant to draw any conclusions from this data.

future, which a habitus adapted to the field is able to anticipate" (Bourdieu 2004:60).

When one's habitus "matches" the field, the field makes sense. One can see options and a future – one is, I would argue, likely to be committed to that field. In contrast a mismatch between habitus and field can lead to a questioning of the habitus (Chambers 2005:340), to holding aspirations that do not "match" the field, or to not seeing the possibilities that exist. The mismatch can lead to a questioning of the field, or of the expected habitus, and/or a decision to leave the field. Either questioning the field or leaving it would also indicate a lower level of commitment to engineering as I have defined it. In the following chapters I will be further exploring elements of the engineering habitus and how the habitus, and its alignment with the field, have an impact on commitment. But first, in establishing the extent to which an engineering habitus exists, is internalized, and becomes a subconscious guide, I will explore how engineers understood their abilities as "natural".

Natural Aptitudes

> *Amy*: … Do I think of myself as an engineer? It's almost like the opposite of what I want to be. And who I think I am. Because I feel like – although it's – I feel very proud that I went through that and made it and - but I still feel like it's not me and I'm almost an impostor doing that.
>
> *Interviewer*: So what do you think it is, being an engineer is?
>
> *Amy*: Oh, um, well left brain, very analytical, not really thinking of – not feeling, not caring, you know, in that way. I'm a healer, I'm a caring, listening, feeling person. Just yeah.
>
> *Interviewer*: And is that something you think you've sort of always been?
>
> *Amy*: Yeah. I've just been kind of putting it on a shelf all this time.

Early research investigating the very low numbers of women in science, engineering and technology-based professions emphasized psychological differences and personality attributes of individuals. Carter and Kirkup (1990a), for example, note that research in the 1950s and 1960s examined how women in engineering differed from other women. While the notion that women in engineering have different personalities than other women is less prevalent today, the idea that engineers possess a particular "personality" or set of traits continues to hold a high degree of currency in popular culture. An Internet search for "engineering personality" brings up both jokes about how to identify an engineer[43] and "the engineer" personality type.

As a personality type "the engineer", in online career counselling interpretations of the Myers-Briggs test, is an INTP (Introverted iNtuition Thinking Perceiving): "logical, individualistic, reserved, and very curious individuals. They focus on ideas, theories and the explanation of how things work ..." (www.mypersonality.info). These traits are presented by these sources as part of how one is "wired"; as the underlying truths of our being that need to be discovered in order to find the "right career". Such personality tests have also been used in academic research; a recent paper by three engineering professors, Carr, de la Garza and Vorster (2002), examined the performance of engineers and architects with different Myers-Briggs Type Indicators. The engineer

[43] A joke, which reflects the technical stereotype of an engineer, reads: "You walk into a room and notice that a picture is hanging crooked. You... A. Straighten it; B. Ignore it; C. Buy a CAD system and spend the next six months designing a solar-powered, self-adjusting picture frame while often stating aloud your belief that the inventor of the nail was a total moron. The correct answer is 'C' but partial credit can be given to anybody who writes 'It depends' in the margin of the test or simply blames the whole stupid thing on 'Marketing'." http://www.joe-ks.com/archives_jun2003/Engineer_Test.htm.

personality can also be seen as masculine. The "Engineer" personality type, for example, is reported to be disproportionately found among males (4% versus 1% of females, according to www.mypersonality.info). Burack and Franks (2004) reported on the gendered nature of the traits that are seen as dominant among engineers based on a study of engineering students' categorizations of 40 adjectives from the Bem Sex Role Inventory (1993) as masculine/feminine or engineer/non-engineer. They report: "across groups, the sorting into masculine and engineer resulted in virtually the same lists, as did the sorting into feminine and non-engineer, suggesting a common understanding of both gender and the ideal attributes of engineers" (Burack and Franks 2004:85).

Given the extent to which an interest in "personality" was a prominent theme for participants in my study, these gendered connections are particularly important. Indeed, all of the women whom I interviewed discussed "personality". They told me about the "kind of people" who are successful, the "types" of people in engineering, or what aspect of their own personality enabled them to succeed in engineering. One described herself as, "I'm not a problem solver. I'm analytical. … I am not a typical engineer". Another in presenting her work ethic stated, "some people are programmed that way, I don't know where it comes from". In addition to the repeated content of the traits, which I will address below, what struck me about these statements was the frequency with which the participants reflected on these traits as inherent aspects of who they and other engineers are. The extent to which they were "natural" can also be understood as an interpretation of these traits as a habitus. They are ways of being and experiencing the world that are unconscious – whether learned or biological – and depending on what traits one has, whether or not they are an “engineer” determines (at least in part) whether they will fit into the engineering field.

The degree to which these traits were seen as “hard wired” into an individual is reflected in participants’ descriptions of their career paths as beginning in their childhood. Eight of the men, for example, relayed having a mechanical orientation from childhood which was critical in their choice to become an engineer. Anthony, the oldest participant in the study, described:

> I was always interested in making things. I built airplanes and I used to build radios and things like that — and also a book that I got [*gets up and gets book from cabinet in his living room*]. My uncle got me a book back when I was about 9 years old, and I still have it, and it’s called *Pictures of the Engineers*. … That’s what I was always interested in; I never thought of any other profession.

For many of the men there was a sense that being an engineer was not a choice, but a natural outcome of who they were. It reflected their interests and matched their aptitudes and personalities. Indeed these aptitudes could be very specific:

> I have a better visualization of how things flow in terms of forces and structures; the, what they call *statics*, as opposed to the dynamics. I can see how things work together, but I get a better feel for the flow in the static. (Nick)

Although none of the women described this degree of interest in the technical or design elements of engineering (a critical gender difference I will return to in the next chapter), a few of the women described other characteristics they had held since childhood that made engineering a good career for them. Tracy, for example, stated “I kind of think it’s just my personality and nature that, um, I’m a bit bossy [*laughs*] and uh, even just, you know as a kid, like I’ve always been social and wanting to be involved in clubs and taking things on and I’m kind of a planner and an organizer, you know.” As an engineering project manager it is these traits she uses every day. The women also very frequently described having had an aptitude for math and science from childhood. Patricia, whose father was an engineer, articulated "I think part of it is I got the math/science genes, right? So math and science were always really easy for me, and I loved problem-solving in math; I thought it was the coolest thing…".

Part of the importance of this sense of natural aptitudes, or that engineering matched their personalities, is that one is doing more than just their job – engineering was not a career but a 'calling'. Don, who was nearing retirement after a career spent in technical engineering positions, described himself as a "tinkerer at heart" and that if he were not doing engineering work for money, he'd be doing it at home or through hobbies. When asked about the hours he worked, he replied "If it's your personality, it's not going to be overtime; you get paid for 8 hours a day; you might be putting in 10 hours or 12 hours, because that's just what you want to do, that's what you want to learn. It makes it more fun; the more you learn, the more you can do." This reflects Peterson's (2007:342) findings from her study of IT consultants that reported that male participants identified consulting as more a calling than a regular job. For these men engineering is something you are devoted to, that you dedicate your spare time to, and that you would do even if you were not paid.

The women also described the importance of finding a "calling", finding something that fit your personality. The discovery of what matched one's aptitude and personality came to the fore as the ideal way to find a career. When I asked Angela whether she felt more diversity in engineering was needed, she responded that as long as people could enter the field of their choice there was not a problem because "it's just based on your personality and what you like to do." The desire to find the job that matched one's aptitudes and interests was very clear among women who questioned staying in engineering. Danielle, for example, spent much of the interview telling me about her struggles to find work where she was happy and that fit with her personality. Veronica, who had found her "fit" outside engineering, described the discovery of this new field like love at first sight:

> But while I was there, medicine kept bubbling underneath the surface, and I started doing shadowing, and I wanted to talk to people. Every time I met anybody who was in the medical field, I got really jealous; almost like that kind of lovesick when you've got a crush on someone kind of feeling: 'I want to talk to them all about it, ask them.'

Tied to this desire to find *the* career that fit was the idea that an engineering personality exists. Those who thrive in the profession view themselves as having this personality. As James explained: "I think that people who gravitate towards the engineering profession or the engineering world, if you will, tend to be more organized, or tend to be more inclined to be organized and that type of thing, and don't like clutter or what might appear to be disorganized." This idea clearly fits with much popular career counseling material, with books such as *Do What You Are: Discover the Perfect Career for You Through the Secrets of Personality Type* (Tieger and Barron 2001), *Career Match: Connecting Who You Are with What You'll Love to Do* (Zichy and Bidou 2007) and *Follow Your True Colors to the Work You Love* (Kalil 1998) dominating job search sections in bookstores. It is also reflected in an article in *The PEGG* (2008:27) that profiled a self-help book entitled *Strength Zone* written by a Calgary engineer. According to *The PEGG* article, *Strength Zone* was based on the author's (David Taylor, P.Eng.) struggle to succeed following a job promotion. Entitled "Sink-or-Swim Leads to Effectiveness System", the article outlines

Taylor's "system's premise that everyone has a strength zone. That's the place where personality types, talents and values overlap."

The importance of finding what one was meant to be was reflected in the comments of seven participants on the need for psychological personality assessments in selecting a career. Notably none of these seven participants were strongly committed to engineering. Indeed, five of them referenced personality profiles as a way of showing, perhaps even proving, that they were not engineers. Laura, for example, stated:

> when I was at [company A] there had been some different personality tests that had been done and … most of the engineers were normally green which is very analytical thinking and I was sort of the green split half and half with what they call an orange personality which is very creative, spontaneous, so I've got these two halves that are equal and I have to balance them. And if I just sit as an engineer and do all of the analytical thinking the creative side goes, 'I am going to go bonkers' and I will. And so then I find the, at least the area that I've picked in IT allows me to do both. … So that was the other thing that was kind of a wakeup call, it was like, 'I'm not matching with' …

For Laura the results of this personality assessment worked both to bring her attention to the fact she was not a "real" engineer and to demonstrate the way she was different; she was an engineer in her analytical skills, but also more than an engineer because of her creativity. This "different" personality type, however, "fits" with the non-engineering career she is now pursuing. Similarly Eric described himself as a people-person unlike other engineers: "I'm INJF or INTF" rather than an INTP. He continued describing other assessments he had completed: "quite a few of the assessments have said, 'well you've got the mental science and math ability to do engineering, but you don't fit the mould'. So that's been a bit of a struggle for me, because I don't fit the normal engineering mould.

I'm not the engineer's engineer." The results of multiple personality assessments became critical in his thinking of his future career.

These personality traits, the results of rationalized scientific assessments, thus became proof of why engineering was not working as a career for these individuals. Indeed, I would argue, the emphasis on rationality and science in the engineering field work to reinforce the expectations of these individuals that "proof" can be found of what the right career is for their personality, much like a solution to an engineering problem can be found by studying the problem and determining the facts. Personality tests would provide the answers, the truths, about their personalities, personalities that in turn can be seen to be "calculable"[44]. This sense of there being traits that make one an engineer,[45] and that they are natural or inherent dispositions, indicates that these norms have been deeply internalized. The idea of an engineering habitus is in turn supported. In the next section I will show how these "natural" aptitudes come into play in explaining one's choice to study, and how without an aptitude (or habitus) finding a match in (or being committed to) a profession is challenged.

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[44] The phrase "calculable personality" was suggested by a colleague, Joseph Verschaeve, in a discussion of this finding and beautifully captures the sense of participant's presentation of one's personality as something to be studied and measured.

[45] This is in relation to a general sense of being an engineer. As I will draw out in the following chapter there exist two dominant narratives of what an engineer is, one focused on the technical, the other on management and communication, which problematize this idea of "an" engineering personality.

Choice of Engineering

In this section I will compare how engineers categorized as committed and non-committed described the timing of their choice of engineering and their explanations of why engineering was a good choice in terms of aptitudes and passions. I will also describe the role that other people and pragmatics played in their choice of the profession, and show that these factors were particularly important in the choices of those not committed to the field. The factors cited by participants – having mechanical interests, being good at science and math, wanting a good career – will also be examined as gendered. Notably, it could be argued that these recollections are distorted based on experiences that individuals had after entering the profession. However, even if these recollections are "colored," what study participants did "recall" is in itself telling.

Most interviews began with respondents telling me about when they had made the choice to be an engineer. For the vast majority, the choice was made during high school. This trend was consistent for both the committed and non-committed engineers. In both groups one participant reported selecting the profession in junior high school; one committed engineer identified grade six as when he chose the field. Where the two groups differed was in the numbers who had begun studying engineering immediately after high school. While only two of the committed engineers had transferred to engineering from another field or returned a few years post high school to study in the field, five of the non-committed engineers had transferred or taken up engineering studies as an older student. While the proportionate difference is small, this later choice connects to the more pragmatic (versus technical passion) factors described below that many of the non-committed engineers expressed.

An important pattern in participants' explanations of their choice of engineering was the extent to which committed and non-committed individuals described themselves as having the aptitudes needed for engineering. This difference was not in terms of being strong in math and science, which was cited by significant numbers of both committed and non-committed engineers, but in terms of mechanical aptitudes and a love of the design elements of the field. Committed engineers were much more likely to describe themselves as mechanically-oriented and to report that they continued to be actively involved and interested in mechanical and technical things. Additionally, all but one of the committed engineers who stressed that their mechanical aptitude and love of design led them to choose engineering were male. What differed between the male and female participants is not an attraction to engineering because of math and/or science (an aptitude for math and sciences as the motivation was reported by only a few more women than men), but that women were very unlikely to report being attracted because of the mechanical and design aspects. This difference in the mechanical interest, as will be examined in the next chapter, is critical to retention and as McIlwee and Robinson (1992) report, "These different starting points, in combination with other factors have a lasting impact on the engineering careers of women and men" (p.24).

Other people, particularly parents, high school teachers, and friends, have been shown in past research to have a large impact on the career choices that young adults make (Madill et al. 2007). In this study, the non-committed engineers were considerably more likely than the committed engineers to identify a person who was influential in their choice. Both groups identified family members (e.g., brothers, cousins, and fathers) who worked in engineering or a related trade, friends in engineering, and teachers as providing them with information on the field. Parents, however, played a distinct role for a number of the non-committed engineers. Five of the non-committed engineers, all of whom were female, stated that their mother or father had suggested that engineering might be a good career for them when they were having difficulty deciding what to study in university. None of these parents were engineers themselves and most had limited knowledge of the profession. Emma, for example, described:

> My mother still blames herself [*laughs*] for suggesting that I go into engineering and then me not really liking it. She still feels like she's to blame for it. But I don't think she's to blame, it was my own choice. I – I don't think they know what engineering is to this day. I don't think my family entirely gets it.

Having a role model was also identified by more of the non-committed engineers. Lisa described a family friend who served as a role model engineer "…he was a fellow who was well-organized. So well-organized, well-prepared, did good financial planning. So I had a positive mental image about engineering as a profession." These parents and role models, while well-intentioned, seemed from the perspective of the participants to have inadvertently given bad advice. They had advised the individual to do something that did not match their personality and inclinations and therefore, in the eyes of the participants, pursue a profession that did not fit.

Another critical factor in choosing engineering was the extent to which it was seen as a good career option. Indeed the likelihood of citing a pragmatic rationale for selecting engineering was one of the most consistent differences between the committed and non-committed engineers. While very few of the committed engineers described selecting engineering because it was a good career, the majority of the non-committed engineers reported on their choice using the rhetoric of engineering being "a good career". One of the few committed engineers who described his choice of engineering in these terms was Ryan:

> Initially I was interested in the sciences as well as literature so the two of those were competing for what I was going to do [*chuckles*]. I came down to what I thought I could make a living at so, basically – and then it was a decision of what kind of engineering.

Non-committed study participants were more likely to describe choosing engineering because it was "sort of a specific undergrad. So basically it was kind of engineering or maybe education or something like that, something where you were done and you had a title and a specific job" (Tracy). Engineering was a degree, at the end of which you were a professional, which was appealing. For Joseph, engineering was interesting as it was "practical" and "recession-proof". For Lisa and Angela, who described their passions as being in writing and art respectively, engineering ensured they would be able to have a salary to support the lifestyle they wanted.

A theme that distinguished the non-committed women's discussions of choosing engineering from the non-committed men's was a desire to find "a path". Danielle described that as an undergraduate she was not even willing to switch sub-disciplines because, "I was on my path." Jennifer, who was working as an engineer when we met, was very discouraged with her career. Despite having a well-paying position, she talked about wanting to find something that would make her happy; however, there was a tension in her words. In terms of going back to school, she stated: "I just don't want to go back and do something that — I want to *know*, I want to know, that's what I want. I want someone to say, 'Jennifer, this is going to be your career path that would make you the happiest. Go do it.' And I'd do it; I'd do it, I think. I think so. I think I would."

For Heather and Veronica, while a pragmatic desire to have a profession led to engineering, they both found it was not the clear path they had imagined. They had left the field for a profession where they felt the path was clearer - medicine. While both recognized the huge variety of careers possible within medicine, they stated that medicine gave a sense of direction.

> I think in medicine, it's fairly straightforward. Like, your role in society has been — I mean, I don't agree with a lot of some of the stuff in medicine, but it's a fairly defined role in many settings. In engineering, I didn't know what my role would be or could be or what I wanted it to be, and that scares me, in a way. I don't know. (Heather)

A similar sense that engineering did not set out a career path clearly enough, or at least a path she wanted to follow, was suggested by Veronica. Despite enjoying her co-op placements, Veronica did not accept any positions that required her engineering degree after graduating. While she did not regret this, since she did not have any interest in the technical aspects of the profession, she reflected on a conversation with her mother:

> … I was, like, "I wish I'd done a degree that was more basic skill-giving, or, like, more well-rounded or something." I was, like, "I should have done" — 'cause all my friends' moms were, like, "You did engineer, you did engineering," but I was, like, "No, but I don't have something I want to use. I wish I had" … And I haven't built — I wish I'd built my path. … So I wrestle a lot with that. So I think very much I needed to have that career feeling.

Thus, for Heather and Veronica, the importance of a path resonates very clearly. They wanted "a career", something where the steps were evident and organized. Both pursued engineering because it appeared to offer this but, without an interest in the field, the concreteness of the path crumbled. Again without a habitus that could see the possibilities that existed in the engineering field, the paths that existed, the 'possibles', disappeared.

In hindsight, a lack of "aptitude", a sense of engineering only as practical, and the strong influence of a parent on the career choice make it seem obvious that in these cases the individual would leave engineering. Melissa provided a particularly clear example. When I asked what led her to select engineering, she responded:

> Didn't really have a choice *[laughs]*. Um, my, um father was only going to pay for school if I did something significant and options were engineer, doctor, lawyer. I had an elder sister who was an engineer and another who was, um, planning on going into the medical field, she was currently in psychology and had to do her undergrad first. And I was good in math and science and I thought, if I have to choose *[laughs]* I'd do engineering, my sister, my eldest sister was just finishing her civil engineering and she really enjoyed it so, I thought I would try it.

As Melissa makes clear she had little interest in the profession from the very start. While she does not report having technical interests, she had aptitudes in math and science and was required by her father to choose a significant, or practical, program in order to be supported. That she did not enjoy engineering and left the profession, in addition to having a strained relationship with her father, does not seem surprising. Melissa's sense of being forced into engineering is certainly more negative than what most of the non-committed engineers reported, but many of the non-committed participants, particularly the women, expressed a similar sentiment of having chosen engineering because it seemed like a "good enough" option.

Based on the participants' reports of what lead them to select engineering, clear correlations between the motivations behind their career choice and their commitment to the profession can be seen. Notably, factors that were frequently stressed in programs and materials presented to young adults, particularly women, to encourage them to pursue engineering did not correlate with increased commitment. Regardless of commitment, almost all participants identified that they were "good at math and science", so while probably necessary, these aptitudes are not sufficient for commitment. The rationale that engineering is "a good career" is even more problematic. This argument may lead individuals into the profession, but it was only recalled among individuals for whom the profession did not work out. Rather, the factor in selecting engineering that was strongly and clearly connected to commitment was having an aptitude for the mechanical and a passion for the technical. Indeed *not* recounting whether or not the original decision was based on it being a "good career" was more indicative of having remained committed to the profession. The importance of the technical aspect of the habitus will be elaborated in the next chapter.

Conclusion

In this chapter the counterpoint to Bourdieu's (2004) field, the habitus, was introduced before turning to a discussion of how the alignment between field and habitus shape commitment to the engineering profession. According to Bourdieu (2004), the habitus functions as the sub-conscious internalization of the field, the ways in which one intuitively knows how to act in a situation. Thus when there is a strong alignment of field and habitus the themes that predominate in the profession (e.g., rationality and innovation), are enacted and become part of individuals' personalities (e.g., logically and technically oriented). I have argued that evidence for the existence of a habitus can be seen in the views of study participants regarding their sense of natural aptitudes for engineering. Participants emphasized the notion of an engineering personality, stressing the ways in which one's personality could be tested, assessed, and proven to fit with a profession. Being an engineer was a calling, it was something evident from childhood, something genetic.

The issue arises when one enters engineering and discovers that one's "natural aptitudes" – or habitus – do not fit with the profession. The degree of (mis)match, I argue, is strongly related to one's commitment to the field. The concept of commitment is central to this study. It was developed during the analysis as a way to go beyond simply identifying individuals who were still or no longer practicing engineers. The concept of commitment, as used in this study, emphasizes the extent to which one identifies with the engineering profession. Do individuals embrace being an engineer? Or do they see it as "just a job," express disillusionment with the field, and report plans to leave?

In subsequent chapters, I will develop the argument that when the habitus and field do not align, the "possibles" in the field are hidden. Without visible paths, commitment can be challenged. The consequences of habitus not aligning with field can be seen when we look back at the reasons people chose to study engineering. For those who were not committed to the profession, the choice of engineering was frequently related as a pragmatic one or a choice based on the advice of parents. Among those committed to the profession, particularly men, technical aptitude and a love of design were frequently reported from childhood. In reflecting on the participants' experiences in the profession, this technical interest (which will be further discussed in later chapters) comes across as necessary for commitment to engineering. It was not, however, sufficient to maintain that commitment. Individuals, such as Eric, were attracted to engineering by an interest in the technical, but are no longer at all interested in the design elements of the profession. What happened in between - a series of negative experiences that led to questioning the profession - has made this early interest insufficient. That commitment is not determined only by one's habitus – but is shaped by the interaction between habitus and field – will come to be seen as critical in the following chapters where the gendered nature of this interaction becomes particularly salient. In anticipation of that discussion, the next chapter will delineate three key themes of the engineering habitus: hard working, independent, and problem-solving.

Chapter 6: The Engineering Habitus: A Dedicated, Responsible Problem-Solver

Engineers are portrayed in the popular media and academic literature as rational, non-emotional, mathematically and mechanically inclined, team-players, “tinkerers”, macho, individualistic, competitive, confident, and dedicated to their work (Dryburgh 1999; McIlwee and Robinson 1992; Miller 2004). In this chapter I will be examining three “traits” of engineers that were repeatedly reported by the participants in my research: hard working, independent and problem-solvers. These traits will then be used to construct a profile of the engineering habitus, “a set of historical relations ‘deposited’ within individual bodies in the form of mental and corporeal schemata of perception, appreciation, and action” (Bourdieu and Wacquant 1992:16). Using Bourdieu’s theoretical ideas, I will ask which traits are internalized and seen by members of the engineering profession as “necessary” in the engineering field.

Bourdieu does not write of an engineering habitus, but he does develop the idea of a scientific habitus. He describes the scientific habitus as “a practical sense of the problems to be dealt with, the appropriate ways of dealing with them, etc.” (Bourdieu 2004:38). In other words, the sub-conscious is acting and evaluating in line with the rules and priorities of science. The scientific habitus can be seen through the study of scientific practices and the ways research is conducted in the laboratory, in particular the intuition or flair for research that is acquired (Bourdieu 2004:39). In developing the idea of an engineering habitus, I am examining the ways in which my study participants internalized (into their self-definition) the values and norms of engineering – particularly the accepted ways of working and "personality" traits of being an engineer. This idea of an engineering habitus reflects Cooper's (2000:388) work on Silicon Valley knowledge workers which reports on an "internalization process," whereby pressure to work and have extreme commitment to productivity are read as personality traits, rather than as reflections of organizational expectations. In addition to this strong commitment to work, I will examine how being independent and rational are seen by study participants as elements of who they are: their personalities and aptitudes.

I will also be asking how these traits are gendered, and if they are connected to professional commitment through alignment with the norms in the field, such as efficiency, innovation and objectivity. As noted in the last chapter, previous research has shown the extent to which "masculine" traits (as defined by the Bem Sex Role Inventory) are also those associated with engineers (Burack and Franks 2004:85). In this chapter I will ask whether men and women who participated in my study differed in the extent to which these traits factored into their self-definition. Evetts (1996:27-28), for example, argued that women can gain the technical skills of engineering, but not its habitus, or the unconscious 'feel for the game'. The habitus, which has been defined by men, remains inaccessible because it is indeterminate; because it is not taught but indirectly gained through networking and sponsorship. Does this hold for the women in my study? Do the men report having gained all the elements of the engineering habitus? Is it an all-or-nothing endeavor? I will argue that the engineering habitus is much more flexible. Some women presented the dominant image of "an engineer", while some men presented as having not internalized this habitus. The degree to which an engineering habitus has been adopted will then become a critical theme in explaining commitment to the engineering profession.

Hard working, Reliable & Goal-Oriented

Being hard working, reliable and goal-oriented clearly resonated with men and women in my study, whether or not they had remained in the profession.[46] Twelve of the 18 women and 13 of the 18 men at some time in the interview described themselves as having a strong work ethic, being dedicated and/or pushing themselves to meet goals.[47] Examples included Vince who stated, "I'm hard-working, I want to work, I couldn't sit too long", Lisa who described being "disciplined" as a requirement for being an engineer and her success, and Erin who identified her non-engineering career as fitting for her because it allows one to be "hard driving and ambitious". In many cases work ethic was reflected in the stories told, particularly of their engineering education. As Nick, one of the younger male engineers, observed:

> *Nick*: I remember one comment made when I was coming through engineering here at the U of A. It was basically that, of those starting off, you'd lose at least 45 percent in the first year, and you'd be expecting a heavy workload. Where most students were capped at

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[46] These three words were highly interrelated. For example participants would describe being hard working in order to meet goals, or being reliable because they had such a strong work ethic. Other terms that were included here were work ethic, diligent, and committed.

[47] In emphasizing this trait I am not suggesting that hard work and dedication are specific to engineering, as it could certainly be argued that most professionals would describe themselves this way. What I am suggesting is that among engineers this trait holds a particularly salient role as reflected in how frequently it was cited. Further, as the below will reflect, work ethic is seen as a requirement for the "survival" of engineering education, which becomes a central rhetorical strategy in the profession.

> six and were recommended five courses a semester, engineers were quite often doing six or seven, and seven, they did not need special permission from the dean or anybody to do; it was 'Here are your seven courses that you will be taking this semester.'
>
> *Interviewer*: Did you ever do that?
>
> *Nick*: Yes.
>
> *Interviewer*: Was it as horrible as it sounds?
>
> *Nick*: It was quite the workload. Even in my master's, I did five and five. I got it done in less than one calendar year, so [*laughs*].
>
> *Interviewer*: I think that would certainly prove something about your work ethic to an employer.
>
> *Nick*: Oh, yes, they like me. They find me quite efficient [*laughs*]!

Being hard-working and disciplined was also part of the self-definition of other study participants, including James and Melissa who both described themselves as having a military inclination. Melissa, who was now pursuing training in another field, stated:

> I'm very methodical, very – I'd fit well into the military ... for me if I see someone just standing around being lazy it just drives me bonkers. And I think that in that kind of brigade system in bigger facilities you just don't kind of get away with it or whatnot. Or, I think you can still have fun but you need to get the work done and that's the way I've, it's always been with me.

A strong work ethic was also a trait that many of the interview participants identified as central to being an engineer. When discussing changes in the profession, Daniel noted that the work ethic of engineers has remained strong while in other fields it appears to have slipped. Engineers, he articulated, must remain hard-working and detail-oriented "because our decisions are bearing on life and limb, we're all pretty much of a level of ethics and personal behavior that we don't want to see anything slip between the cracks." Heather, who was no longer in engineering, described her positive perceptions of the profession in terms of the profession's work ethic:

> I like a lot of values of the profession … their professionalism, I forget what it is "working to your highest", whatever that — and due diligence; like, a lot of that I like. I like the idea of the humble engineer, people who work hard.

While the traits were reflective of the profession she had left, they remained traits she identified with. As Heather's comments indicate, whether or not one remained in engineering did not affect one's self identification as having a strong work ethic. This suggests that this inclination may be so pervasive within engineering – particularly engineering training – that if it is not part of one's self-image they are not likely to have completed an engineering degree. Additionally, being very hard working and doing work to the best of one's abilities were not presented as gendered by any of the participants, nor were they something that the males or females were more likely to identify with.

Linked to the emphasis on dedication and hard work was a focus on reaching goals. Veronica, in a very telling response to my question about what would have been different in her life had she been a man rather than a woman, stated:

> I was just so driven, and from kindergarten have been, like, 'What am I going to do with my life? What am I — like, I've put a huge degree of pressure on myself all the way along the way to achieve and be important and be special and be good and be smart; you know? Like, I was your classic geek. I remember in kindergarten, there's this great story, and my mom loves to tell it, because apparently, we had little small groups, and one group was doing math, and one group was doing painting, and one group was in the sandbox, and I refused to go to the sandbox. I was, like, 'I do that at home. I'm here at school to learn. You're here to teach me.' And the teacher was, like, 'Who *are* you?' I have never been very good at

> taking the time just to chill out; I've always been very driven and very high achieving, and everything I do, I do it well.

Similarly Karen reflected back on her high school years wishing she could have been easier on herself when young, taken time to enjoy things, "enjoy the process a bit more, rather than just the end point". A number of participants also emphasized their interest in meeting concrete goals (e.g., completing a project). Ryan observed:

> I mean it [engineering] is very pragmatic focused. If you don't have a result then I'm not interested in focusing on it, so that's the counter to the – if you're more interested in the ill-defined then you probably won't like engineering.

Christopher, Daniel, Michelle, and Joseph each described the importance to them of seeing a project completed – and completed well. This type of goal (a project) was one that these individuals, who were all committed engineers, were able to work towards and reach.[48] The desire to achieve goals, however, did not match everyday assumptions that males are more goal-oriented. Being goal-oriented was something that the majority of the study participants noted about themselves. While the men were more likely to refer to having concrete goals, there were certainly also women who were oriented to concrete goals of project completion.

Having a "personality" which is oriented towards working hard and reaching goals was also presented by a few of the participants, particularly women who had left or were considering leaving the profession, as the reason they had remained in unfavorable work situations. Four women (Danielle, Erin,

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[48] The importance of well completed projects was also reported by Lisa, whose categorization as non-committed I discuss in the previous chapter.

Melissa and Veronica) and one man (Eric) described how their work ethic had come at a cost to their well-being. Melissa, who I quote above describing her military style, stated:

> I had a *really* crappy job for a year and a bit and it was making me sick and I still wouldn't quit on them. Like what's going through my head? Why, why, tough it out? And I think it's just getting paid to do a job and I need to be doing it even if I'm not capable of doing it I've got to find a way to do it. And that just kind of, some people are programmed that way, I don't know where it comes from.

After a year in the position, Melissa applied for and found a new job, "they wanted me to start within two days, but as much as I hated working for [company B] I just couldn't leave them in the middle of an even small project without notice. I thought that even as much as I hated them that it just wasn't right." Veronica described a similar tension between realizing that she did not want to be an engineer and accepting this, "I think I knew from my first lecture that it [engineering] probably wasn't my gig, but it took me *[laughs]* 10 years to accept that." Each of these women described a sense of personal responsibility in making it work. To change one's mind was tantamount to failure, which these high achievers were unwilling to accept. Eric directly linked an episode of poor psychological health to his work-ethic:

> I was very close to a mental, emotional burnout … I now realize is more my own problem than anything else. Like most engineers I have a very poorly defined set of boundaries as to when to say no, positively over-optimistic of their ability to produce, think they can produce reports in a week when it takes a month, and as a consequence say 'I can do that, of course I can do that.' And then you find yourself with five things to do in a week and then – an underlying pressure in the industry is to be very, very billable. Most, I mean, we, this particular office of [company A] has a billable percentage in the region of 125 to 130%. That's because people are working so much overtime. So it's a very profitable office, but man are we getting some people who are frazzled and burnt out.

Eric linked his experience of being burnt-out to a set of personality traits that appear to be widespread within the industry. And as he explains, for the organization these personality "traits" are highly profitable, particularly in the short term. Yet he simultaneously rejects a critique of these organizational "norms," explaining that it is "more my own problem", suggesting the internalization of these norms (which "happen" to benefit one's employer) as inherent aspects of who one is, rather than as part of the profession's expectations.

This discussion of the emphasis by individuals on their own work ethic also reflects a number of the themes that were addressed in the discussion of the field (Chapter Three). Being hard working and committed, as Nick relates above, leads to efficiency – a key value of the field. Commitment and dedication means ensuring that your job is done correctly, reflecting an internalized enactment of the ethical standards and integrity critical to the profession. These individual traits align with elements of the field creating an opportunity for a match – for commitment. And, by being personal traits, they further place the responsibility for "fitting in" with the individual, a critical element of the engineering habitus as explored in the next section.

Individual Responsibility

> I'm kind of a cuss for stuff; I believe I handle things differently. You couldn't make me go to Chicago unless I wanted to go to Chicago. … I didn't live under the consequences of someone else's choices. Never will. (Matthew)

Study participants also repeatedly described themselves as being independent, being self-motivated and personally responsible, and preferring to have autonomy in their work. These forms of independence will be explored and their gendered constructions probed in this section. Linked to the sense of personal responsibility, described by Eric above in terms of work ethic, is the critical corollary of self-blame. Once again, this absolves the work organization of responsibility for employee's problems.

Comments about the desire for independence in one's work were more pervasive among the men (11 of 18, versus 6 of the 18 women). Given the emphasis on teamwork in the field (Chapter Three), independence was infrequently described as a preference for working alone. Christopher, for example, identified a preference for solitary work: "I like to get focused on something and work through it, rather than a lot of distractions". Similarly, Michael observed that "I like to work mostly independently. I enjoy collaboration on ideas and problems if it's someone that I value their input and we're sharing ideas ... But when it comes down to *how* I like to work, I like to sit down at my desk with the computer and the calculator, and work things out." That said, these examples were much more the exception than the norm. The majority of participants indicated that they enjoying working in teams.

The independence that was reflected in the interviews was more about decision-making power than working in a solitary situation. This decision-making power was reflected in participants' desires to see projects through which, in turn, was described as a preference for smaller projects (e.g., Michelle), a criticism of certain industries where it was not possible (e.g., Laura and Alex), and as necessary to ensure the quality of a product for which one is ethically responsible (e.g., Matthew and Michael). The idealization of decision-making in engineering was reflected in the following statement from Michelle who described independence as what was most attractive about the profession:

> I think because you get to be given responsibility and be your own boss — well, not completely be your own boss, but I guess what I mean by that is engineers tend to be the leaders in their organizations, they tend not to be the followers. It's like the difference between being a nurse and doctor: I wouldn't want to be a nurse, because I don't want to be the person who always takes direction from someone else on how to do everything, I'd rather be the doctor, and if I can't be the doctor, then I'll do something else.

In describing her childhood ambitions, it is clear that Michelle sees this leader orientation as an inherent element of her personality. For Michelle, finding a match between a professional field and her desire for independence was possible through engineering. This can also be seen in Joseph's comments about choosing his area of engineering after a summer work placement where he experienced the independence of consulting:

> ... the summer after my second year. I thought, "Yeah, civil is — it's in my blood, 'cause this is what I want to do: a little bit of *everything*." And being out there outside the confines of an office and not having someone breathing down your neck. You knew your work for the day, and you were left to do it. So that sense of freedom and control over your environment, that was major.

In some cases, a subject's "independent" nature pushed them away from a particular engineering organization or the profession itself, if their roles did not offer enough autonomy. Kelly, who described an earlier position that she loved which gave her a great deal of responsibility and space for decision-making, was deeply dissatisfied with her current role (in part) because it lacked this opportunity:

> This company that I'm currently with ... it's very regulated, it's very rigid, it's very conformist, you have to conform and if you don't you really have

> difficulty and I'm not much of a conformist so I'm having difficulty *[laughs]*.

The earlier organization had embraced her non-conformist nature. The second, in contrast, did not allow her creativity as following rules was paramount. Kelly's sentiments here reflect an interesting tension that was expressed a number of times; one's engineering identity is torn between being a "creative problem-solver" and a "rule follower". The individual engineer may desire independent decision-making authority, but organizations and the profession do not always enable this. Indeed, despite the widespread desire for independence among participants, a number of the participants identified themselves as different from stereotypical engineers who they saw as rule-followers. And while some of the participants did not embrace the desire to be independent to the same extent as Kelly, Joseph and Michelle, I cannot imagine any of the participants identifying as a rule-follower over that of "creative problem-solver." Yet the opinion that engineers are rule-followers was wide-spread. This might mean that my study participants were not "typical engineers". Alternately, it may reflect a broader cultural endorsement of the creative non-conformist as superior and consequently be an image that individuals, including engineers, prefer to identify with.

The rigid leadership that a number of the engineers reported, alongside the limited autonomy of field described in Chapter Three, was therefore problematic for a number of the participants in this study. In part this may reflect a disconnect between the presentation of the profession and the actual work available. For example, my review of textual materials (Chapter Three) showed that the image of a successful engineer as entrepreneurial was frequent, but through working in the field participants came to understand that engineering was much more likely to involve being employed by someone else. In Ben's words,

> If you're a really good engineer and if you're really a technical person, what you do is – you're not an entrepreneurial person at all, you just do some more technical job, there are a lot of technical details that you have to deal with that they just don't see the big picture. ... you just have to be working for someone all of your life and just deal with a lot of technical details, take a lot of responsibility with the quality of the, of the product, or the building that you're involved in while the other person who pays you a little money is actually making a lot of money [*chuckles*] from those things.

Joseph related a similar sentiment. He felt that through his years of work experience he had pulled back the curtains and had seen the wizard (of Engineering). He continued:

> I used to think it's all because of us [engineers] the contours of the earth get shaped, and now I look back, they're so naive little notions I had. It's true: we're the ones that pave paradise, unfortunately. Back then, I used to think, "I had a hand in paving that"; now I'm at the point where it's really the guy who owns the land who decided he wasn't just going to sit on it. Really, he's the guy who decided, "I want to do something. I want to put up housing. Let me hire an engineer to help me."

As an engineer, in the eyes of Joseph and Ben, you help someone with more money and power to meet their goals. You are forever under the thumb of another.

The second way in which independence was indicated was in participants' descriptions of their successes and failures as being the outcome of *their* choices and actions. Ten men and 14 women made statements of this type.[49] They

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[49] This includes some cases where the emphasis was more directly on broad ideological notions of individuals as being responsible for their own success, which may also reflect a broader societal shifts towards individualization (e.g., Bauman 2001; Beck and Beck-Gernsheim 2002).

described themselves as not being controlled by others and told of a willingness to deal individually with difficult circumstances. This is reflected in the above quote from Matthew, where he identifies that he will not live under the consequences of another's choices. These study participants also described taking initiative in the face of difficult circumstances, be that a downturn in the economy or losing a job. Ryan, for example, described a job at which he was very unhappy, but unable to leave due to the need to support his family. Coping with this was very individual: "so you sort of just sucked it up and soldiered on. … Dealing with it [*chuckles*]. Just live with it I guess." When I asked Lisa about problems at her current organization, she responded that if she faced something that she thought needed to be changed, she would change it.

While this ability to be self-motivated, and to deal independently with challenges, was idealized within the profession, there was a downside to it: self-blame. This sentiment was expressed by Jennifer, who had very challenging and negative experiences within engineering which she discussed in terms of what *she* had done wrong. At the time we talked, Jennifer was grappling with whether to leave engineering and expressed a sense of failure about "giving up":

> I feel that I need to redeem myself in some other profession sometimes. Because I think that I was always on a good track. Like, through school, I was always a top achiever and I always did really well, and people had high expectations of me, and I had high expectations of me. And now I feel like it's stopped. I don't know. I feel like I could do so much more, but I don't have the opportunities. I know that you have to create them for yourself; I'm not trying to blame anybody for that, I'm just saying that's kind of how I feel.

Jennifer's refusal to "blame anyone" seemed particularly jarring as she had just finished explaining a number of very negative workplace experiences and describing the hostile male-dominated environment she worked in, which would very likely limit any woman's opportunities. Her refusal to assign this blame to the organization or her colleagues, and her willingness to frame it as though it were up to her to "find" the opportunities, reflects the degree to which this discourse of individual responsibility has been prioritized and internalized. Indeed, the idealization of individual responsibility in the field, and it's internalization into the habitus of the engineers, reflects one of the most powerful ways in which the status quo of engineering is maintained. Notably, this emphasis on individual responsibility can be seen elsewhere in society as a reflection of what social theorists have examined as the individualization of society: "Whereas illness, addiction, unemployment and other deviations from the norm used to count as blows of fate, the emphasis today is on individual blame and responsibility" (Beck and Beck-Gernsheim 2002:24). In engineering, as I will return to in the conclusion, this responsibility is magnified by the ethos that engineers are people who solve problems. If they can make solutions that fix the problems of the physical world then "logically" they should also be able to fix the dilemmas of their individual lives.

Independence is also broadly aligned with masculinity in contemporary Western culture. The masculine nature of independence can be seen in two discursive themes in my interviews, "sink or swim," and the "explorer". "Sink or swim" is the idea that individuals should survive training and early work experiences on their own. It can be understood as linked to the "weed out" system, which Etzkowitz, Kemelgor and Uzzi (2000:52-54) discuss as sifting out students by a seemingly meritocratic process that simultaneously removes individuals without the "desired" (or dominant) social, cultural and economic characteristics. Central to this weeding out is "challenge," a masculine motivational strategy that tests one's ability to withstand stress, pain or humiliation, and that requires the individual to meet their "challenges" individually. Within the engineering profession, this challenge was described by a number of the men in relation to early work experiences where they had to learn on their own to deal with difficult clients or subordinates. Matthew, for example, recounted:

> Here I am at 22 years old, full supervisor, supervising my neighbor — because I grew up not far from [company G] in a blue-collar neighborhood. … there were not formal training programs at this point. It was fly by the seat of your pants. This was done as an experiment to see if we could learn to swim or drown, and we were thrown into the middle of it — we had some training — 'Okay, you're in charge of that gang.' Twenty-five guys, and I'm putting them to work … The guys would do little things. We went toe-to-toe, like, screaming matches, guys upset — not me screaming, but guys very, very mad at me. He said, 'You're never going to change the world. You'll not make us do that.' 'Yes, I can.' And these guys are my dad's age, 55 years old, and I'm 22 years old, telling them, 'Guess what? The world just changed.' Made 'em nuts, absolutely nuts.

This statement of Matthew's clearly reflects a sense of pride in having dealt with this challenge of leadership on his own, and in not having been intimidated by considerably older men with more experience than himself. That this sink-or-swim model was seen as a norm in the profession was reflected in the words of a few of the younger engineers such as Jennifer: "I didn't know what I expected, but I expected some mentorship, someone to show me the way, help me around, and I didn't get it because there wasn't enough time or people to do that".

Closely tied to this idea of being able to succeed on one's own was a construction of oneself as an explorer, as challenging the frontiers of engineering. This construction, which was also frequently found in the textual materials analyzed in Chapter Three and Four, was again more prevalent among the men.

These “explorers” described how they resisted and resented organizational processes and rules, how they preferred doing things on their own. When reflecting on a past position, Joseph explained, “I felt handcuffed a lot. I felt I knew what needed to be done and what I needed to get the job done, but I was handcuffed by policy and by accountability and bureaucracy”. Jack also identified this emphasis on rules and processes as varying between organizations and making some (those with less rules) more desirable. This is also reflected in Kelly’s earlier self-identification as a “non-conformist.”

Again, any simple connection between gender and the ability to gain the “engineering habitus” is brought into question by examining the traits emphasizing autonomy. Despite a distinctly masculine construction of autonomy, as reflected in the discursive construction of “sink-or-swim” training and an explorer mentality, some women did incorporate these traits. There were also men who did not, and who sought support and mentoring. Across all study participants, an emphasis on being personally responsible for one’s choices was expressed, whether one had found a fit in engineering or not. Despite this, there were gendered trends in responses such that women, like Jennifer, were more likely to blame themselves. Acceptance of this individual responsibility for negative experiences, furthermore, implies that no systemic change or programs are needed to change the profession or work organizations. It is up to the individual to find solutions.

Rational / Linear / Problem Solvers

Popular stereotypes of engineers portray them as rational, objective, and analytical problem-solvers. Among the engineers I interviewed, 89% (16) of the men and 78% (14) of the women described themselves as being rational or, more often, a problem-solver. These self-descriptions were equally common among males and females, and among those committed and not committed to the field. Participants also described themselves as being logical, analytical, liking “the concrete”, and preferring things that were “black and white”. For example when I asked Michelle if she would recommend engineering as a career, she stated:

> Well, you *[chuckles]* have to be a bit like me, but I really like math, I like physics, I like that there’s ways to rationalize the real world into something that’s sort of black and white, and you know what you’re dealing with, and you can give a fixed answer; I like the fixity of the kind of work, I like that there is an answer.

Julie described herself as “a practical person.” Karen stated that she was “a very linear think[er].” Melissa saw herself, and other engineers including her husband, as “very, very thorough, methodical.” For Kevin, it was “the concrete nature of right and wrong answers, calculating, using numbers” that made engineering appealing. This preference for the black and white, and the concrete nature of technical issues, reflects what Mellstrom has called “binary thinking”. Mellstrom (1995:76, cited in Faulkner 2000) writes, “Technical problems are given the character of either-or, plus-minus, negative-positive, and in its most basic technical form: zero or one” (p.760). This binary thinking is grounded in “a complete faith in cause and effect”, which Mellstrom exemplifies through the words of a designer who states “Either things work or they don’t!”

Due to the nature of my study, the participants rarely discussed the technical aspects of their work, so the extent to which their work processes are rational and logical is hard to determine. Their linear perspective, however, often came through in more oblique ways, such as the manner in which individuals (particularly the men) dealt with my questions. On numerous occasions, individuals repeated my questions, confirmed that they were answering them 'correctly', or answered them in unexpectedly literal ways. When I asked about culture in his workplace, for example, Jacob elaborated on how one of his employers was "cultured", referring to his musical interests and the size of his CD collection. When I asked William what a successful engineer was, he quoted the professional act and the requirements outlined within it.

This ideal of rationality / pragmatism was also expressed by participants when discussing their lives more generally, as in how they had chosen engineering. As described in Chapter Five, an emphasis on pragmatics was particularly common among those who were not committed to the profession. The importance of making a "rational" choice was reflected in the following statement from Joseph:

> When I came to university, maybe it was a personal character trait or not, but it had to be something practical. I had to learn something that gave me a sense of personal satisfaction, where I could look at a product and say, "Wow, gee, yeah, I accomplished this," or "I did this, I did that," or — it had to be something practical. … I just thought engineering had a lot of the buzzwords that seemed important to me, and kind of interesting — building, constructing. It sounded practical. … So that's what made me choose engineering from the get-go, was probably my own personal traits that made me think of practicality over artistic, social considerations.

For many of the participants, particularly those who were questioning or had left engineering, the choice of engineering was based on the knowledge that it was a four year program that made one a "professional", and ensured a well paid and in-demand career. Tracy, when I asked her what she thought were the best reasons to be an engineer, responded:

> I think it's like a pretty well-respected career. Um, I think it's challenging like you have to use your brain and think of, like it's not the kind of job where once you get good at job you can just like do it without thinking … And I do like that it – you have the opportunity to make a good salary.

Being pragmatic was also clearly reflected in other career path choices. Danielle, who had previously resigned her professional status and never planned to return, explained her motivation to return in terms of rational factors: "…ideally I would have really liked to stay home for a few more years, but the work, I'm a practical person and there's so much work out there right now that you go, 'well, let's get your foot in the job market and then you're good to go'…". The selection of a particular industry within engineering was also described in very rational terms by a couple of the women. Angela, for example, identified selecting the organization that employs her because it is a leader in a new and growing field. In all these cases the choices made were framed as "rational" choices rather than as reflecting a passion for the industry or organization.

This organized and rational approach to work was one that a number of study participants described as carrying over into their lives more generally. They talked about themselves as "planners" and about making spreadsheets to organize their lives. A very clear example of this highly organized approach was found in Daniel's discussion of his life plan and aspirations.

> … what I call a life plan I put together a number of years ago. It basically is a matrix where you've got the years, my age, my wife's age, the kids' ages, when they start and finish university, when the mortgage runs out *[chuckles]*, you know, all those sorts of things: when you want a new house, a new car, it's all on there and it goes up until I hit 100 — not that I will get there. But at least you can look ahead and say, "What are the possibilities and the opportunities, and where do they come on the chart?"

This rational planning approach was further revealed when I asked what he would do if money was not a concern. After explaining how money was not a major factor for him, he stated, “Just for fun, calculating if I was to walk out the door tomorrow and never work again in engineering or [industry], what would it take for me to walk out that door and just sit around and do my own research and have fun, and I figured 4 million bucks would be fine.” Such a quick and decisive answer to this hypothetical question suggests a highly rational mindset. A rational approach to one’s life was also seen as very positive, as Anthony stated, “Engineering education sets you up to run your life the same way: organized, I think. Most engineers are pretty organized in their home life as well. That’s a big advantage that I see.” Lisa elaborated on this organized personality:

> It’s very odd for you to see an engineer who’s at the tail end of their career who isn’t very well off. They’re people who have all their coverages in place, their house is paid for, they had a financial plan back 20 years ago, 30 years ago, 40 years ago, whatever, and it has come to fruition. They’ve thought about what kind of a retirement place they wanted, they’ve got it. They’ve got a reliable car and they know it’s reliable because they had it either for 10 years or they’re about to go out and buy exactly the same one. It’s like a decision criteria. It doesn’t matter if you start out with what looks good or price ranges, I don’t know an engineer who doesn’t go onto the Lemon-Aide Car Guide and the Consumer Reports to figure out, to get the expert opinion. They know how to get expert opinions on the things that they want to do, including financial advice, legal advice, etc. They tend to be fairly well together people.

Lisa continued a few minutes later that engineers, she believes, “tend to have a lower incidence of divorce rate, they tend to be more family oriented people”. Engineers are, according to Lisa, people who plan their lives, who are careful and who are committed.

A number of the women also described their approach to career/family balance in highly rational terms. Julie stated that she “architected a solution to support my worklife” and described the very rational manner in which she and her husband balanced their careers to ensure that their children would be cared for. She “architected” the balance; she planned and reasoned in light of the demands of her career and her husband’s. Melissa also articulated the search for career and family balance in a highly rational way that emphasized biological necessity and economic realities.

> … One of the parents is going to have to make that choice. It’s generally the woman just because [*pause*] physiology, you know, you’re the one to nurse them and you’re the one that whatever. And by the time you’re - the time you’re done all that child care, the basic child care that you have to do as a parent, you can’t just get a babysitter to do or nanny to do, um, you’re, even if you started at the same level as your husband, there’s, they’ve exceeded you and then it becomes a financial decision whether the family, whose going to be doing what. … When I started working I was making more than my husband, but by the time I went on maternity leave he had surpassed me. And that’s kind of the nature of his company and we do different work, it’s not an equal, looking at. But even now if I were to go back into engineering, there’s no way I’d make half of what he does *[laughs]*, so you know. When you’re looking at your household finances, what are you going to choose?

For Melissa, therefore, that the woman is going to make the career sacrifices is rational; it is a black and white calculation based on biology and earnings.

As I conducted my research, I had to confront the question of whether this rational/problem solving orientation was inherent to these individuals or whether it was learned through engineering programs. Was this an element of habitus that individuals came to engineering with? Or did it develop during their schooling? Past research, particularly Sally Hacker’s (1989) ethnographic work as an engineering student, takes the position that this rational / linear way of seeing the world is something that is drilled into students through their education, for example, via the repetitive mathematical problem-solving drills that students are required to complete. The emphasis on teaching rationality is also reflected in research that has examined the content of engineering education. Bucciarelli's (1994) deconstruction of a university engineering problem leads to the conclusion that "The student must learn to perceive the world of mechanisms and machinery as embodying mathematical and physical principle alone, must in effect learn to *not* see what is there but irrelevant … Reductionism is the lesson" (p.108).

The idea that a linear mindset was developed in one's education was discussed by a number of men and women, both those still in the field and those who had left. Ben, when he was not able to get into architecture, had pursued engineering on the advice of his father. He described:

> The other thing is my father is an engineer and he was just recommending me that, like, the engineering education is a type of education that really, you know, teaches you a certain way of thinking that is more systematic and, uh, analytical. So he recommended that if you are an engineer, even if you do something else, if you do – your way of thinking that you learned in the program is going to help you become successful.

James emphasized that the demands of an engineering education created logical and organized workers:

> But the profession itself teaches it, builds some discipline in, and, if you will, forces you to be organized. Forces you to be organized in terms of just getting your education, 'cause they cram a lot into a short time frame. It forces you to be organized when you move from the school world into the work world, and how you deliver what you do as an engineer, and all that.

Michelle, who had entered engineering as a pre-architecture program, observed the way in which her engineering education shifted her interests and abilities away from the creative. Once in engineering, Michelle decided not to pursue architecture. When I asked her what had changed her initial aspiration, she replied:

> … I did take fine arts as my electives during my engineering program. But I found that my way of thinking changed over the course of the years I spent in engineering. I felt that sort of the creative side, my artistic side had *really* been absolutely pushed back down into the back, and my approach was all sort of trained into being a very logical way of approaching things, and I actually felt more like an engineer by the end. I kind of couldn't see myself anymore doing architecture — which is interesting.

In contrast to linearity being learned, as Hacker (1989) argued, other study participants indicated that they had an innately rational, linear, or practical problem-solving disposition that had been reinforced through their engineering training. Lisa stated this most directly:

> It's kind of a chicken and egg. Does it reinforce the personality traits? Absolutely. That's probably a reason that, you know, insurance companies have special rates for engineers *[laughs]*. They don't tend to get in as many accidents. They just tend to be able to recognize the conditions in the world and respond to it appropriately in terms of discipline and planning.

Karen also observed that the source of the linear engineering approach is one of "chicken and egg":

> …people who tend to go into engineering are very linear thinkers. It *tends* to attract that kind of person. I'm a very linear thinker, and it's hard; it just reinforces that in you, right, that this is the way to do it, and you just kind of, uh. So if you hit a brick wall, it's hard for some engineers to go around it because you don't have that creative — those creative skills aren't taught to you.

This notion that being rational is both important for finding success in engineering, and reinforced within the profession, reflects the idea of the habitus/field relationship whereby a habitus that is aligned with the field is bolstered and enhanced. If the habitus does not include the requisite elements (e.g., a linear approach to problems) the individual will become aware of this disjuncture, identifying either a lack in themselves or a structural issue in the field.

Notably, a few participants who had left the profession, while they saw themselves as either problem-solvers or detail-oriented, also explained how they differed from this norm. This was most clearly articulated by Laura who reflected upon how her creativity differentiated her from her engineering friends:

> I went with all my girlfriends who are all engineers and we went pottery painting. They measured exactly where they wanted to put everything, okay, it was 'I'm going to do squares all around', the one girl was going to do squares, sponge colours all the way around the edge of her bowl. She measured out the size of the square and she measured how everything how everything was going to lay out. I kind of looked at my bowl and went, 'hmm, what do I want to do?', slap, slap, slap, I was the first one done and I did two while everyone else was working on their first one. I didn't – I mean some things I plan out, kind of had an idea, but I just wanted to go with the flow. Where, you know, even in that type of environment they wanted to measure everything very carefully. It's just a different style.

Laura identified herself as analytical, but also creative. Her female engineer friends, in contrast, are presented as methodical through and through. Another participant who had left the field, stated, "I was always an atypical engineer, had the ability to do analytical work, but my forte was on the creative side. So my successes came from looking at the world from a different place and going, 'Oh. Well, why don't we do it this way?'" The lack of creativity in engineering was also described by Ben as a major factor in leading him out of the profession. He described his current path as "a move from less creative to more creative. So that's actually the most important factor that drew me to make this move." These comments thus suggest that a tension exists between being an engineer and being creative. The detail-oriented, black-and-white nature of engineering was seen by a few of the participants as stifling creativity and potentially innovation which, given the emphasis in the field on innovation, is ironic.

Returning to the notion of an engineering habitus, the extent to which the vast majority of the participants, male and female, committed to engineering or not, described themselves as logical and their career paths as rational is notable. Despite cultural connotations of rationality and a scientific approach being masculine (Chapter Four), both the men and women interviewed were very likely to describe themselves as being rational problem-solvers. For the women and the non-committed engineers, it was their rational and practical bent that had drawn them towards engineering. This, however, led to a problematic disconnect for, although the field and habitus both stress rationality, if this was the main reason for selecting one's career, one had little to reinforce commitment when difficulties arose (indeed to stay when things were going poorly could be seen as irrational).

Conclusion

In this chapter I have presented an image of the "ideal type" engineer: hard working, self-motivated, and problem-solving. These are also traits that align with the values of the engineering field and cultural notions of masculinity (Chapter Four). The emphasis on ethics in the field aligns with being conscientious and reliable. The goal of innovation is enacted through definitions of oneself as a problem-solver. Rationality and objectivity are shown in the emphasis on being pragmatic. Efficiency is achieved through the engineer's willingness to work hard. Thus one can see these ideals of the profession being upheld as ideals for individual behavior.

The link to masculinity can be seen in Brenner and Bromer's (1981) research, which used Barrett's Taxonomy of Leadership Behavior to find that most graduate students agreed that male stereotypes included "aggressive, ambitious, analytical ability, competitive, consistent, desires responsibility, emotionally stable, forceful, leadership ability, logical, self-confident, objective, steady, well-informed, and no desire for friendship". Female stereotypes were "aware of feelings of others, cheerful, creative, helpful, humanitarian values, intuitive, modest, and sophisticated". The connections between these stereotypes and what was reflected in my participants' comments are clear. While almost all described engineers as objective, consistent, and desiring independence and leadership, none emphasized being cheerful, intuitive or modest as critical to being an engineer.

In this chapter I have argued that the idea of a direct correlation between an individual's gender and the enactment of particular characteristics is somewhat simplistic. While Evetts (1996) argued that women were unable to develop an engineering habitus, or a feel for the engineering game, I would contend that a number of the women who were highly committed, for example Michelle, had very much internalized this habitus. They expressed the same beliefs in work ethic, self-motivation, and problem-solving as the men. In turn being male was not sufficient to ensure that an engineering habitus was internalized. As Eric reflects, despite having a strong work ethic and a belief in self-motivation he did not see himself as an engineer. That the ideas of being rational, hard working, and individually responsible for choices was held by the majority of male and female engineers I interviewed, regardless of their degree of commitment, suggests that while these characteristics are seen as necessary for an engineer, they are not sufficient to retaining an individual in the profession. Thus while one's internalized characteristics and dispositions are important, there are other factors involving organizational structures and practices, coworkers, parenting and partners that come into play and alter trajectories. Yet because viewing responsibility as individual is one of these dominant traits, such other factors can be overlooked by individuals, organizations and professional associations. In the next chapter I will be developing an additional element of the engineering habitus: the emphasis on the technical elements of the profession. Here I will introduce Faulkner's (2007) description of the two dominant narratives of the engineering identity, technically oriented and technically *and* socially oriented (or heterogeneous) and argue for extending this to a continuum that includes a non-technicist orientation. These orientations to the technical will then be examined for how they align with commitment and reflect constructions of gender.

Chapter 7: From embodying to rejecting the technical

As noted frequently in previous chapters, the technical is critical in engineering, both as a field and as an element of the internalized habitus. In particular, the responses given by interviewees of how they had chosen engineering brought my attention to the division between engineers who emphasized the technical elements of the field, those who were more focused upon the managerial elements of the profession, and those who expressed no interest in the technical elements. As a number of study participants related, there appeared to be different "kinds" of engineers, with one kind being those who embraced the technical and another who found it secondary.

This idea is reflected in Wendy Faulkner's (2007) ethnographic study of the engineering profession, "'Nuts and Bolts and People': Gender-Troubled Engineering Identities". Here Faulkner explores two dominant ways engineers explain what "real" engineering involves through an ethnographic study of two offices of a business design engineering consultancy company in the UK. One form is a technically oriented, or technicist, story that emphasizes design and calculations. The other narrative, which she labels "heterogeneous", emphasizes management and people skills. While both the technical and social are required in the building design engineering field where she conducted the study, some engineers come to view the social aspects of their work as more interesting and rewarding, while others "cleave to a 'nuts and bolts' identity." (p.332). These two versions of 'real' engineering can, in turn, be seen as associated with two versions of masculinity: "Where the technicist engineering identity takes its marker from science and technology, the heterogeneous identity takes its marker from corporate authority and business" (Faulkner 2007:347). Further the two identities are also experienced differently by men and women engineers:

> ... many men engineers cleave to a technicist engineering identity because it feels consistent with versions of masculinity with which they are comfortable. While most women engineers also take pleasure in and identify with the material power of the technologies they build or use, the majority nonetheless identify more readily with the science base of engineering than with hands-on engineering. Significantly, whereas these women are, in effect, creating new gender identities as women engineers, their male colleagues do not have to do equivalent gender work. (Faulkner 2007:350)

My own research largely supports Faulkner's findings, as the participants also fall into these broad patterns, but extends it through the inclusion of a broader range of engineering sub-fields, a considerably larger sample, and the addition of people who have left the field. As a product of these differences I also had in my sample people who reported no interest in the technical, along with people with less interest in the social than Faulkner found (e.g., mechanical engineers with very little involvement in management). In this chapter I will take up Faulkner's work in understanding this identity continuum, which I will argue runs from "technicist" through "heterogeneous" engineers to "non-technicist" non-engineers. In doing so I will examine the relationship between these engineering identities and commitment to the profession and consider which of these positions are emphasized in the materials of the professional association, whether there is a consistent parallel between commitment to the profession and a technical orientation, and how these identities and positions are gendered.

To begin this discussion, it is useful to highlight the dominant stereotype of engineers today, that of the "nerd". Of concern, particularly to the women in my sample, was the perception that people do not enter engineering because they are socially gifted. Rather, engineers are fascinated with technology and characterized as lacking social skills. Now, while this is the stereotype, I cannot accurately describe any of the participants in this study as fitting this image. While some may have been more reserved and others more outgoing, none were "socially inept".

The issue, then, is whether my study participants reflect the reality of engineers, in contrast to the "nerd" stereotype, or if their more social nature was a by-product of my recruitment strategy. The people who participated in my study did so voluntarily. They saw my request for information and independently contacted me to talk. Based on this, whether these participants reflect the "norm" of sociability among engineers is difficult to assess. It may be that they fall further towards the "social" end of this continuum than the average engineer. Thus, if anything, the discussion that follows may underestimate the technical orientation of engineers.

Technicist

"Men's love affair with technology is something we take for granted" (Oldenziel 1999:9). So begins Ruth Oldenziel's (1999) book examining the way in which technology and engineering were constructed as masculine in America between 1870 and 1945. In her study of the construction of technology she examines the development of a white, middle-class, male identity for the engineer. Part of the creation of this identity, she argues, was a set of autobiographies written by engineers that chronicled their work histories from the 1890s through to 1940s. These literary works employed a similar style, "tunnel-vision observations, dry technical descriptions, and disembodied prose" (Oldenziel's 1999:91). The personal, the self, was nearly invisible in these works that were "elaborate descriptions of engineering projects that read like technical reports…" (Oldenziel 1999:96). This world of technical focus can be seen to continue today in the comments of the six men that I have categorized as technicist. That all of the participants who reflected this orientation were male falls in line with Faulkner's (2007) work and identification of the connection between masculinity and a technicist engineering identity.

Individuals were categorized as having a technicist identity, or falling towards the technical end of the interest spectrum, if they emphasized the design, mechanical and hands-on aspects of their work. Of the engineers I interviewed, only a small number fit this category, again perhaps due to the voluntary nature of recruitment into my study. All but one of the engineers who emphasized the technical aspect of their careers was committed to the profession. And all of these "technicist" engineers were male. These men spoke of the importance of passion for the technical, the enjoyment of the tangible, and a need to see the results of their work. The majority of these men had chosen engineering because of their mechanical aptitudes, with only one mentioning the fact it was a "good career" as playing a part in his decision-making.

When I asked these men about the elements of their work which they enjoyed, it was the technical that was stressed. One younger male, who had been a mechanic before completing his engineering degree, described having started engineering right after high school but hating it because it was too theoretical. He "couldn't see any way to really apply it, so that's when I went and went through technical school to become a mechanic, was because it was hands-on". As we discussed his current position, he told me that the aspect he enjoys most is "seeing your ideas come into fruition". When I ask what he would change about this job, his preference for the technical was again clear: "If I could change it? I would try and do more [*laughs*] I would sit at my desk and do more design work and machine design and less management and less fieldwork and, yeah, those kind of things. Less management and less fieldwork." In examining the lives of these six men it quickly became clear that their dedication and commitment was not just to "a job". Engineering was something that they saw as a central element of who they were. This was reflected in their reports of having hobbies that were similar to the technical roles they held at work such as metalworking, woodworking, home renovations, and working on electronics, stereos and cars. Don, for example, stated:

> I'm kind of a tinkerer at heart, so if I'm not doing it here, potentially getting paid for it, I'd be doing it at home, doing something else. … I mean, I'd either be tinkering at that or something else. It's just my personality; that's me.

These men who emphasized their attachment to the technical indicated that they placed less importance on the interpersonal aspects of engineering and/or had limited interest in working with people. Both Don and Christopher, for example, described the element of engineering they most disliked as "dealing with politics". Christopher's work as an owner of a small engineering consulting firm required management in addition to design. Of these duties, it was the management and business elements that he described as being his major challenges and the least enjoyable aspects. This lack of interest in the business side of engineering was further articulated by Don:

> I went there with the understanding that I wouldn't have to market. Usually in a consulting company, engineers are out marketing. I didn't do that in the [industry], other than to my own little department, and I wasn't about to try and do that; I'm not a salesman. I didn't want to do that; that's not my interest. If I wanted to be a salesman, I'd go and sell cars when I was 17 or something.

These participants' comments reflect what Faulkner (2007) reports: a preference for "facts" and "takes comfort in certainty and seeks to maintain a very clear line around what is 'known' or unchallengeable and what is not" (p.344). John reflects this in his description of what he would do if he were to re-do his education:

> I'd probably take mechanical engineering or civil engineering, mostly because I think I could have been a project manager if I'd been in either course, but they're more detailed engineering involved and that's part of my job that I actually like, is the actual design side. And unfortunately in mining that design side – sometimes it's a little more personal oriented, personnel oriented, ironically as opposed to the math and science … Every problem a project has is based on humans and their lack of communication, pure and simple. You can't break it down any – and it's – there's no other explanation involved. It almost always boils down to - you do a root cause and then you get these two people didn't talk enough, it's almost certain.

As John's words reveal, an element of interpersonal relations that was recognized by the technically-oriented engineers as essential was communication, particularly as it pertained to technical and design issues. This communication, however, is not socially oriented, but technically oriented. It relates to ensuring that detailed design work is done correctly, rather than developing people's potential or providing support. People are a part of a process that needs to be managed and controlled in order to do the real (and enjoyable) work of engineering design.

Heterogeneous

While an element of the technicist orientation is a valuation of technical skills over social skills, the two are not mutually exclusive. Indeed the reality is, as Faulkner (2007) outlines, that both communication and technical skills are necessary in any engineering position. In a prototypical engineering career one starts in a technical role and progressively moves further and further into management positions, eventually leaving the technical almost entirely. While the technicist men had either rejected this progression (as in Don's case) or clung to the technicist (as Christopher did), the other committed engineers with whom I spoke, and a few non-committed engineers who continued to work in the profession, constructed their engineering identity as a combination of technical and management, or what I have labeled, based on Faulkner's work, a heterogeneous approach. In comparison the number of participants who identified both the technical and social as being important and enjoyable was much larger. Notably, interpersonal skills were identified by the majority of participants as necessary for success: one needs to be able to communicate their technical ideas, share with people the importance of their work, and sell their products. The difference between the technicist engineers, and those I have categorized as heterogeneous engineers, is the extent to which the latter embraced the interpersonal and management aspects of engineering. Among the heterogeneous engineers, having people skills, being a team player, and excelling at communication were valued.

This dual role of the engineer can be seen in the profession since its inception in nineteenth century North America as a middle class occupation. At that time, Oldenziel (1999) writes, young men "Starting as laborers responsible for clearing land alongside the Irish and slave African-American workers, on the railroad and canal building sites, they worked with the expectation that they would move up the ladder from chainman to rodman, to transitman, to surveyor and eventually to assistant engineer" (p.55). As engineers then became managers, they moved into a position between the worker and industrial capitalists. They were at once in contact with the worker, yet undertook to differentiate themselves. The "manliness" of the workers rubbed off on them, which helped make connections with the workers they managed, yet they used symbolic practices, such as clothing, to show their distance and superiority.

This moving back and forth between the shop floor and the office tower continues to be a central element of the engineering identity. The idealized engineer, particularly as imaged in textual materials, emphasizes the engineer who is able to be both hands-on and a leader. Recruitment advertisements show "engineers" in coveralls and hardhats, while calling to them as "leaders". An advertisement by Klohn Crippen Berger exemplifies this, listing their company's expertise, alongside photos of the staff, the Calgary skyline, and hardhats in front of a wintery field. The text sells the company as offering "high-profile, challenging projects in innovative and collaborative work settings. ... we offer a co-operative team environment, access to senior management, open communication styles and an emphasis on our clients" (*The PEGG* September 2007:42). This heterogeneous approach is also clearly reflected in the awards given yearly by APEGGA. The twelve "Summit Awards" range in focus from leadership, to contribution to the professional association, to technical awards. In every instance the criteria for the awards for engineers include both the quality of work conducted and the interpersonal skills of the recipient (*The PEGG* July 2007:14-15).

The centrality of these "softer skills" can be seen in the professional association materials. Each issue of *The PEGG* includes a column by Nancy Toth, APEGGA's "Manager, Professional Development and Human Resources", that promotes professional development activities. Her October 2007 article, "Getting a Return on Your People Investment", describes teamwork and communication skill seminars that are available for members in training – seminars that will have "multiplied value ... for your organization in the areas of business writing, basic financial skills and more" (Toth 2007b:7). In her June 2007 article Toth reviews the professional development sessions conducted by APEGGA since 2004, which offer "the potential to transform your thinking – and, therefore, transform the way you do your job, technically or in the 'soft' areas of leadership, management and personal performance" (Toth 2007a:9).

The push towards a more heterogeneous norm is particularly evident in the rhetoric surrounding undergraduate engineering programs. The need for "well-rounded professionals" can be seen in the comments of Dean Cannon, of the University of Calgary's School of Engineering. Engineering graduates, Cannon is quoted as stating, "will have not only technical expertise but will also be grounded in leadership" (Toth, *PEGG* June 2007:9). Engineering courses at the University of Calgary have recently been transformed to integrate these elements, for example the first year engineering design course is now project based and "targets four pillars: teamwork, engineering design, drawing and clear communication" (*Schulich Engineer* Spring 2007:12). The emphasis is also seen in the Fall 2007 issue of the *Schulich Engineer*, which was dedicated to leadership and included the piece “7 Points on Leadership in a Global Economy” by Robert Fripp. This article begins with a quotation from Janaka Ruwanpura, a University of Calgary Civil Engineering faculty member: “I have a saying: ‘People are hired for their technical skills; they will be promoted for their leadership and management skills; they may be fired for their lack of people skills!’ It’s really important we teach the soft aspects of management” (p.5).

The participants in this study whom I have categorized as heterogeneous identified their strengths as engineers in terms that reflect Ruwanpura’s words. They described themselves as technically strong, good managers, and interpersonally skilled. This group was nearly equal in the proportion of males and females and included both committed and non-committed engineers. Notably, the extent to which the technical was embraced differed somewhat with Kelly emphasizing the technical, while Kim stressed the interpersonal. These heterogeneous engineers cited the full range of reasons for selecting engineering, from having a mechanical interest to believing that engineering was a “good career”. In comparison to the technicist engineers, they were much more likely to discuss a person who had played a role in their choice, either having suggested engineering or being a positive role model of “an engineer”. Many of these individuals worked in management in engineering, or roles related to engineering, but they were not “hard-core” engineers. Rather than being designers, they tended to be managers of processes and projects. And it appears that, for at least some of these heterogeneous committed engineers, it was the ability to find these “non-traditional” roles that enabled them to remain in the profession.

Before describing the emphasis on the social as it differentiates this group, it should be clarified that members of this group were also interested in the technical elements of engineering. This is particularly important in considering the women's experiences, given that gender norms would lead one to expect that women would reject the technical. For the women I am describing as heterogeneous this was not the case. One female participant, for example, responded much like the technical engineers when I ask her about elements of her work that she does and does not enjoy; she could imagine leaving the "political parts", but not the "technical parts". She elaborated on her technical interests with this story:

> I mean, I go hunting and the first time I went hunting with my husband and his family, we went out to the bush and I, you know, had a discussion about – they brought like some porto-potties and stuff for me, but I looked at the stuff and I went "this is outrageous" and designed a portable latrine, my husband and I then built, and we're actually thinking of maybe refining that one and sending that through and getting a patent on it and stuff because, you know, everyone was scoffing, "oh, we're macho and whatever" and now it's the very first thing they get set-up in camp. So do I like the invention, the technical part? Absolutely.

Yet, despite this enjoyment of the technical, she continued a few minutes later to explain that this mechanical aptitude was not sufficient to becoming an engineer. "So having a mechanical aptitude and going into engineering thinking that because you happen to know which way to turn a screwdriver you're going to make it through – no. … the one's who made it through tended to be the good planners, the disciplined people and they go on to be disciplined in life as well." Another woman stated, "I like the technical aspects of my work. … I love problem-solving, and I still love science." That said, she had chosen her current position because it was focused on management and marketing. The heterogeneous men and women, like many of the technicist engineers, emphasized their enjoyment of the concrete elements of their work. But unlike the men who I have categorized as technicist, none of the women expressed the same degree of dislike or discomfort with the social elements of the profession.

For this group, the technical was necessary, but it was in no way sufficient. Indeed a number of these individuals stressed that it was having variety in a role that made it enjoyable. These individuals would talk of doing both design and management tasks; they worked with clients and with technical tools. Jennifer, for example, described an earlier position she enjoyed where she could "wear a lot of hats." She was a procurement person, gathering and researching components; a designer, putting them together; a draftsperson, designing the layout; and a project manager, documenting, presenting and dealing with vendors. Similarly Kim stated:

> I enjoy the technical work, but I also, you know it's funny, I think one of the reasons why I haven't changed companies or jobs or career paths is that I get a lot of non-technical with it. It's a very - all the roles that I've had have tended to be team-oriented, been able to use a lot of my communication and facilitation skills to succeed. … My husband has his … MSc in mechanical engineering. I'd slit my wrists before I did that. I could not even contemplate doing research and technical stuff. Boring. It's just not my personality.

Social, communication, and teamwork skills were very frequently emphasized by this group. These heterogeneous engineers described people skills as critical and emphasized the ways in which they were people oriented. Nick, for example, stated that success as an engineer requires "Good technical abilities, coupled with very good people skills". A self-described "people person", he stated that his intuition and social skills have helped him, particularly as he became more senior in his career and began to mentor newer engineers and be involved with the public relations aspects of the company where he works. James, who had left engineering to pursue an MBA, "warned" me at the start of our interview that he was very talkative. He described to me that in every workplace people are critical elements, and the development of rapport and relationships with people is part of what he likes about his work. Indeed it is the variation in workplaces and situations created by differences between people that he identifies as making his work as a business consultant enjoyable:

> The people: like I said, I do a lot of communicating, a lot of interpersonal stuff is a big part of my job ... I'd say, too, that I see a lot of variety. Part of the drug of consulting is the variety that you get: every project, every client's different. I remember laughing with a client who said, "You've done this for 10 years. Don't you get bored doing the same project over and over?" I said, "You don't understand: they're *never* the same; they're always different." Just people alone would make it different. If I could hold every other variable constant — here I am, talking like an engineer again — and only changed the people variable, that alone would make every project different, significantly different. But the reality is that almost all the other variables will change.

His work, which he described as engineering for the sake of business, emphasized communication and interpersonal skills, but at the same time he remained (as he notes) very much "an engineer". People are variables to be dealt with.

An element that clearly set this group apart was the degree to which they emphasized communication skills. For Kevin, people and communication skills were the most critical skills for an engineer: "People skills is still huge, because if you don't communicate well, you don't understand the needs. So your solution, you maybe design a wonderful solution to somebody else's problem, but not the one you were asked to solve." In contrast to several of the technicist engineers who described themselves, or came across, as shy and quiet, everyone I have categorized as heterogeneous was confident in speaking and a number identified communication skills as something they excelled in. Michelle, when describing her strengths, stated, “I’m articulate, I write well, I speak well”. As with the technical engineers, the element of communication that was emphasized here was the ability to share ideas. Because of the importance of getting ideas across correctly, several of the heterogeneous participants, like the technicist engineers, identified communication as in need of more attention in the post-secondary training of engineers. Indeed, according to Anthony, the poor communication skills of engineers today reflects a change in emphasis in the education of engineers:

> … nowadays, they come out of university, a lot of them, and they’re very technical-oriented, very technically clever, but they can’t write a proper report and they can’t express themselves too well. … In my time, you had to take French and Latin; you took Latin in university. And also, we had English in engineering, and the engineering professors used to mark your reports for grammar. I’ve got reports downstairs that I had in fourth year that are scratched all over with spelling errors or grammatical errors. That, you don’t get nowadays. So we came out of there, I think, at that time, with a better understanding of the English language and how to express ourselves and how to write. I think that’s partly what’s missing. So engineers don’t have enough communication skills to come out and let people know how important they are *[chuckles]* and what they’re doing.

Anthony’s recollections point to a time when the training of engineers fell more towards the heterogeneous, rather than the technicist, end of the continuum. His comments also underscore that contemporary engineering educational priorities are not inherent requirements of the discipline.

Several of the heterogeneous engineers emphasized the importance of creativity in strengthening the field. As discussed in Chapter Three, creativity, particularly as it leads to the creation of innovative and marketable products, is desired in engineering. Patricia reflected this connection between the technical and creative in discussing why engineering is a good career:

> The thing that I tell students is that it's about liking math and science and problem-solving, and being able to apply that. That's the really cool thing about engineering: it can be anything, from making the coolest new Gortex jacket and designing really cool cars, to the space shuttle, bridges, whatever; like, engineers are involved in a lot of different things. It's a really cool way to be creative and to make something…

Similarly Lisa described the need for creativity in doing engineering problem solving and coming up with new inventions and solutions. Yet, much like communication, the role of creativity is to improve engineering and lead to the development of new solutions that can be produced, patented, and sold. So while being creative is valued, the value comes largely from the products and business value created. Undergraduate education was again critiqued by a number of individuals for the lack of emphasis placed on creativity. Karen, for example, stated that most engineers are linear thinkers and that this approach is reinforced through their education. The major downfall being that when one leaves school and is faced with questions for which one has no answer, they lack the creative thinking skills needed. But when an engineer does have both technical and creative abilities, she or he can really succeed:

> I think some people who are really successful are the ones that bring both of those things together; you know, be circular thinking and really creative, and then have that engineering understanding and that math and those skills set. I think that's when you become, like, wow, super successful.

Three of the heterogeneous women, including Michelle whose thoughts on creativity are quoted above, however, reported that their engineering education had limited their creative capacity.

Overall, the study participants within the heterogeneous category had achieved positions with higher levels of responsibility and seniority than the other participants in the study, which may indicate that interests in both the technical and managerial are necessary to "succeed" within the field. The importance of this is reflected in the fact that it cannot be explained by age. The heterogeneous engineers were on average 42 years of age, while the average age of the technicist engineers was 46 years. Thus, although the career path of engineers is typically one that moves from the technical into management, those engineers who did closely align with the technical were less likely not only to embrace the social aspects of management, but also to move into these kinds of positions.

A related element was the emphasis the heterogeneous engineers placed on the business and management elements of the profession. When describing a "successful engineer," Matthew mentioned engineers who had also been important business figures: "Lee Iacocca, Henry Ford — those kinds of people. What I think they're like is failure's not an option." In describing her own career transitions, Patricia also emphasized this move towards management and business:

> I got involved in the sales and marketing and market research and all this stuff, and slowly began to figure out that while the engineers get to do really cool technical stuff, it seemed to be the marketing and strategic planning people who got to do the really cool stuff in terms of strategy development and "Where is this company going and what products do we need to develop?" and all of that.

Several participants discussed taking courses to develop their interpersonal and leadership abilities. Notably, a few of the heterogeneous engineers clearly distanced themselves from the business side, particularly the sales aspects of the industries they worked with. Two of these individuals identified more with the importance of engineering design for environmental protection, rather than economic gain. James, despite his MBA, made a particularly telling statement:

"I'm only so-so at selling, probably. To be honest, I think it's the engineer in me that gets in the way sometimes."

In talking it was clear, particularly from the heterogeneous men, that the managerial and interpersonal elements of engineering were enacted in masculine ways. The models of leadership these men identified with retained a rational and distanced approach, suggesting that the relational and interpersonal aspects stressed by the profession's textual materials remain associated with the feminine and, as Fletcher ([2002] 2003:207) identifies, "tainted" for it is those who have less power who need to be sensitive and attuned to more powerful others. Further, the social competence idealized by the males was of a very particular form, a form that can be seen to fit a masculine norm. It emphasized being able to push your employees and make them productive. As Ryan stated:

> ...the senior, senior levels, they also have to be hardnosed, right? You have to actually be able to set unrealistic goals, know they're unrealistic and make people try to meet them. So you have to be drive – good at driving people, that's the other piece that at the higher levels, and at the sort of intermediate, middle management levels where I am it's more people focused and less driven. So within that there are people who are also – those who have the balance between the both of them are very rare, but there are a few, I've seen a few in my career and those are the ones who really make it to the top. They are able to know when to say "that's too much", but also know how to really push people.

Social or "soft" skills are desirable insofar as they work to meet corporate objectives for increased profit. This reflects the findings of Kerfoot and Knights (1993) who describe teambuilding and similar human resource management programs:

> ... as an attempt to elicit commitment to corporate objectives of profitability under the rubric of success and efficiency by means of 'synthetic sociability'. In these instances management, in effect, seeks to manipulate intimacy within social relations and channel it in the direction

> of achieving corporate goals. Intimacy thus becomes reconstituted and transformed into purposive-rational action. (p. 670)

There were also a small number of heterogeneous engineers, all but one of whom was female, who emphasized the more supportive elements, namely mentoring and teaching, as what they most enjoyed about their profession. This interpersonal emphasis was clear in Kelly's response when I asked if her aspirations for the future would change if money were no object: "… I like to teach people, I like to help people learn things, I like to learn things. It wouldn't change. Not at all." That women were much more likely to cite mentoring as a critical aspect of their work may relate to traditional notions of femininity as more caring and support oriented, but it may also reflect the greater isolation that women feel in the profession. Nick, the one heterogeneous male who commented on the importance to him of his mentoring and support roles, made this point. When I asked him what would have been different in his career if he were a woman, he responded in terms of the lower numbers of women and the lack of mentorship this would have meant:

> … Out of a class of maybe 500, we'd have 150 coming out of the school that were ladies; there just weren't that many people that necessarily would be prepared to mentor or that you could go to, just because there was a time not that long ago where it was almost exclusively a male profession, and there's that intimidation factor that was present.

It may therefore be that these heterogeneous women who stressed mentoring did so out of a recollection of the lack of support they had personally received early in their careers.

A final element that came out in interviews with several of the heterogeneous engineers was that they saw themselves as different from "most engineers". Ryan, a senior engineer with an international corporation, reflected his belief that his engineering colleagues were "too narrow". When I asked how he viewed the average engineer he stated:

> …certainly technically competent, curious, results focused, but narrow. I think that – I mean we talked about this last night actually, we were out with a few colleagues and my wife and I were talking afterwards and the conversation never got very broad. You couldn't bring up religion, you couldn't bring up politics, you couldn't bring up general things, just because it died. So that's my perception.

His own interests, in contrast, were much broader. He described debating between studying literature or engineering when starting university and a continued interest in philosophy. Jennifer told of finding engineers "weird" and lacking in social interaction skills, while Emma described how social and interpersonal elements had been critical in selecting her path. Emma recalled realizing as an undergraduate in electrical engineering that her sub-discipline was not of interest. After talking to her sister's friend in chemical engineering, who described that in chemical engineering "people talked to each other, maybe they spoke English, a bit more teamwork", she decided to switch. In commenting on engineers she stated that she is not a "normal engineer", which I asked her to elaborate on:

> Usually it's based on my social skills. Apparently I have social skills. There's a lot of engineers who do have social skills, the funny thing is they seem to, they seem to kind of do their own thing and it's more they're fragmented from the rest of the engineers if they have those social skills.

This distancing from "other engineers", along with their emphasis on being people-oriented, differentiated these heterogeneous participants from the technicist engineers. But the retention of an interest in the technical aspects of the field, and in half the cases a continued commitment to engineering, separated these heterogeneous engineers from the engineers on the social end of the continuum who had rejected the technical.[50]

Rejecting the technical

> I don't want to do drawings and punch a calculator pretty much ever again. I would rather be working with other professionals to see how we could change the market conditions under which consultants work to ensure higher value for the work we do. (Eric)

In addition to the two types of engineering narratives Faulkner identifies, there were also a significant number of individuals I interviewed who did not emphasize the mechanical or report enjoying the technical. At best the technical was a necessity. Notably, I had previously categorized all of these non-technical participants as non-committed engineers (see Chapter Five). Of the thirteen participants that fell towards this end of the technical/social continuum, four were male and nine were female. Thus half of the women who participated in the study related a dislike and/or distancing from the technical; among the men it was a much smaller proportion. The majority of these individuals had left engineering or were in the process of training for another career. Five of these non-technical engineers continued to work in engineering positions. Among those who remained in the field, the technical was a "necessary" part of their professional training, from which they had found ways to distance themselves.

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[50] An interesting proposition in relation to the importance of soft skills is that these skills are becoming increasingly important. Based on the limited number of participants in this study it is hard to confirm whether this is the case. The ages of participants ranged greatly among the individuals categorized in each group of technical interest, suggesting that it is not purely a generational shift (e.g., that the young engineers embrace soft skills, but the older did not). That said, it does seem likely that the engineering profession is embracing the importance of "soft" skills given the attention to them in the textual materials analyzed and broader management trends.

Joseph, for example, reported having a portfolio of projects, but the actual doing of anything technical was never brought up when we spoke. The technical seemed more like a requirement, a hoop one had to jump through, in order to acquire the status and prestige associated with engineering, rather than a central element in the doing of engineering. Interestingly this group was also the youngest of the three with an average age of 34 years (compared to the 46 of the technicist and 42 of the heterogeneous engineers). This again reinforces my argument that one does not start out technicist and then move up or out, but that distinct orientations towards the technical exist upon entering the field.

This non-technical orientation was also reflected in these individual's descriptions of what lead them to start engineering. Although a few, such as Eric, did have technical interests as a child, the majority had chosen engineering because it was a "profession", it fit with their math and science skills, or it was something a friend or family member had recommended. A number of the women emphasized that they were in fact not mechanically-oriented. Veronica, who had left engineering for a career in the health sciences, stated:

> I really didn't enjoy the mechanical stuff so much. And I'm not mechanically minded; I've never — like, I started to notice I didn't think or talk the same way as a lot of people in the class. Like, I loved the academic side, I loved the math, I loved that kind of thinking side of it, but I really wasn't into — like, the guys would talk about engineering things at home, or the latest cars, or the latest projects or things, and I wasn't into that. I was, like, "Whatever."

These individuals who had trained in engineering, but distanced from or rejected the technical, had moved in two distinct directions. For a number, the transition involved a move to positions of increasing managerial responsibility within engineering or to a departure from engineering and development of their own (non-engineering) small business. Another sizable group described their transition away from the technical as part of a move towards caring and helping roles.

Transitioning for business and entrepreneurial success

> I was always in high school on student council and stuff and so when they always ask you what you want to do once you're out of high school, I was just like "I just want to do what I do on the student's council, I just want to plan school events", but you know you can't do that once you're not in school anymore… (Tracy)

Clear overlaps existed between study participants who emphasized the interpersonal and management aspects of their careers while distancing themselves from the technical elements of engineering and some of the heterogeneous engineers. Like the heterogeneous engineers, these individuals emphasized the business side of engineering, rather than the technical or design elements that were the focus for the technicist men. What differentiates these individuals from the heterogeneous engineers, however, was a much greater separation from the design aspects of engineering. The individuals who completely rejected the technical elements of engineering for management and entrepreneurial opportunities included three who continued to work in engineering, two who were studying business/management, and one who had begun her own non-engineering related company. The three who remained in engineering were all in project management roles that did not emphasize engineering design.

These six non-technical individuals (two males, four females) described their interest in business and management in a variety of ways. Laura described being "the interpreter between business and technology because they do speak very different languages." She emphasized her ability to understand the technical and linear-thinking, while preferring business and creative-thinking. Danielle observed that she enjoys bringing people together, working with clients and planning, but not technical or detailed "problem-solving" which creates "stress". Ben left engineering to pursue "something behavioral" and to find a profession that allowed more freedom and more entrepreneurial opportunities. Most of these individuals were competitive, entrepreneurial, and desired opportunities to work independently. Ben, for example, reported on his desire to be the best at something, and explicitly identified a shortcoming of engineering as not allowing one to be a creative entrepreneur.

Along with this desire to succeed, these business-oriented engineers expressed a desire to work with people and improve organizations. This created a tension between people and profit for several participants, which was most apparent in the comments made by Joseph. From the start of our conversation Joseph was clear in identifying that his emphasis was towards his own personal career success. He described moving between companies looking for personal challenge and increased responsibility. Despite presenting as very individualistic and goal oriented, he also described the challenges he perceived that he would face as a manager because he was a "people person". The tension this created was clear in his description of success:

> Successful? I would consider myself successful if I could have under me as many people as I've been under. [*laughs*] It's almost like, "Okay, there, I did it. I did what you guys could do. Now I can move on to the next phase of my life because there, I've done it." [*pause*] Or even more so than that is to see people around me be happier, or to make them happy. I'm also a people-pleaser, so I want to see them happy. If they're happy, I feel success. If they feel disappointed, I feel terrible. I take it 10 times worse. To me, if I see people around me, under me and above me that are happy, then I feel successful.

This emphasis on how others feel in many ways seemed to contradict what he had been saying. Instead of the emphasis being on personal achievement, it suggested a much more other-oriented focus, a focus which has traditionally been associated with the feminine. Yet because it was linked with his business interests and competitiveness, his masculinity was arguably protected.[51] This gendered tension between self and other orientation within the engineering profession became particularly salient in the group to be discussed next: those who had left engineering for opportunities to help people.

Transitioning to help people

> So I finished my stream, finished my degree, enjoyed my biomedical engineering, but still, that kind of techie side of things; like, we did courses on MRI and courses on all the mathematical transformations on how it works, which was very interesting — again, the mathematics, I enjoyed it. But then we had a course in rehabilitation medicine, and where they were — like, we were learning how they help people who have nerve damage and their foot drags along; like, it doesn't contract properly, and I remember being, 'That's so cool. Look at the difference you're making in that person's life.' That was when I started to think, 'I want the patients. I want the patients, I don't want the computers.' (Veronica)

Among my participants there was a relatively small group who all reported moving away from engineering due to a desire to help people. None of these individuals were committed to the engineering profession; however, Angela and Eric did continue to work in engineering. The majority of the helping-oriented individuals, with the exception of Eric and Jack, were female. The women in this group were also demographically similar: all were under the age of 35 and none had children at the time of the interview. Eric and Jack were both older and held

[51] The forms of masculinity within engineering, including the corporate or "competitive masculinity" (Kerfoot and Knights 1993) reflected by Joseph, will be elaborated upon in the next chapter.

(or had held) senior engineering positions. These individuals, like the business-oriented engineers described above, made no reference to any current interest in the technical or design aspects of engineering. Veronica for example described how she "tried to find a bit of engineering work, but it was, like, 'I don't want to do it.' It was like this panic, like you're holding on to the end of a cliff, and you're, like, 'I don't want to do it.' Just in my gut, I knew I didn't want to work."

But rather than turning towards business and sales, these individuals described being focused on making a difference, healing, and giving back to society. As Veronica stated above, for these participants the emphasis was on "patients", on "people." For both Eric and Jack, the focus on people arose from negative corporate experiences and the bottom-line emphasis of the profession. Jack reflected on leaving engineering when his "organization had, in my opinion, forsaken people leadership to really focusing on short-term business results." He then developed his own company which allowed him to do what "really mattered to me, and that was investing in people."

The differences between the positions on the technical/social continuum are reflected in participants' statements on creativity. While the technical engineers cited the need for technical creativity, and the heterogeneous and business-oriented engineers emphasized creativity for market or organizational purposes, many of these people-oriented individuals argued for creativity as necessary to rounding out an individual's lived experience. Indeed the women in the group described feeling that their creative side was antithetical to engineering. Angela, for example, described that she "had always wanted to be an artist or a musician. Then I realized that you don't really make a lot of money doing that unless you're very successful." Engineering provided a way to earn a living to support her lifestyle. Both Veronica and Amy described the health-care areas in which they are currently studying as embracing their more artistic and creative side.

> Helping people, being able to use my right brain [*pause*] left brains analytical, right brain's like the artsy, creative, because [specialty] is kind of an art, there's nothing cut and dry, there's no formulas. You just have to figure it out, kind of thing. And sense almost what's right, so that's more me. (Amy)

The desire to make a difference and help people, it should be clarified, was not limited to this group. Participants across the spectrum of engineering identities that I have described discussed the importance of bettering the world. What separated these helping-oriented individuals was a distinct lack of interest in the technical combined with a critique of the dominant capitalist business model (albeit not necessarily that explicitly stated). This was perhaps most apparent with Angela, who was in many ways very similar to the heterogeneous engineers. When we spoke she was working in engineering and described finding her work in the field enjoyable. Yet she and the other caring-oriented participants were distinct in the way they described the economic focus in the profession and industries where engineering is employed as problematic and in opposition to their personal desire to make a difference. Angela described to me how, at the time we met, she was weighing the bottom-line motivation of engineering with the social-orientation of the volunteer sector:

> I guess here, it's a technical position, and it's geared towards [company B] increasing their production and reducing impact on the environment. So it's very defined, and it's very [*pause*] I don't know, it's not about people, it's about [*pause*] well, dollars, in the end — that impact. Whereas the other way is about people and making people feel better.

Finally, in this "helping" oriented identity, gender becomes particularly significant, thus highlighting the implicit masculinity of the other positions on the continuum. This emerged clearly in the comments of Eric, one of the two men in this category. Eric identified himself as an outsider to the field and framed his social orientation as aligning him with women. When we met, Eric was someone I expected to be "An Engineer"; he worked in consulting engineering as a senior engineer. But from the start of our interview it was clear that this was not how he viewed himself, and indeed this contradiction seemed to be central to why he had wanted to talk with me. While he told the same type of story of childhood mechanical inclinations as many of the technical engineers, "I can remember building canals in rivers and wondering as a kid why if you made the canal narrower the water got faster and it actually got shallower", he did not identify with being an engineer.

> …the last two years I've started to really think about what am I? Where I do fit in? And it's principally because I've had this conflict with myself in terms of engineering, where engineering's taking me. And my personality and my character. So I am much more of a people-person, although introverted, I'm very much sort of intuitive in my connections with people, whereas a lot of engineers are not intuitive.

Eric perceived that his "instinctive" and "relational" approach made him more similar to, and able to empathize with, female engineers. After describing how women have to work harder to fit into engineering, he stated:

> … and I think it comes back to the fact that women are relational, they're not technically oriented. Now I understand the situation because I'm also relational so I feel for these young ladies who come in and start communicating and creating networks and are viewed as not really doing their job because they spend too much time talking.

Although Eric entered engineering with mechanical and technical interests, his experiences throughout his career, the stresses and demands of the engineering workplace, challenged this. At the time we spoke, any sense of still enjoying the technical was lost. His concern now, he explained, was not the designs, but the people. Simultaneously, he reported, his own approach had changed. Intuition, instinct and relationality, now dominated. And all of these characteristics, as he indicated, put him outside of the norm of "the engineer" and aligned him with a more traditionally feminine approach.

The emotional, caring, intimate aspects of the "soft" skills that were marginalized by many of the men, were critically important for Jack and Eric. Rather than these soft skills being useful to the extent that they could assist in reaching financial goals, both men clearly articulated that this bottom-line emphasis denigrated interpersonal relations. Jack, for example, described what he called the "maturing" of a company that employed him wherein

> … the organization had, in my opinion, forsaken people leadership to really focusing on short-term business results. … There was this idea that people stuff was intangible, hard to identify what the return on investment is; everybody needs a requisite number of hours of training, but that's what we'll call development, and in the meantime, focus on project delivery, lowest operating cost, that kind of thing.

In this field composed of companies focused on the bottom-line, people became cogs that occasionally needed oiling, but otherwise should be self-sufficient. Management became "drive-by leadership". For Jack, leadership needed to be about the emotional well-being and personal development of employees, rather than a routinized and efficient system. When I asked him to describe a good manager, he stated:[52]

> I think having a manager that cares enough and believes in what he's doing to provide ongoing feedback, engagement, support, mentoring, encouraging, and inspiring on a regular basis, because they fundamentally believe in that and the value of it, without having to adhere to a top-down directive. Because I can guarantee you those three or four performance reviews are totally useless: 'I have to do this, Bob, so sit down. I know you don't want to be here any more than I do, so we'll get this thing over with quickly. I see you've rated yourself 4 out of 5, so I guess I can live with that. Did you have any questions? Next!' *[laughs]*

Thus both Eric and Jack appear to have been pushed from engineering because of their negative experiences and perceptions of the traditionally masculinist orientation of the field's management.

Conclusion

In this chapter I have explored the relationships between commitment, gender, and the individual's focus on the technical or social. Taking up the work of Wendy Faulkner (2007) on dominant engineering identity narratives, I have identified a continuum of approaches to engineering running from a technical focus, through a combined technical and social (or heterogeneous) focus, to a rejection of the technical. In other words, I have adapted Faulkner's two positions into a continuum with technical and social interests lying at the ends. I have also tried to describe the non-determinate nature of these positions, and have argued that the extent to which an individual was committed to engineering paralleled the extent to which they identified as a people-person. As such the

[52] Given the semi-structured and conversational nature of the interviews, not every one of the questions was asked of each participant. The general interview protocol is in Appendix B, but it should be noted that interviews varied from this. The protocol was mainly to ensure main topics were covered and to provide me with prompts if necessary.

technicist orientation can be seen to function as the ideal habitus for the field – it is the habitus most likely to engender commitment. All of the highly technically-oriented engineers were committed to the profession. In contrast none of those who had rejected the technical were committed. For the largest group, however, both the technical and the social are requisite parts of doing well in this profession. This heterogenous group included individuals both committed and not committed to the profession. This suggests that the field itself may be faced with issues whereby the people who are most likely to move into management and leadership positions, those with a heterogeneous set of interests, are often not committed.

In addition to commitment, the extent to which an individual took up the social or technical also reflects constructions of gender. The technicist position, which was only presented by the men in this study, reflects what Faulkner (2007) identifies as a masculinity rooted in science and technical prowess. This form of masculinity, which will be discussed further in the next chapter, emphasizes power through control over the known and concrete, rather than interpersonal relationships. The extent to which engineering can be seen as a calling to technicist men reflects the integration of this technical identity with the men's sense of self. Masculinity is both reinforced by, and invested in, this tie to the technical, making a move away from the technical to management a potential challenge to not only one's professional but also gender identity.

The heterogeneous engineers, in contrast, reflected an interest in both the technical and the interpersonal. Unlike the technicist group, both men and women reflected heterogeneous professional identities. What I will explore as a corporate masculinity in the next chapter can be seen enacted by these men.

They understood that the interpersonal was critical to design and financial success, and presented as very social individuals. This sociability, however, still fit within a male model. It was typically a pragmatic interpersonal interaction – one guided by the need to meet goals rather than develop relationships. Arguably, the women whom I have categorized as heterogeneous would also fit this description. These women were typically more confident and did not display the "other" orientation aligned with emphasized femininity (Connell 1987), which was seen among the non-technicist engineers.

Among the predominantly non-technicist engineers, I detailed two distinct sub-groups. The first included participants who were focused on business interests; in many ways they were similar to the heterogeneous engineers. Again the masculinity presented was very much in line with a corporate masculinity; indeed in many ways it was closer to the ideal of this approach as will be discussed in the next chapter. The other non-technicist engineers reflected a decidedly different orientation – helping people. While two men fit this category, their orientation to others in many ways reflected the norms of emphasized femininity. That there is not a firm alignment between "masculine" and "feminine" norms and the bodies through which they are enacted is critical, as it underscores the constructed nature of gender and the multiple ways in which masculinity and femininity can be enacted. These enactments will be the focus of the next two chapters.

Chapter 8: Men and Masculinities in the Engineering Profession

To state that "engineering is a male dominated field" is to say something as seemingly obvious as "the grass is green". Within research on science and engineering fields, both the demographic dominance of men in these fields and the conceptual link between the ideals of the field (e.g., rationality and technical expertise) and masculinity have been well established (e.g., Cooper 2000; Hacker 1990; Turkle 1984). Of all the professional fields, engineering exemplifies a "densely masculine" domain. In this chapter I will begin to examine the impact of this "dense masculinity" on the engineering field, in particular the forms of masculinity enacted within the field. In doing so, I will draw upon the work of R.W. Connell (2002, 2005) to argue for an examination of masculinity as tentative and multiple. In taking this approach, moments of masculinity are interrogated not as "given" but as part of a "dynamic process where masculinity is an *outcome* or product of social processes", rather than a quality one possesses (Keerfoot and Knights 1998:11). In contemporary society, as Keerfoot and Knights (1998) identify, hegemonic masculinity is epitomized in a masculinity that is "aggressively competitive, goal driven, and instrumental in its pursuit of success" (p.8).

Using Connell's ideas in combination with Bourdieu's theoretical tools, I will begin with an examination of how gender was understood by the participants in this project: as a given and determined element of an individual's nature. Employing Connell's (2002, 2005) concept of hegemonic masculinity I will explore how the positions of commitment to engineering, and the "technical", the “heterogeneous”, and the “rejecting the technical” orientations outlined in the last chapter, intersect with the evolving norms of masculinity within the engineering field and the gender regime in engineering organizations (Connell 2002:53). These intersections will show that the links between commitment to the profession and identification with the profession’s technical aspects parallel different forms of hegemonic masculinity, with committed and technicist men enacting a more traditional, breadwinner masculinity, while non-committed and more socially-oriented men reflect a newer “corporate model” of masculinity.

Building on Faulkner’s work, these multiple masculinities will then be used to examine three inter-connected factors that reflect differences in commitment, professional identity, and masculinity. First is the role of family in the individual’s life, with committed engineers being more likely to describe family as an “encumbrance.” In turn, non-committed engineers identified family, or personal interests, as being more important than one’s career. Second, differences in how committed and non-committed engineers understand success can be seen to reflect a changing notion of hegemonic masculinity. Central to all of the men’s discussions of success was its construction as individual. This individualism will also be central to the final theme, which will explore links between enactments of masculinity and responses to whether retention in engineering is a problem. In concluding this chapter, I will discuss whether changing norms of masculinity represent a challenge to masculine dominance and argue that, given the emphasis on individual responsibility, these changes may indicate a small shift in hegemonic masculinity, but not a radical change in gendered power relations or the “densely masculine” culture of engineering.

Born on Mars – or as a woman

> ... that's just a whole, huge, "what if I were a woman?". But "what if was born on Mars", I don't know! (Kevin)

A trend that was consistent across the male participants in this study was the idea of natural differences between men and women. During the interviews, in an attempt to assess participant's views on gender and the engineering profession as gendered, I asked participants: "If you think about your career, do you think it would have been any different if you were a woman rather than a man?" Kevin's response above is reflective of what the majority of the men stated. Joseph, after laughing, stated "Hell, yeah! Oh, yeah!" John replied, "Wow. That's a really interesting question. Yeah. Absolutely." Men whom I have categorized as committed and not-committed to engineering, and participants across the fields of engineering and age range, reported that their careers would have been different if they had been female.[53] Of particular interest were the explanations that the men provided for why their careers would have been different.

Two discourses were drawn upon here: 1) that organizations created inequalities that would have led to different experiences for men and women, and 2) that men and women are naturally different. Of these, the belief that men and women are naturally different was much more frequently stated,[54] although a

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[53] It may be that men in other professions, if asked the same question, would have answered similarly. That said, given the dense masculinity of the field and degree to which it is accepted as dominated by men (as explored in Chapter Four) it seems reasonable that this sense of a gendered experience would be particularly strong among engineers.

[54] Notably, some of these statements were made in other parts of the interview, rather than during discussion of their careers if female. A few of the men who reported that structural issues were involved in explaining why being female would have made their career different described gender differences as natural at another point in the interview.

very few of the men made no reference to natural differences and emphasized only organizational and structural explanations.[55] The few who emphasized structural factors included Christopher, a committed engineer, who stated that his organization would treat a woman the same, however,

> … as far as the industry I'm in, it would have been tough trying to sell that. With another partner, maybe it would have been fine, but if it was just a female going out trying to get those contracts with engineering companies or with the [industry], it just wouldn't have happened. … They're just very closed, they don't trust people unless you can prove yourself to them.

Christopher's statement highlights the masculine nature of the field, but also implicitly recognizes that this masculinity is constructed, for it differs between organizations and industries.

Unlike Christopher, most of the men drew on ideas of natural abilities, passions, and interests as tied to physiological sex to explain why being a woman engineer would have been different.

> Would it [his career] have been different if I was a woman? Well, I can't say that I've met any, ever met any women who have shared the same [*laughs*] interests or desires, you know same sort of passion I guess for mechanical systems as I have. And most of, I can't say that I've met very many men either, but I have met men who share the same passion, I have not met women that share the same. So, from an early age too, I think that would definitely make it different. (Jacob)

> The way a woman works is quite different to the way the profession is structured and that's principally why I think women have battled. Not because there is anything wrong with them, but because of the way the profession works it doesn't value that particular way of doing things. (Eric)

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[55] In one interview gender was not directly discussed; in three the participant's response either did not indicate any natural difference or focused on numbers in the field rather than explanations of why women were not more prevalent.

The men spoke of women as "relational", as "more intuitive", as having a different perspective. Women ask for directions, while men bring maps. Women do not have the same interest in the technical. They don't have the passion. Women are also bound to a biological imperative to reproduce. James for example stated that it is the "generalities of human kind that the woman is the child bearer, and that, as a species, we're meant to procreate, so sooner or later, a woman's going to decide, 'I want to procreate, and I can't do that *and* work.'"

This construction of gender as natural leads one to a position in which the construction and valuing of difference, and the maintenance of power, can be ignored. It is because the division of the genders, and all the "arbitrary" meanings that are affiliated with gender, are to some extent grounded upon differences in biology that they become "natural" (Fowler 2003:470). An example of how natural these differences were perceived to be was related by John: "Let's not kid ourselves, men and women are different in every respect." After describing how he learned through courses with women that they have different forms of logic (quoted in Chapter Four), he continued,

> … what I have seen is the ladies who tend to be fairly successful in our profession act like everyone else is. There's a certain way you need to comport yourself. Why do you need to? Because you're men, but it's like the cart before the horse. So it's not men act this way to be men, they just are. We're hardwired that way. Men are hardwired, literally hardwired to be aggressive, I mean the testosterone we have in our bodies and all of that, it's the chemical balances, biology being what it is, that's why we, the reason why we're the ones that go out and face the brontosaurus.

Through John's words the gender regime of expected behaviors and interrelations can be seen as embedded in notions of what is "natural". As such the power of the gender regime to direct behavior is reinforced and even if gender is up to the individual to enact, enacting it in a different way means doing gender in a way that, in this setting, may be seen as unnatural and therefore sanctioned.

It is this explanation of something as natural, as predetermined, that creates the resilience of this discourse. “The particular strength of the masculine sociodicy comes from the fact that it combines and condenses two operations: it legitimates a relationship of domination by embedding it in a biological nature that is itself a naturalized social construction” (Bourdieu 2001:23). It is this circularity, this ability to make the constructed appear natural, which is key to the continued success of male domination. While this domination, as Connell and Messerschmidt (2005) argue, can be challenged, this discourse plays a powerful role in ensuring the continued maintenance of a gendered power order. The power of this “naturalistic” understanding can be seen in engineering in the logical outcome of this natural difference discourse: if these gender aptitudes, roles, and passions are inevitable, then they should not be challenged.

> There are certain people and personalities interested in this kind of work, and if it’s only 20 percent of the female population that’s interested in that kind of work, then I don’t think you should see any more than 20 percent of the population being female. At the same time, not every male is interested in engineering; it just happens to be a higher percentage. So let the cards fall where they may. But to try to develop diversity, no, I think it’s just a — it’s a federal government, provincial government paper game. I don’t believe it for the moment. (Matthew)

Commitment to engineering and masculinities

When examining the different forms of masculinity enacted by my participants, parallels between masculinity and the commitment of the individual to the engineering profession become significant. In arguing this I am returning to the discussion of commitment outlined in Chapter Five and the forms of professional identity (technicist, heterogeneous, non-technicist) detailed in Chapter Seven. As described in Chapter Five, I have categorized ten of the men interviewed as committed to the engineering profession and eight as non-committed engineers. Notably, men were much more likely to be categorized as committed engineers than were women (I only categorized four of the women I interviewed as committed to the profession), indicating a gendered connection from the outset. The men were also the only interviewees to present a technicist professional orientation, and were less likely than the women to be non-technicist. In the following discussion I will examine three themes that are tied to differences in both commitment and enactments of masculinity: views on family; ideas of what constitutes success; and beliefs about engineering retention.

Personal lives of engineers

Based on the interviews, an element of the men's non-professional lives that clearly differed for the committed and non-committed engineers was their family involvement. While the majority of men in both the committed (70%) and non-committed (75%) positions were married or living with a partner at the time of interview, and 50% had children living in the household, the extent to which they perceived their family as playing a major role in their careers differed greatly. In describing this I will draw upon typologies of men's working/caring roles developed by Cooper (2000), Halrynjo (2009) and Ranson (2001) to outline four positions the men in my study held in relation to family involvement and paid labor: the unencumbered ideal; the breadwinner; the "me" orientation; and a transitional position. The first two of these were presented by the committed engineers and reflect traditional expectations of masculinity. The latter two, the “me” and transitional positions, were presented by non-committed engineers and reflect newer forms of masculinity.

In reviewing past work, fatherhood and careers in science and engineering oriented fields has received limited attention. Three exceptions are the work of Cooper (2000), Ranson (2001) and Halrynjo (2009). Cooper (2000:379) conducted a study of men working in information technology organizations in Silicon Valley, a “male-dominated, turbo-capitalism environment,” and the ways in which it impacts men’s thinking and balancing of work and family. The ideal worker in this field remains the “unencumbered worker”[56] who has no other obligations and for whom work comes first. Cooper (2000) argues that the masculinity that dominates in this world is one that “involves displaying one’s exhaustion, physically and verbally, in order to convey the depth of one’s commitment, stamina, and virility.” Among the men, who perceive themselves as “‘modern’, not frat boys; progressive, not stupid jocks” (p.383), those who do have children were faced with a conflict: they desire to be the “go-to guy at work and at home” (p.391). Three ways of resolving this conflict emerged among her participants: the superdad who was heavily invested in both work and family; the traditionals who divided domestic labour along traditionally gendered lines; and the transitionals who were more involved fathers than the traditionals, but were more likely to hand off duties and emotional work to their wives than the superdads.

Based on interviews with 22 men from the larger study described in Chapter Two Ranson (2001) examined the implications of involved fatherhood

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[56] The notion of the unencumbered worker was developed by Joan Acker (1990).

on working lives. Rather than studying how work impacted parenting, Ranson (2001) questioned how parenting affected men's working lives (p.24) arguing that involvement in fatherhood was impacted by confidence and willingness to question or challenge the norm of spending long hours on the job (p.10). Her participants were grouped into four categories that emphasized their acceptance of the norm of long hours: conformers, qualified conformers, strategic accommodators, and challengers. Although these four categories are identified, it is important to note (as Ranson does) the "fairly narrow range" (p.22) of options enacted and that, although the men's involvement in parenting reflected a historical change, their "involvement had to be fitted around workplace demands" (p.24).

A fairly similar set of positions was reported by Halrynjo (2009) based on a study of 102 European men, half of whom were working in technical and financial organizations, the other half in social or health-related organizations. Using a multivariate statistical technique for uncovering patterns in categorical data Halrynjo (2009) reports four positions based on a volume of work continuum and a volume of care continuum. The "career position" consisted of men who work longer hours (46-75 hours a week), earn more than their partners, and have limited involvement with childcare. The opposite of this (lower work hours, more childcare involvement) was labeled the "caring position". The third position was a "care and career position" in which men work 40-45 hours a week with 20-29 hours a week of childcare. A final position was the "patchwork position." These men were characterized by part-time work and precarious jobs due to a desire to pursue other work, studies, or hobbies (not care tasks). A critical conclusion of Halrynjo's (2009:119) study is that, while men do take on non-traditional positions (e.g., the “caring” or “care and career” positions), the overall relation between work and care continues to be traditional. The men who spend the most time on work spend the least on childcare and vice-versa. Additionally, Halrynjo (2009) states, “the explicit – and implicit – ‘rules of the game’ in working life still favor the unencumbered worker” (p.118).

In reading these studies by Cooper (2000), Ranson (2001), and Halrynjo (2009) alongside my data I found parallels to the positions described. Similar to Cooper’s “traditional”, Ranson’s “qualified conformity”, and Halrynjo’s “career position,” many of the committed male engineers interviewed fit traditional breadwinner roles. The “transitional” position Cooper describes and the “challenger” position in Ranson’s work was reflected in the statements of a number of the non-committed men who emphasized the extent to which they desired to be involved in caring work, although they often retained quite traditionally gendered parenting roles. Only one man, a non-committed engineer, could be seen to fit the “superdad” or “care” position, with his wife’s career taking precedence. Notably none of the men in Ranson’s (2001) study, which was conducted in the same context a decade earlier, would have fit into this “superdad” or “care” category. [57]

Among the committed engineers who were in partnerships and/or had children, there were two distinct ways of responding to questions regarding the

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[57] As in Halrynjo’s research, my study also included a small number of men who were unpartnered and/or did not have children. These individuals exhibited a more pronounced version of the work/family orientation that dominated among the men with whom they shared their degree of commitment to the field. Thus, those who were committed to the field were even more dedicated to the profession. Those who were not committed to engineering were even more focused upon their personal lives and finding balance.

extent to which family demands had impacted their career: that family had "no impact," or that family had "a great deal" of impact. Both responses, although on the surface very different, can be seen to fit within a "breadwinner" model of masculinity. The men who reported that their family had little impact on their careers included Ryan and Matthew. Ryan, who had agreed to remain in one city while his children went through high school, stated that family had "not really" impacted his career. "Pretty much where I went, we went and it wasn't something that was a concern…" Even more clearly, when discussing if family had impacted his career Matthew responded:

> *[pause]* In a roundabout way. When we go on holiday, we'll go on holiday to [Canadian location], and I'll inspect our [project] while I'm there. But no, not major. The guys [his sons] laugh. They say, "We can't go to Hawaii. There's no [project] in Hawaii." *[participant and interviewer laugh]*

Later in our discussion I reversed the question, asking Matthew if work affects his home life:

> Yes, it does. It means that in the state that I'm in with the company, I am *needed* to know. *I* don't need to know; *people* need me to know everything that's going on. And that's the part that I'd like to give up on. I'd love to go ride a bicycle across Canada for 6 weeks and not carry any technology with me, so I don't have to stop and answer the calls on how to fix something. Then again, when I'm sitting around doing woodworking, whatever else, somebody calls and says, "I've got a problem. What do you think I should do?" I have no problem answering that, but I'd love to be able to go hide from it once in a while. Right now, I cannot hide from it; it's impossible. Like, on holiday, my laptop, conference calls, my cell phone, it's every day; like, I leave dinner to answer calls.

Ryan and Matthew, with their wives performing the domestic and caring tasks, were free to pursue their careers. Thus although they had children these men were very close to the ideal of the unencumbered worker. Like the “conformers” in Ranson’s (2001) study, the engineer’s career was placed at the forefront.

Of my study participants, only Christopher truly fit the description of a “person with few obligations outside work that could distract him from the centrality of work” (Acker 1998:197 cited in Halrynjo 2009:99). Christopher reported having no caring duties or other commitments to distract his time, focus, loyalty, or energy from work – he was the true unencumbered worker (Halford et al., 1997 cited in Halrynjo 2009). As a partner at a consulting engineering firm he reported working 70 to 75 hours a week on a regular basis because “I don’t have a family, so that means that I can.” When discussing how he envisioned life five years in the future, he exemplified the ideal of the unencumbered worker. He indicated that this ability to work extreme hours will be challenged if he were to find a partner: “If I get married or meet somebody, then my focus gets completely re-evaluated.”

While being the primary earners in their households and dedicated to their careers, some of the men committed to engineering indicated that their families did impact their career choices. The reflections of these men also resonate with the words of Ranson’s (2001) “qualified conformers.” Particularly interesting were Nick and Daniel who independently used the term “encumbrances” to discuss the impact their families had played on their careers. Both men reflected back on their younger days when they were free from these “encumbrances”. While discussing ways to change the engineering industry, Daniel stated:

> Having a family now puts a huge encumbrance and restraint on what kind of moves I could entertain… So how do you take that [retraining and a pay cut] into account while you have a mortgage and a family and all those sorts of issues. Those kinds of decisions are something you have to deal with, of course, so you factor in whatever you need to, and you make the decision. In my case, I felt that the family has got a higher level of importance than my personal aspirations. …

The idea of "encumbrance," as used by Daniel and Nick, did not indicate they were disinterested or unaware of their families needs, but that their involvement in meeting these needs was through their breadwinner role. For these men, family meant not being able to follow one's dreams and having a responsibility to provide for their family.

For the non-committed engineers, two alternate positions were much more apparent, a "me first" orientation among the men without children, and a transitional position among the men with children. Ben and Joseph, both unencumbered non-committed engineers, indicated that they had prioritized personal satisfaction and development over commitment to a career. Notably, one of the committed engineers, Jacob also reported that he was focused on quality of life over "quality of career." Jacob's commitment to his own personal development and enjoyment align him more closely with the non-committed men in his age group (Ben and Joseph) than with the committed engineers. Given the small number of young male engineers (under 35) who did not have children, it is hard to ascertain whether this trend towards a "me focus" reflects a generational trend. While a number of participants reported that there are major generational differences between young engineers and those who are established, a study that compared different age cohorts would be needed to reach this conclusion. In fact, it is important to note that these "me" men generally had the fewest family demands and commitments. It may be that, with increased family responsibilities, their views will come to reflect those that predominate among engineers with similar levels of commitment. Alternately, they may take up newer enactments of parenting and engineers – as superdads or transformative partners.

More common among the non-committed engineers was a transitional, or "care and career," orientation. To some extent I hesitate in using these terms, particularly as Halrynjo (2009) and Cooper (2000) did, as I am not convinced that these men actually enact different behaviors than their more traditional breadwinner colleagues. These non-committed male engineers did, however, use a different rhetoric in discussing their family. They described family as having a major and important impact on their careers, not only in terms of providing, but also on their choices for advancement and the extent of their involvement in work. In this way the conceptualization of the "challenger" presented by Ranson (2001) may more accurately fit these men's experiences as they did reflect a different discourse, but it remained within a narrow range of acceptable behaviors. Alex, for example, reported choosing to stay in his current position rather than moving to another that would be more profitable in order to have the flexibility to spend time with his children. John emphasized that, if he were able to afford it, he would (as per the introductory quote to this chapter) be very involved with his children's lives.

While there were differences in the extent to which male engineers wanted to be involved with their children, the actual role in providing care they reported was far from "radical." Individuals, such as John, talked about how they wanted to be more involved with their children, but in reality it was his wife who had left her career to be a stay-at-home mother. Alex talked about the importance of flexibility, but it was flexibility to do “fun things” with his children, not take them to doctor’s appointments or stay home with them when they were sick.[58] Jack, who had been let go from his last engineering position and was now developing a different career, described a “role reversal” in his home. Whereas he had worked long hours while his wife was at home, he was now the one at home more and she had returned to work. He states,

> When I left [work] and then she subsequently started work again full-time, there’s absolutely been a role reversal there, so I configure my work around the family’s needs. It just seems to makes sense. And as the kids grow older, too, they become more autonomous; they don’t need and/or want the same level of parental involvement *[laughs]*. So from that perspective — *[laughs]*

Yes, it is a change. But a reversal? Among these men there seems to be even less deviation from the traditional division of domestic labor than what was reported by Halrynjo (2009) and Cooper (2000). There are discussions that allude to a changed or changing ideal of the “modern man”, but actual behaviors, whether due to economic realities or gendered habituses and fields, remain largely unchallenged. The one exception to this was William, whose wife’s career had taken precedence:

> … she’s an extremely busy person. If I was to adopt that same kind of gung-ho attitude about the career, where would we be? Would we be together? I don’t think so; we would have gone our separate ways there. So to a certain extent, I relaxed. Is it a question of aptitude or desire or ability? Well, yeah, certainly,

[58] This “fun” aspect of fathering also comes through in a few recruitment advertisements posted in *The PEGG* and *Alberta Innovators* Magazine. Here men are imaged having fun and playing in the outdoors with children, connoting a happy, balanced employee, and a clear division between work and family.

> maybe I wouldn't have done that well, but on the other hand, I didn't really have the heart to get too far in experimenting that with, you know, the consequences. And we have a fairly big family, too; we have four kids.

Of all the men William was the only one to report that his wife's career was very demanding or that he had taken on a substantial role in child and domestic care.

Defining Success

During the interviews, after asking participants to describe what they viewed as a "successful engineer" (I will explore this below), I asked "What does success mean to you more broadly?"[59] While research on careers, and work-life balance, frequently examines respondents' aspirations and views of career success, few studies have investigated how people explain personal success and whether they differentiate this from success in their career. An exception was Thomas (2005) who was investigating the career development of executive level women in information technology and asked participants broadly about their ideas of success. Although responses were not analyzed in detail, Thomas (2005) indicates that the majority of respondents included both work and life aspects in their answers, for example: "I define success as being authentic and living with integrity and having a positive impact both at work and at home" (p.145-6). Perhaps in the era of self-help manuals and guides to *Live Your Best Life* (O, The

[59] The wording used in the interviews varied, however I did aim to ensure that the questions on their view of personal success came after what they considered a successful engineer. Examples of how their view of personal success was asked included: "I asked you about what a successful engineer was; forgetting about the engineer part, what does it mean to be successful to you?"; "And how about for yourself, what does it mean to be successful?"; "Going back to success, you already talked about how you would define someone who is successful; for yourself personally, how do you define success?"

Oprah Magazine Editors 2005), it is not surprising that my participants reflected very similar responses to the question of what they personally defined as success:

> In general, having your needs met, *[pause]* whether that is roof over your head, decent salary, whatever you need that way; needs met, happy with your job, and happy with your family or home life. Doesn't have to be big cars or anything fancy. I know guys who have the big cars and the big houses, and they're not really happy. They might be successful in terms of monetary, but they don't necessarily have the success in other areas. So I guess, in general, kind of balance. *[laughs]* If you can get the balance in there and be happy with it, you're successful *[laughs]*. (Nick)

Across the board, success was consistently defined by the men I spoke with in terms of personal happiness, a happiness that included family, career and social connections. Don, for example, responded

> I guess *successful* I equate to enjoying and happiness in the job, in what I do, and therefore I judge myself as successful in my career. … In life in general? Again, I can't imagine somebody not wanting families and so forth, but to me, I'm blessed with wife and kids and grandkids and family, extended family. That's happiness to me. Yeah, there's always more you would like, you would want, but I'm satisfied.

Among the unpartnered participants, friends and social life were identified as central to a sense of personal success.

An unexpected element of many of the men's responses was, as both Nick and Don indicated, a definition of success as involving more than only monetary criteria.[60] If economics were mentioned (in only three cases) it was in terms of a

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[60] This may also reflect the way in which this question was asked and that in many cases I asked the participant to reflect on their image of success beyond engineering (which was their career and therefore the source of financial compensation). That said, the participants inclusion of the desire for interesting work and work they enjoyed indicates that they were considering career elements in responding to the question and suggests that the fact they did not respond in terms of economic capital is more than an artifact of the question.

desire for security and stability, as Nick states, “having your needs met”. This lack of emphasis on the economic may relate to the nature of engineering and that none of these participants risked poverty. All were comfortable, if not well-off. What was lacking was happiness, balance, and time. And it was these elements that came to be seen as representing success. The desire to find balance was particularly stressed by a number of the committed engineers who reported long work hours and limited time with their family. James, for example, who worked out of town, away from his family every week on contracts, described wanting:

> Work-life balance; job satisfaction in terms of being able to influence and to share my experience to help others, to make a difference … that would be a definition of success for me, but to do it in a way or a type of job where I can strike a better balance between my work life and my personal life in regards to my kids and my wife, that would be the sweet spot.

James’s desire to influence change, either in the profession or more broadly, was also identified by a few other male participants, both committed and non-committed engineers. Similarly, some of the men indicated the importance of “self-actualization”. This included a desire for variety, learning, achievement, and challenge both in their career and/or life generally.

> Happy family. Health. And a, you know, a – and this is going to sound perhaps odd, but a good balance between what I’m going at work and what I’m doing outside of work. Because what I’m doing at work really needs to be challenging and interesting and have variety. But what I need to do outside of work has to be different than what I do at work, so I need variety beyond what I get at work. So I definitely need a variety of activities that I’m successful at, that I’m good at, that I can demonstrate competency and do better than others. That’s part of – I’m fairly competitive… (Ryan)

Being a success, whether or not one is committed to engineering, also remains in line with the values of hegemonic masculinity. The implicit connection between masculinity and success can most directly be seen in the pronouns used by participants in describing people they viewed as successful. The question itself was gender neutral; the responses often were distinctly masculine. This masculinity is clear in Joseph's words, quoted in Chapter Three about who makes a good leader: "...He'd be very diplomatic in what he says. He'd be extremely calm. He would be generous with his knowledge. He would be forthright and honest...".[61] Yet it is more than a generic male to which these men referred – it is a particular enactment of masculinity. As Connell (2005) argues in *Masculinities*, there has long been a division between forms of masculinity that emphasize direct domination and those that emphasize technical knowledge. The former were exemplified by military leaders and chief executive officers, the latter by scientists. Forms of masculinity that emphasize the technical, Connell (2005) argues, have "challenged the former [direct domination] in the gender order of advanced capitalist societies, without complete success. They currently coexist as inflections or alternative emphases within hegemonic masculinity" (p.165). The engineering field is a clear example of a setting in which this technical form of masculinity dominates, such that these men, like the men of the "new middle class" studied by Connell, "have a claim to expertise but ... lack the social authority given by wealth, the status of old professions or corporate power" (Connell 2005:165).

From my participants' comments, particularly in relation to their professional association, it was clear that broader social authority was not generally seen as available to engineers as engineers. The possibility for doctors

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[61] William, Jack and Matthew also gave responses in similarly masculine terms.

and lawyers to become politicians and espouse their views was not seen as available to engineers. Matthew, for example, stated:

> We're traditionally so cut-and-dried; yeah, there's a lot of lateral thinking, but just not able to handle the malarkey that goes on with that kind of stuff … And at the end of it all, because you're an engineer, you're expected to be accurate all the time; you can't just have an opinion. So if you publish into general media, and someone takes exception to anything you say without knowing every fact, you suddenly become a less valuable engineer. So unless you double- and triple-check every fact and write it as, you know, a major paper, you can't just discuss opinion. What's law? Law is a series of opinions, right? There is black and white, sure, but there's always a lot of it — all this range of it, except the engineer has to be black and white. So as a result, keep your head down, leave it alone.

Joseph and Eric made similar observations. If these men lack access to social authority, which would traditionally reflect influence, what does it mean to be a "successful engineer"?

While ideas of what it means to be a successful "person" consistently reflected ideas of happiness, challenge and "self-actualization", the men diverged in terms of what they identified as necessary for success in the engineering profession – or what in Bourdieuian terms would be engineering capital. For the committed and technicist engineers' success was measured in terms of a technical product, a tangible object. It secured their identity and expertise in a concrete form. Among non-committed engineers, other forms of recognition were sought: awards, money, prestige, decision-making, power. Thus the capital associated with career success was closely linked to one's professional identity narrative.

For the committed male engineers, one's technical insights and developments, as unique expressions of one's expertise, were critical to being a successful engineer. Christopher stated, "I wouldn't base it solely on monetary terms; I think *successful* would be more of a résumé of what they've done and accomplished as far as design work goes." Indeed what the public may view as a negative stereotype of the engineer, the focus on the technical, was seen by James as an image that engineers take pride in:

> …The Dilbert kind of thing has popularized what an engineer looks like or acts like, in many ways. In the engineering culture, we almost take pride in that. There's an aspect of engineering culture that I've seen that's manifested in a Dilbert cartoon or Dilbert strip, if you will, that I think is called "the knack." I believe that the public sees engineers as "they have the knack"; they understand how things work, why they work.

The technical, the built objects and products you had made, were in essence the proof of one's value as an engineer among these committed and technicist men. The importance of this was reflected in my interactions with two of these men. Matthew, who in our interview emphasized his pride in the products and designs he had developed, took me to his office after our interview to show me photos and a video of his designs "in action". Vince, a foreign trained engineer struggling to find work in the booming Alberta economy, came to our interview with copies of newsletters containing stories about his technical work. That these men chose to show someone who was clearly not an engineer their work indicated not only a pride in this work but a sense that the technical, the product, is itself a form of capital. Interestingly, capital did not seem to be measured by accolades given to the design or product. As Matthew and Christopher both discussed, awards were nice, but somewhat meaningless: "A lot of the awards are kind of — I don't know; I'm kind of a little bit cynical in that regard, but they kind of make those awards for themselves so that they can sell themselves to their clients as saying 'We've won so many awards'… and there's no MVP for engineers."

The non-committed engineers, in comparison, were much less concerned with the technical outcomes of their work. Only three of these eight men identified technical expertise as a critical component to being a successful engineer. And even in these cases the technical was a secondary component – a necessary but not sufficient element for success. What non-committed engineers were more likely to emphasize were the economic rewards and the general social prestige gained from the profession. Kevin, while stating awards were not important, identified liking "pats on the back" when things went smoothly. Joseph described the prestige and the recognition that came with being an engineer as important in cementing his choice. In talking about how he finalized what would be his area of study through a summer job, he stated:

> ... because you were the one out there wearing that white hard hat, and that's kind of a symbol of some supervisory task that you had to do. So that really nailed it for me. Of course, you get to wear your hard hat and your safety vest and your steel-toed shoes, so you've got a bit of a uniform almost; it's almost like a bit of a uniform where you get to put on a sort of an identity. And you're expected to act, to project an image to the public, project a different image to the contractor, and then, of course, you represent [organization]. So that variety and those roles — responsibility in that one role was what really got my juices flowing. So that clinched it for me...

Also consistent for the majority of men was a reliance on individual explanations for success. Very much in line with the individualization thesis (Bauman 2002; Beck & Beck-Gernshiem 2002) individuals were seen to be responsible for their success. Individuals who were successful were described as hard working, results focused, creative, clever, intuitive, having the 'knack', and being willing to sacrifice. The explanations of success as achieved by the person due to their traits and commitment reflect not only the cultural ideal of individualism, but also the engineering habitus (Chapter Six) and the norms of masculinity. As Connell (2005:123) explains, even among men who actively take up non-traditional forms of masculinity, their life histories reflect similar trends of "competitiveness, career orientation, suppression of emotions, homophobia".[62] The stress on individual responsibility could also be seen as a reflection of gendered differences in locus of control,[63] wherein women have been found to be more external in their locus of control than men (Bernardi 2001). However, as the following chapter will reflect, the women in this study were also very likely to report individualized explanations for their success suggesting this emphasis on individual responsibility reflects a field specific form of explanation – and perhaps the masculinity of the field. Alternately it may reflect a broader social trend of individualization.

Is Retention "an Issue"?

A central element in this project was understanding the factors related to an individual's likelihood of remaining in the engineering field. This interest led to the development of my sampling strategy which emphasized having both people employed as engineers and individuals who had left the field. As detailed in Chapter Five, while I had anticipated a clear-cut distinction, I quickly realized that one's retention in, and commitment to, engineering were far more nuanced. The literature from the engineering field and my conversations with people working with various professional associations and engineering affiliated groups,

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[62] In this quote Connell (2005) identifies the predominance of homophobia. I am unable to detail if this would apply to my sample as views on sexuality were not asked about nor raised during any of the interviews.

[63]Locus of control is a psychological term representing individuals' range of beliefs concerning personal control over their environment; the range extends from strong personal control (internal locus of control) to weak or no personal control (external locus of control) (Rotter 1966 cited in Bernardi 2001).

however, clearly indicated a concern that people were being lost – that the engineering pipeline was “leaky”.[64] When trying to address this issue with individual engineers, I asked them about two issues: 1) whether they personally had ever contemplated leaving engineering; and 2) if they believed retention in engineering was an issue. As I will explain below, the question of whether retention is an issue was further complicated by differentiations between retention in an organization versus the profession of engineering itself.

During the interviews each participant was asked if they had ever considered leaving the engineering profession. Anthony, a committed engineer who continued to practice the profession in his retirement, responded:

> No, the only time was actually after I retired completely, I thought of going back to university and taking law, just because I was kind of interested. But that’s the only thing. No, I never wanted to leave it. … I just enjoyed what I was doing, and fortunately, I was reasonably successful at it, and made a few dollars, and enjoyed it.

This sentiment was reflected throughout the interviews with the committed engineers. Many had contemplated changing companies, or perhaps industries (e.g., from transportation to oil and gas), but they did not report wanting to leave the profession. In contrast, all of those categorized as non-committed had contemplated leaving the profession for reasons including not being satisfied with compensation, wanting to have a more balanced lifestyle, and seeing other (non-engineering) opportunities within their work organization. Most frequently

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[64] Despite this being a topic in my discussions with people working for the professional association, the analysis of materials produced by the professional associations and alumni groups made very few references to retention. The few references were in articles from *The PEGG* (September and November 2007) that related to mentoring as a tool for attraction and retention and a description of a mixer held by UA-WiSE and WISEST which encouraged women to keep science in their futures.

stated was the desire for greater work-life balance. This was reflected by Eric (quoted in Chapter Five) when he discussed the two times he had considered leaving the profession and the extreme workplace pressures and emotional burnout that led him to these points.

As noted earlier, in undertaking this study I had assumed from the existent literature and informal conversations that retention was an issue, but quickly found that it was not seen as such by the vast majority of the men whom I interviewed. While doing pilot test interviews I realized that I could not assume retention was considered an issue and recognized the need to ask participants whether they viewed it as such. While a range of views on retention were revealed, the majority only discussed organizational retention as a concern. Retention in the profession was rarely emphasized.[65] In exploring why retention was, or was not, seen as an issue, four major themes arose: personal choice, organizational issues, economic climate, and the role of foreign trained engineers.

Among the committed engineers, only two indicated that *retention in the profession* was an issue and for one of these individuals it was not clear that this "issue" really indicated a problem (e.g., something requiring a solution). A number responded that they could only think of one or two individuals they had know in their career who had left, so did not think (or were unsure) if it could be

[65] Respondent comments on retention, much like their comments on success, should be read as statements made within the context of an interview with very particular words being used in the question. In reflection it may be that the choice of the term "issue" was too negatively loaded to use in introducing retention. Furthermore the "boom" context of the interviews should be seen as very critical to the views on retention reported and participants assumption that the retention of interest would be to organizations (which many reported were troubled by trying to retain workers) than the profession (which was of much less immediate concern).

considered a problem. In reflecting on whether retention in the field was an issue, the majority of those who believed it was not, turned to personal choice. Matthew, for example, emphasized that individuals should follow their passion. If people are lost from the profession, it is not a problem because if they do not love the field they should leave. These committed men loved the field, engineering was their passion, their hobby, their calling. But if it wasn't your passion or calling, why should you stay? Retention was not an issue, because those lost were never really engineers. As Matthew stated:

> And there are a lot of the guys I went to university with — a third of the class; *[pause]* I don't know if it was that many; yeah, let's say a third of them were just kicking the tires. They were never to be retained in engineering, they didn't know what their passion was, they just went down that stream. So the fact that they were never retained in engineering, I don't know; maybe that makes them a better landscaper, or a better trumpet player, or whatever it may be. And that's okay. So there's a certain portion that's just gone - the angel share in the champagne industry; they're there some place, but not here any more.

The other explanation the committed engineers suggested was the economic climate; in the case of recession engineers might be forced to pursue other careers.

> When I came in, it was a little more of a challenge. … As a junior engineer, you were faced with folks who had 20 years of experience who were looking for work, and there weren't that many jobs … That was the tricky part, because in my class, I know at least a handful of acquaintances from my class that I know aren't in the field. (Nick)

Nick had completed his degree in the late 1990s. At this time the price of oil was around $15 a barrel, much lower than at the time of interview (approximately $75/a barrel). Like Nick, a number of the participants who had graduated in the mid-1980s through to late 1990s reported challenges finding work and spoke of friends who had been forced into other professions. Nick later discussed how, when the economy had improved and these people wanted to come back to engineering, they were unable to do so having not been in the field immediately following their undergraduate studies. These reflections on the impact of the economic climate on retention, however, stand in contrast to the notion that one is personally responsible for their path. It opens the door to the need for more than just a calling to be an engineer– or perhaps more accurately that this interest may be necessary for retention, but is not sufficient. For these committed men the ability to earn a (good) living was also a necessity. Without the ability to fulfill the role of earner, passion for the technical was insufficient.[66]

The majority of non-committed men, like their committed counterparts, emphasized retention as an issue for organizations rather than for the profession. Again the role of an individual's choice weighed heavily in responses. Both Ben and Jack who had left the engineering profession stated that leaving was a personal choice. Jack, for example, estimated that less than 50% of individuals who graduate from engineering aspire to the engineering profession. So in this sense retention is not an issue, if the majority of people pursued engineering only for the degree, not the career, then that they left was not something of concern. Of these eight non-committed men, only one directly stated that he believed the engineering profession had a retention issue. This was Eric, who stated that he only remained in the profession to be in a position to be "part of changing the way the industry works". The changes needed, he argued, were finding more

[66] The degree to which job availability made a difference also appeared to vary by the men's identification with the technical. In contrast to Nick who is a heterogeneous engineer, Don, one of the committed engineers, was committed to working in the field even when times were tough and opportunities scarce.

reasonable workloads, changing the pressure employees felt, appreciating employees' contributions, and acknowledging that employees' lives impact their work.

The element of retention the engineers were concerned with was the *ability of work organizations to retain workers*. Young engineers were one group identified as not being adequately retained by organizations. Joseph described to me his thoughts when deciding on whether to stay with an organization:

> Okay, I see what you're saying, but I also read your chart and I can read between the lines. What can you teach me, or what can I glean from you in 3 or 4 years, and at the end of those 3 or 4 years, if I'm not satisfied, I'm moving on. So you'd better get with the program and either keep me challenged enough, show me that you have a succession plan, show me that you're thinking about my future as much as I am, and show me how I fit into your long-term plans. If you don't show me any of those, then I'm out of here.

This value did not have to be monetary – it could be small things like coffee, parking spots, and birthday cakes – things that indicated that the organization respected them as a whole person. He continued later: "All my generation, the first thing people want before salary is first, 'Is it diverse, is it challenging; are you going to be controlling my every hour? No? Done! P.S., what's the salary again?'" Jack also emphasized the need to retain young engineers and the negative patterns within organizations that led these individuals to leave companies:

> I saw because of the way that Canadian business, at least in the oil patch had progressed, certainly new employees, for example, were getting drive-by leadership,[67] and getting frustrated at not being heard or being seen by the organizations they worked for. ... 'Cause what was happening is they would quit: "I've been here 2 years, they don't even know my name, my ideas aren't supported, I don't get any good feedback, I'm not growing the

[67] Further discussion of this term is presented in Chapter Seven.

> way I wanted to. So I'm going to go over here." And quite frankly, over there was just the same! *[laughs]*

It is important to note that the comments that Joseph and John relate here on organizational retention may be more a reflection of the economic boom that was occurring at the time of the interviews, rather than a broader shift in priorities. Were the interviews to take place today in Alberta, or in a region with high unemployment, the demands for recognition and personal development may have taken a back-seat to job security and a good wage. Indeed, in line with the committed engineers, the majority of the non-committed engineers reflected on the economic climate in explaining retention. Of the non-committed men, three discussed the economic climate in relation to one's ability to find work after finishing their education (in line with Nick's comments above), while another three focused on the ability of people to switch companies due to the boom in the Alberta oil and gas sector that was occurring. John, for example, stated:

> [Wife] and I used to live on $30 a week in groceries. That was, so it's like, I've gone through the, I haven't starved, I haven't slept on the street, but by god it's been curled up on a mattress in the middle of the living room at the whim of whoever decides to get up and [rip noise] it out. So you put up. So some companies are hasty and then they end up turfing people, but I think the big problem is it's the money is what's causing people to jump more often than not.

A central theme, from both committed and non-committed engineers, therefore, was that retention problems could be seen as a symptom of the rapidly growing economy. If one wanted to work as an engineer they could find work. The need for foreign trained workers attested to this, according to both Kevin and John. In a sense it was not organizations but too many opportunities that were creating an issue with retention. Thus the majority of these non-committed engineers gave the impression of not seeing their choices and their questioning of the field as reflecting systemic issues, for it was particular companies, or their particular interests, that did not fit.

Only one of the male engineers, Eric, independently elaborated on how women faced greater obstacles, and were therefore more likely to leave engineering. He stated:

> And this whole thing of "oh, you'll have babies and go away anyway so why invest in you," might have been valid in the '50s when there were enough men to go around to do all the work, but man that's not the case now. Every female engineer is worth her weight in gold because of what she knows. Man if she goes off to have children you phone her every month and see if she's happy. "Coming back? How can we help you? How can we assist you to be interested in coming back?" There needs to be a much more interactive engagement to retain those women because they're an invaluable resource.

Yet, while Eric clearly identified organizational and managerial issues that exist within the profession, he does so without challenging essentialist notions of gender or the emphasis on profitability and corporate opportunity.

Conclusion

Throughout this chapter I have argued that, although the masculine culture of the engineering field can be seen to be changing and different enactments of gender are accepted (perhaps even privileged) within the profession, the underlying gendered power relations remain intact. Through constructions of gender difference as natural and ideas that men and women have different skills, the densely male nature of the engineering field is maintained. In so far as men and women are accepted as being "naturally different" there is no impetus to challenge the gendered nature of the field, or the way in which different gendered habituses fit into this field.

Developing the connection between commitment and masculinity, as introduced in Chapter Six in relation to the form of professional identity along the technical to non-technical continuum, in this chapter I examined the personal lives, definitions of success, and concerns about retention of the men involved in this study. In relation to their personal lives a clear difference can be seen between the committed and non-committed men. Those committed to the profession reflected attachments to the family that were much more in alignment with traditional norms of masculinity. Unpartnered, they embodied the unencumbered, ideal worker. As partners and parents they became breadwinners whose responsibility it was to provide for the family and for whom the division between work and family was clear. Among the non-committed men, newer forms of masculinity and connection to family were presented. The single men emphasized their goals and interests, placing themselves and their self-development first. Those with family related the importance of being involved in family, of balance. They embraced a new image of what fathers should be – involved. Notably only one of these men presented a truly non-traditional role in relation to the family.

In discussing success the men emphasized happiness, time, and balance as critical to personal success. It was not money or recognition that were important. This emphasis on happiness, I argue, reflects both current social trends and what is missing in these men's lives – not money, but time. In describing a successful engineer, however, the men differed in relation to their commitment. Those committed to the field emphasized technical accomplishments in determining success. In contrast, for those not committed the technical was secondary at best. Money and prestige, for these men, were more likely to signify success as an engineer. As engineers, these men also faced a limitation to success. Engineering, while being very "manly", lacks access to broader social authority that is needed for decision-making power. Due to the lack of autonomy of the field, these men felt limited in their ability to fully reach hegemonic masculinity.

The final topic examined were views on retention. For the majority of the participants, retention was only an issue from the perspective of the work organization, not the profession. Organizations were losing people due to the booming economy and poor leadership practices. This meant a waste of resources and training. Retention in the profession, in contrast, was much less problematic. Leaving engineering, from the perspective of almost all of the men, was a personal choice. Some people were not meant to be engineers, or never really wanted to be. Of interest, particularly in comparison to the opinions of the women interviewed, who are the focus of the next chapter, only one of the men commented on the gendered nature of retention. Retention in the profession was an outcome of individual decision-making, a theme I will return to in the concluding chapter.

Chapter 9: Enacting Femininities in a Masculine World

As seen in the previous chapter, the engineering profession is densely masculine. It is dominated numerically, culturally, and symbolically by men and masculinity. This is not a generic masculinity but a specific one: it is a masculinity of rationality, commitment, competition and individualism. It is enacted in a range of ways by the men who remain in the profession, such that those who are committed to the profession are also those who are more technically oriented, more driven towards success, and less "distracted" by non-work concerns.

How can a woman fit into this world? Is she forced to enact the masculine traits of her colleagues? Must she take up a secondary, subordinated role? Based on the low numbers of women in engineering, and the disproportionately high dropout rates of women in the field, it is apparent that the space is not easily negotiated (Preston 2004; Ranson 2003). Women are less likely to enter engineering and are more likely to leave at every stage of their education and career (Etzkowitz, Kemelgor and Uzzi 2000). Yet entry is not precluded. A few women do enter engineering, thrive within the profession and reach high levels of organizational power. That said, reports indicate that women in SET are less likely to have advanced degrees, less likely to be employed in industry, less likely to be married, less likely to be in a supervisory position, more likely to work part-time, more likely to work outside traditional occupations, and more likely to earn considerably lower salaries (Ahern and Scott 1981; Perrucci 1970; Rossi 1965; Sidlofsky and Goodings 1973; Tang 1997; Zuckerman 1991).

Furthermore differences between men and women are broadly understood as "natural". For women in engineering the ramifications of this "natural" masculinity are multiplied. This is reflected in the work of Powell, Bagilhole, and Dainty (2009) who report that women in engineering studies are likely to enact a masculine gender role by "conforming to dominant, hegemonic masculinity and by rejecting femininity" (Powell et al. 2009:10). Following West and Zimmerman (1987), Powell et al. (2009) identify that women face an additional challenge because, "[o]nly 'traditional' masculinity performed by men is valued in engineering cultures specifically and by society generally. This means that women in engineering face further role conflict because they are perceived as defective women for choosing the 'masculine' occupation of engineering, and also as defective engineers because they are not men" (p.13).

This contradiction between gender enacted and the gender accepted in the profession reflects the focus of this project on the intersection of the gendered habitus with the gendered engineering field. With a match, or fit, between habitus and field, one's ability to function within the field is maximized, in large part because the majority of what happens within that social world (in this case engineering) "makes sense". Without a match, however, individuals are either unable to "function" and cannot see the potentialities of the field, and/or become conscious of the arbitrary nature of the rules that exist and conscious of their dispositions. A third option that may result from this mismatch is the possibility of new potentials.[68]

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[68] Themes from the experiences of women in engineering, and the (mis)matches created in attempting to enact femininity within a masculine world, can also be found in the

This notion of match / mismatch between individual and field, and the potential for changing how gender is enacted, is closely tied to the extent to which an individual is committed to the profession and their professional identity. As described earlier, in comparison to the men interviewed who were fairly evenly split between those committed and those non-committed to the profession, the women were considerably more likely to be non-committed, with only 4 of the 18 women interviewed reflecting what I have labeled as a "committed" position. Yet this connection between gender and commitment is complex. For example, some of the women who were committed to the profession had found organizations and positions that allow them to enact "engineer" in a way that worked for them, but was not the dominant norm for an engineer. How these differences in commitment reflect matches, mismatches, and new possibilities of enacting gender in a masculine world will be explored in this chapter through a series of themes: notions of gender as natural; proving oneself and confidence in the profession; family and caregiving compromises; definitions of success; and notions of retention. Throughout, the complexities of multiple identities – woman, engineer, mother, spouse – and the diverse ways they are enacted will be underscored, with the suggestion made that, for women in a sphere where norms reflect masculinity, constructing a cohesive life project is an ongoing and continual challenge.

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research examining women's experiences in other male dominated fields that was reviewed in Chapter Two.

Gender difference or personality?

In the earlier examination of the engineering habitus (Chapter Six), a series of traits that dominate among engineers were discussed: being hardworking, reliable and goal-oriented; emphasizing autonomy and individual responsibility; and being rational/linear/problem solvers. Affirming the importance of these traits was the extent to which study participants believed that they reflected natural aptitudes. People were good engineers because they *were engineers*. They had these traits, therefore they were able to succeed. As described, these traits of the engineer are also typically associated with masculinity, creating an additional challenge for women in the profession.

Along with the presence of engineering traits, "nature" was also seen to determine important gender truths. While men appeared to take this position somewhat more quickly, six of the women interviewed also identified what they perceived to be innate differences between men and women, in particular that women are more invested in family, communication and emotionality. Julie, for example, described the "natural strengths of women, they do tend to be more – kinder as well as have a good perspective, and better communication skills." Erin, in responding to my question about her experience as a woman in a male dominated field, stated "I think women have the same ability to be just as effective, they just have to think about 'how can I be effective on my terms in a way that makes sense for me?' So instead of being whatever, the top-down hierarchical leader, it's more about building consensus and you know, supporting my team so they win, right?" Others related that women were more emotional and sensitive; women were more likely to cry; women placed more importance on social relationships. Somewhat surprisingly maternal instinct was only addressed by one of the participants:

> … I think anyone's career is different if they're a man. Not so much in a – I'm not really like complaining or anything, it is the way it is I think because we are the ones that do have to take the time off, or I mean even if we don't take a lot of time off, like our, natural focus, I mean I think it's unnatural if you're like so hard-core focused on your career …

The impact of viewing gender as natural was most interestingly, and problematically, related by Jennifer. Her years as an engineer had been very difficult and, as a woman, she had remained on the margins of her very traditionally male workplace. When discussing this workplace, she stated something that she found "embarrassing to admit":

> … you know, I never questioned my abilities before; I never did, and I never thought that men were smarter before. Now I'm starting to think that way, and it concerns me, because it's ridiculous. But it's kind of, like, what's around you and what messages you hear, they start to penetrate you after a while. Even my husband, his views have changed after working and being around a lot of older men, and it's frustrating. I feel very *[pause]* I don't want to admit that, but I'm feeling that. But I'm questioning, 'Maybe he *is* more capable, maybe he *is* a better fit than I am.'

That the power of these negative experiences in her workplace forced her to question her abilities and those of women in general, is startling. A very well-spoken and thoughtful woman, Jennifer was clearly aware of the implications and inaccuracies of what she was saying. That her experiences have brought her to this point – and that she can also see these changes within her husband's mindset – indicates the extent to which these views of what is "natural" are engrained into the engineering profession. This impact on self-perception reflects Roth's (2004:203) observations of status expectations, such that believing that one group (males) is superior to another (women) impacts opportunities to perform in informal networks. Among engineers, as Pierce (1995) found among litigators and Roth (2004) reports of Wall Street bankers, characteristics that are stereotyped as masculine "spill over" into definitions of a competent professional.

Overall, the women interviewed were much less likely to stress that males and females are innately different than the men were. According to Michelle and Kim, while their careers would have been different as men in the profession due to the choices they had each made to be highly involved in the raising of their children, this choice would have also limited their careers if they had been male. Danielle, who expressed some of the most negative sentiments towards the profession, stressed the non-fit between her personality and the environment of the profession as the cause of her issues. In doing so she drew an interesting conclusion, one also noted by Michelle and Lisa: the issue was not her gender but her personality "... I mean if I was my personality [and male] it would be worse. But because, because I'm sensitive, so it would be worse if it was me just being a man." For these three women, their careers had been limited because of their personalities, which happened to fit normative models of female gender and would, therefore, have been even more problematic if enacted by men.

Confidence and Assertiveness: Proving oneself as engineers

Whether gender differences in personality (or habitus) were understood as innate, structural, or learned, a consistent theme arose: women were perceived as not having the confidence and aggressiveness required to succeed in the field.

The gendered nature of these traits is particularly critical given their centrality to the engineering identity. Amy, who had left the profession, for example described an engineer as, "Someone with a lot of confidence in their abilities and their knowledge." Similarly John stated, "…you have to be some damn confident to be an engineer". References to confidence are also very prominent in the literature on women's experiences in the profession, particularly attempts to explain women's lower entrance and retention rates. A longitudinal study of undergraduate women in science and engineering by Brainard and Carlin (1997), for example, found that high-achieving women entered these programs with high levels of confidence in their math and science abilities, but this self-confidence dropped over the course of their first year and did not recover to original levels by the end of their four-year programs. Other research supports the correlation of women's confidence with achievement and performance (Hackett et al., 1992, cited in Fencl and Schell 2006), retention in academic SET education (Marra, Rodgers, Shen and Bogue 2009; Etzkowitz, Kemelgor and Uzzi 2000), and success in academia (Sonnert and Holton 1995). The gendered nature of confidence is demonstrated in the following quotation from a female faculty member quoted by Etzkowitz et al. (2000):

> 'I guess it's our socialization. I have a lack of self-confidence myself. I guess I've gotten more confident as I get older and take on more jobs like editor in chief of a journal and so on. I still notice feelings of lack of confidence and maybe I'm not good enough to do this. I see it in lots and lots of my colleagues. I see it at the faculty level and especially in young graduate students.' (P.109)

While only one of the men noted how confidence may be gendered, eleven of the women described ways in which confidence is gendered. They discussed a number of gendered aspects of confidence including having to develop confidence, the need to be confident and prove one's abilities, and beliefs that to be successful in engineering as a woman one has to be confident.

The women articulated a sense that confidence itself, particularly within engineering, was gendered. Melissa, for example, identified her lower confidence as an outcome of being female:

> … well not saying that women don't have confidence, but me personally I think that a lot of men are just more confident and I think I would have had a little bit more – I would have felt like I could stand up for myself a little bit better and say, "look, this situations not good" and fix it early on instead of waiting 'til it was too late. But [*pause*] there could be women out there that do that as well. But, I don't know, maybe that's a trait I associate with men, just being more confident.

According to Melissa, her lower confidence and insecurity in confronting superiors in part led to her negative experience in her first engineering position, which was central to her choice to leave the profession. If she were a man or a more confident woman, this would not have happened. This idea is also reflected by women who have stayed and been successful. Lisa, for example, presents as precisely this type of woman and she directly links her confidence, and that of other females, to being successful:

> I mean when you come right down to it, you know, if you could go from nothing to earning enough money half way through, you know, to retire to do whatever you want, the fact is anybody can do what I did and what many senior female managers have chosen to do. It's just a matter of deciding to do it. Having the confidence and get off your butt and do it *[laughs*].

Most of the women described professional confidence as something that had developed. Kelly, in describing standing up to her employer stated, "did I have this confidence 5 years ago? Nooo. I didn't. You kind of get it *[laughs]* as you go along. If you're born with it you're really fortunate. If you're not, then you're not. I certainly wasn't." Closely linked to confidence was willingness to present in an assertive, even aggressive, manner. Michelle, Lisa and Julie all proudly told stories of telling employers why to hire them. Lisa, for example, described an employment experience early in her career:

> I wanted to work on [details on area]. So I did that and then I moved over to [international branch of organization]. I had an interest in travel and doing different things and I'd gone and talked to the fellow who headed that up, [name], he was the president, and they called me up and, after a while, first of all he told me what he had for me and I said I wasn't interested. So then he called me up and he wanted me to do really what was mainly an administrative role. And I said, "Listen", I said, "I'll tell you what I'll do. This is what I'm interested in doing for you. I can mechanize everything you asked me to do and get your clerk to do it." So I did. And I got the job and I worked there for a bit.

Michelle told a similar story of graduating at an economically difficult time, but not being dissuaded by the lack of job postings. Rather she used the Yellow Pages to find companies in her field and went to their offices: "And the first one I applied to hired me."

Unlike other traits that predominated in the field, which were accepted as positive by participants, a substantial number of women described disliking the assertive and aggressive approach of others in the field. These women were also much more likely to question the profession. Jennifer, who had started to question her abilities, reflected having had to learn to be assertive. She stated, "…I'm very humble. In fact, to the extreme at times, I think, I'm not confident … sometimes if I feel passionately about some subject, and I'm assertive — try to be assertive — and I'm assertive in a way — like, I've been at Toastmaster's; I know how to be assertive, I know the rules". But being assertive was clearly not something that comes naturally for Jennifer, it was a role, a performance that she put on. This sense of confidence as an act was also reflected by Amy who described one of the aspects of her engineering work that she most disliked as the need to present confidently:

> Having to speak authoritatively on the phone [*laughs*]. Like just, I felt like an imposter right, so really it took every ounce of energy to be professional in that way and to speak like I knew what I was talking about to people – and to men, middle-aged men talking down to me and you know and trying to combat that. Like the public speaking aspect of speaking in a meeting of 15 middle-aged men, judging you.

That assertiveness was not only an engineering trait, but also a masculine trait, came through in the reflections of the women.[69] Even women who came across as assertive questioned whether as a woman she has been assertive *enough*:

> … men they go, they're sort of, you know, you go into the workforce, they're expected to have a job and if it's not working they figure out how to get it to work. And sometimes I think with women, and even with myself, it's like "am I trying hard enough?" I mean am I really looking for what are the alternatives, am I willing to go forward and negotiate … have I negotiated enough? Have I been willing to go forward to a superior and say, you know, how do I do that? (Laura)

Thus as a stereotypically masculine trait, assertiveness was a trait that the women were less sure of their ability to fully enact. When I asked Lisa what she did not enjoy about engineering she stated: "…similar to many female middle-managers, we're okay at politics, but we're not cutthroat. I certainly know some people who've gone on to be EVPs and Vice Presidents, but I'm very much of a collaborator. Really don't want to do knock-down drag-out fights." Across the board these women were confident and forthright in their opinions. They were

[69] The masculinization of a professional field created by aggressive interactional styles has also been seen in other professions. Pierce (1995) reflects this in her study of litigation attorneys, with the ideal litigator being focused on destroying enemies with little concern for the impacts on others lives.

proud of their education, of having completed a difficult degree, and of being intelligent. That even these women felt they were not assertive enough for the profession seems very telling.

In turn, when the women did try to act assertively, it created further challenges. When Jennifer, whose attempts to learn assertiveness are described above, did communicate in a confident manner she reported being told:

> "Calm down, calm down, don't be so aggressive." But I'm not. And my colleague is worse; he swears when he sells his ideas. How am I being aggressive in how I say things? Oh, because I'm a girl and I'm expected to be soft-spoken and nice and please everybody. So I can't have an authoritative voice. Ah! You know? It's *[pause]* frustrating. Suddenly I'm a bitch because I have an idea? ...

Women are thus confronted with what has been labeled a double-bind or double standard (Catalyst 2007; Demaiter and Adams 2009; Pierce 1995; Roth 2004). "Those conforming to traditional characteristics of femininity are often thought to lack the requisite assertiveness and initiative, yet those conforming to a masculine model of success may be ostracized at work settings as bitchy, aggressive and uncooperative" (Rhode 1988 cited in Pierce 1995: 115).[70]To be successful women need to fit the engineering habitus – an assertive masculine habitus. But in doing so they cross the lines of accepted behavior for a woman. If they do not embody what they are supposed to bring to the profession – a softer, caring approach – they are further marginalized. Erin, in a very insightful critique of gender within the profession, clearly articulated this point:

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[70] Catalyst (2007) identified that women leaders face three double-bind dilemmas: 1) extreme perceptions as too soft or too tough; 2) higher competence standards and lower rewards; and 3) perception as competent or likable, but rarely both (p.7).

> … women are always negotiating their, their organizational self versus their personal self as well. And um, to be seen as effective you need to be seen as more masculine which may not necessarily mean being true to yourself. I don't think men have that same disjuncture of personal and private selves. And for a lot of women I think it's a lose, lose situation. If you act more like a man you're accused of being a bitch and aggressive, right, which are seen as being attributes in a male, right? So had I been a man it wouldn't have been so complicated trying to negotiate these multiple selves, it wouldn't have been so complicated trying to determine who I should be, right, how I should present myself.

Gender is a performance that is consciously undertaken – and one for which there is no accepted script of how to be or how to act as a woman within the engineering profession.

As an outsider because of one's gender, being accepted and respected was a struggle that the majority of the women I spoke with faced. Laura described the experiences of female friends attending meetings as the only woman: "[it] can be very daunting, it can be very overwhelming. You know, how do I, am I gonna be respected? Listened to? Are my, is what I'm going to say, is it going to be valued?" These issues of being respected and valued were discussed by many of the women, with almost three-quarters directly noting that they felt they needed to prove themselves within the engineering profession.[71]

Among the non-committed women, having to prove oneself was articulated in a number of different ways, such as defending oneself, the sense women had to be better than men, proving one's commitment, and developing a "thick skin". Karen, who had been quite successful in academia, related having to defend the accolades she received as more than "given" to her because of her

[71] The sense of needing to prove oneself has also been reported in other masculine fields (Davey 2008; Metcalfe and Linstead 2003; Poggio 2000; Roth 2004).

gender. Having one's accomplishments dismissed based on their gender, she believed, lead women to overcompensate: "What you find, actually, is that in undergrad, when you start out with numbers of men and women, more of the women end up completing and getting their degrees in the end, because they're working so much harder than the men because of those, I think, resonating underlying vibes."

Proving that one was better than a male, particularly in areas where men were expected to excel (the technical and strength), were related as proud moments. Laura used a particularly interesting rhetorical tool in telling of these moments – she presented herself as "a little person" who was able to contradict the expectations of employers. In describing an early position working in the field in the forestry industry she describes having "surprised" her boss by being able to handle the physical challenge of working in the bush: "he was like, 'I had a guy who was'– I don't know how big this guy was – and he said, 'he didn't last a week and I have this – when you arrived in my office I'd never and I think, uh-oh, here's this little person' and yet I was like 'let's do that again, that was fun.' So it just kind of I think my attitude style is just kind of to take that in." Having physical stamina and keeping up with, even exceeding, the men, was critical to proving her worth for Laura. A number of women also related having denied the impact of children in an attempt to prove their engineering identity. Danielle and Michelle, for example, both report taking shortened maternity leaves to show their commitment to their employers.

The need to prove oneself, whether physically in the bush or emotionally in the boardroom, was frequently presented as "toughness". In the engineering field, being confident becomes synonymous for some with having a "thick skin" and being able to take other's abuse.[72] Melissa describes this in relation to her engineering husband:

> … My husband does really well [*laughs*]. He can be very tactful, and take abuse. Like you just have to – there's one, there's his one boss is just a hard ass … he's a pretty abrasive man and tells you that you're crap and you're – you don't know what you're doing, and then at the end of the project is like "you guys, you're the best group I ever worked with and it was because I was a hardass". And [husband] would just come home and laugh, "can you believe he said this today" or whatever, and so he's really thick – he'd get offended every once in a while, but sometimes he'd just laugh and he really took to this guy and got a lot of knowledge from him, but frankly if that was me in that situation I'd be home bawling [*laughs*]. You know, like I'd be just crushed, you have to have that – well maybe with any profession you have to have a thick skin, but, yeah, you have to be confident and true to yourself [*laughs*] and have a thick skin [*laughs*].

While Melissa is clearly aware of the inappropriate approach of her husband's supervisor, she admires her husband for being able to take this type of treatment, a treatment she would not have been able to handle. Both Heather and Amy, who had left engineering, identified that knowing that they would continually have to prove themselves was part of what led them and, in their opinions, other women out of the profession:

> I always had the feeling I'd have to fight to get wherever I went in engineering … and that didn't appeal to me — that you'd really have to fight to earn the respect of your colleagues to prove that you can do it. There are other things I'd rather fight for than that. … (Heather)

Family / Work-life Balance

The gendered family expectations that women face are a consistent theme throughout the literature examining the experiences of women in SET. The

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[72] Roth (2004:206) also found that the women in her study of Wall Street investors described the need to develop a "thick skin".

National Science Foundation's Committee on Science, Engineering and Public Policy (COSEPUP 2006), for example, reported that "[m]otherhood has been identified as the factor most likely to preclude a woman with science and engineering training from pursuing or advancing in an academic career" (p.176-177; See also McIlwee and Robinson 1992; Rosser 2004). Ranson's (2005b) research further reflects the impacts of family on women engineers careers identifying that "women enter engineering not as women, but conceptually as men – a status that, as mothers, they may find difficult to maintain" (p.145). This was further reflected by Demaiter and Adams (2009) in the information technology field where "respondents were unanimous in believing that having children affected women's ability to do their jobs the same as men" (p.45). This statement, they note, is particularly interesting as participants in their study had commented that gender was irrelevant to their careers.

The women I interviewed also entered engineering as "conceptual" men. For men, as reflected in the previous chapter, spouses and children tended to have limited career impacts. Among the committed men, families had little impact or were "encumbrances" that limited their geographic mobility. For the non-committed men two positions were salient: a "me first" orientation among the men without children, reflected in a prioritization of personal satisfaction over career, and a transitional position among the men with children. For the men characterized as "transitional", family had a major and important impact on their careers, not only in terms of providing, but also on their choices for advancement and the extent of their involvement in work. Yet, as I have argued, their actual involvement in providing care was far from a "radical" shift, thus this parental involvement seemed in many cases to be more a shift in rhetoric than actions. But for the women in my study, the impacts of both being partnered and having children on their engineering careers were much more direct and dramatic.

Similar to the men, the majority of the 18 women (83%) were married or living with a partner. In line with past research (Blaser n.d.; Sonnert and Holton 1995; Xie and Shauman 2003) on the marriage patterns of women with PhDs in sciences, the women I interviewed were also very likely to be married or partnered with another engineer. Of the 15, the partners of 10 (or 67%), were also engineers.

One of the main impacts of marriage for women was where they lived. For some the choice to relocate to follow or be with their spouse was described evenhandedly as based on their priorities to parent with or live with their spouse. For others, however, relocating was described negatively. Both Jennifer and Kelly spoke of giving up the best job she had held, her "perfect job", in order to relocate closer to her spouse. Danielle described following her husband on many moves, as his engineering career progressed up the corporate ladder and her career was stunted. A few women also described their chances for promotion diminishing because they were not willing to move. Jennifer, in describing a conversation with her mentor, reported:

> … he told me that to move up in the company, you have to move around. I said, '[Name], your wife stayed at home and raised your kids, and you *could* move around. I can't; my husband's a professional. I can't move around. He makes more money than me, therefore, he makes the decision. I'm not moving for you guys to go and be a [role] in Winnipeg just so I can be a CEO, and you're not going to find anyone who will.' But they do; they find people who will, and that frustrates me.

As Jennifer's concluding words reflect, there is an underlying sense that there are others – people more like the male mentor - who can move and who have spouses whose careers are supplemental to their own and can take care of their children. Similar to Jennifer, Erin described how early in her career:

> … I thought, yeah I could be Vice President, I could be whatever, I could do this … I thought, you know, they want me to move to Prince George for a year or two years, my husband's never going to move to Prince George. If I move to Prince George, cause they tell me I'm going to be [position title] at the next step effectively what I'm doing is it's the kiss of death for my marriage, right. So it was specific career choices, or career choices not taken, um, so I guess it was time, it was maturity, it was acknowledgement that you know, what am I trading off here and are those trade-offs that I'm willing to make? And um, and I made some pretty explicit decisions that um, I'm not going to be promoted.

For Erin, marriage and promotion were experienced as two competing and incompatible desires. It is also important to point out that she did not reflect on her choice negatively or with regret.

Of much greater impact for the women I spoke with, as Ranson (2005b) describes, is the impact – and anticipated impact – of children. Of the 18 women, 11 had children, four were planning to in the next few years, two were unsure whether they would have children, and one was childless. Having children created demands on time and energy that many of the men also faced, but for these women also reinforced particular gendered norms and expectations. A number of the women, for example, directly identified that they believed their careers would have been "radically different" had they been male – a father – rather than a mother. Melissa went so far as to argue that this would hold true for any female engineer with children:

> I think you probably would have been eventually paid less because you're doing less if you can't be there all the time and you can't go working overnight for four days on no notice, you know, that's going to impact how you progress through the company and that's just a factor of having kids. One of the parents is going to have to make that choice. It's generally the woman just because [*pause*] physiology, you know, you're the one to nurse them and you're the one that whatever. And by the time you're - the time you're done all that child care, the basic child care that you have to do as a parent, you can't just get a babysitter to do or nanny to do, um, you're, even if you started at the same level as your husband, there's, they've exceeded you and then it becomes a financial decision whether the family, whose going to be doing what. … if I were to go back into engineering, there's no way I'd make half of what he does *[laughs]*, so you know…

What is particularly interesting about these words is the non-traditional division of labor in Melissa's household. After spending three years at home with her two children she was currently training for a new career and her husband, also an engineer, was staying at home with their children. Despite the traditional notions of father as primary breadwinner and mother as primary caregiver she speaks of, Melissa and her spouse were enacting something very different and accepting a severe financial cut-back (neither were employed) in order to fulfill their desires.

Childcare was discussed by all of the women with children and, for most, had critical impacts on their careers. For the majority of the women it involved a combination of caregivers: themselves, their spouse, grandparents, nannies, and daycare. For a number of the women their high household income – or husband's high income – had afforded the opportunity to either rely on nannies or stay home. Of the women only one, an individual who was married to a non-professional, described needing to work for financial reasons. Of surprise, and without precedent in the literature, three of the women's husbands were the primary caregivers: one woman's spouse was currently at home with their children while she studied; another two had husbands who worked reduced hours, while they worked full time. All three of these husbands were also engineers. [73]

The four women I have categorized as committed engineers all had children, with two having young children (under age 5). One worked reduced hours (under 15 per week); the others worked full-time. A strong theme for these women was the positive response of their employer to their need for balance. Kim had worked with her current organization for over 15 years, in large part because it was so supportive and allowed for flexible and part-time work arrangements. Part of what enabled Kim's experience was having a female superior who also has children (although the superior had taken a more "career" oriented path).

> ... And it's very accepted here. My boss, for example, is taking today off, her kids are off today ... she's working from home. ... she had a problem with her nanny and she had to let her go and so her boss, who's the site leader, said "why don't you just work short days and do the balance of the time from home until you've resolved this". So you know it's really a systemic, organizational culture thing.

Patricia also described the organization she worked with when her son was younger as very good at promoting work-life balance, particularly in contrast to the large bureaucratic company where she was currently employed:

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[73] These men reflect the "caring" position that Halrynjo (2009) identified, indicating that a broader range of approaches to balancing work and family do exist among male engineers than the men that I spoke directly with reported. While the frequency of this type of non-traditional arrangement is difficult to hypothesize, that three of the women reported them – and that the arrangements involved husbands who were also engineers – indicates that change is occurring in expectations of gendered parenting involvement in engineering.

> … they're [past organization] a very close-knit family. Because they didn't have any policies that said *work-life balance*, but they were very good at it. … my boss always said to me, "Your family life is the most important thing…" Nobody's ever said that to me at [company B]. We have policies and all of that, but it's not the close-knit family that the other company was, and we have a lot more turnover, too, so it's hard to build that bond with people coming and going all the time.

For both Kim and Patricia there was a sense that luck led them to organizations that were good at allowing balance and a recognition that this was not the norm. In comparing their reflections, it is interesting to note that one found strong support of work-family balance and caregiving from a large organization with extensive policies, while the other found it in a small company with no policies. Recognizing that these are only two cases, this does suggest that whether an organization will be supportive of work-life balance is not simply a matter of policies existing, but also the culture of the organization, a topic to be returned to in the Conclusion.

The other two committed women, Michelle and Julie, explained the challenges they had faced balancing work and children in highly individualized terms. Michelle stated that, despite her organization's willingness to try to accommodate her, it was not possible to do the senior level work she had been doing on a part-time basis: "they were very nice about it. But none of us understood how it should work". She left the organization, discouraged by not being able to continue at the same level and concluded: "I think they were exasperated with me not realizing right away I couldn't do the same kind of work, and that if I was going to work more casual hours, I was going to have to do different kinds of things." Balance, for Michelle, was not something that the company could have enabled. It was impossible. And the only one to blame for things not working out was herself – she should have realized this. This individual responsibility was also reflected by Julie, who had needed to balance having children with a position that required large amounts of travel: "So I ended up just finding different support systems instead of changing my worklife, I changed my – I architected a solution to support my worklife." It was Julie who created the solution – her workplace played no role in finding a middle ground. With the support of her family, spouse and childcare, she was able to "have it all".

In comparison, the women who were not committed to the profession were much more critical of organizational approaches to work-life balance. Among those planning to have children, Jennifer, who was working in engineering, related concerns about the perceived impacts of having a child: "I think I'd be passed up for opportunities." She continued later:

> I don't want to leave [company E] if I'm going to have a baby, because I don't want to start another job, then go have a baby right away, because of how I feel it would look. Whereas at [company E], I feel I've at least established my reputation here; if I go have a baby, then I don't think I'd come back after I left because I just don't think it would be something I could cope with because of how I think I would be treated…

Her concern about how she would be treated on returning from a maternity leave was validated by the experiences of a number of the other non-committed women who had already had children. Danielle and Karen reported dealing with negative reactions from their employers and colleagues during their pregnancies. Erin and Kelly both described very hostile reactions from their employers when they returned from maternity leave, which led them to question their organizations and profession. Erin states,

> Um, when I came back from my maternity leave with [*name*] I was sent to [*city*] for 9 months, so it was the penalty box. When I came back to work

> after [*name*] effectively it was constructive dismissal. They put me on nights, um, doing uh, basically shift work in the [*name*]. ... I was punished both times. So at that point in time, you know, I'm punished. And I can choose to whatever, work through it, or I could say, you know what, if this is the kind of organization that this is then I don't need to work here, right?

Kelly reported a similar experience of being punished when she came back after her first child. When she returned requests for reduced hours were met with threats of job loss. Karen kept her position, but faced a greatly increased workload and requirements to travel. In both cases that they were "being punished," as Erin observes, seems a very apt description. Having a child was read as an indication that they had other priorities so their work commitment came under question. Erin later left the organization and had, at the time we spoke, left engineering. Kelly was on a second maternity leave and seriously questioning whether she would return to the organization or any engineering position.

Success

In describing men's reflections on success, particularly success in the engineering field, I argued in Chapter Eight that the elements that each individual emphasized reflected both their commitment to the profession and, in turn, the form of masculinity they enacted. For the women, in contrast, the themes that arose in discussing success did not align with professional commitment. In this section I will elaborate on their perceptions of success in the engineering field and differentiate what participants perceived would be seen by organizations as defining a successful engineer from what they personally defined as a successful engineer. In this I will discuss a number of different themes: financial rewards, prestige, technical achievements, leadership and communication, love of one's work, personal satisfaction, balanced lifestyle, being valued and respected, and making a difference. The last – making a difference – will be emphasized, particularly as it reflects a particularly gendered notion of success. I will then move on to discuss how the women defined personal success.[74]

A Successful Engineer

In line with the norms of the long hours culture described in Chapter Three, the women believed that to be successful (from an organizational standpoint) required *extensive hours of work and a devotion to the organization*.[75] Success was based on efficiency and cost-effectiveness in producing engineering outcomes. For those who are able to reach the goals of the profession, rewards come in the form of *wages, promotions, and prestige*. According to Amy, however, the engineers who did meet the desired expectations of the profession are unable to enjoy the rewards of their commitment:

> … we're told what success is through the media is having a lot of money and a lot of things, which are great if you have time to enjoy them but I feel that a lot of people in those traditional engineering roles probably don't have a whole lot of time, they're working long hours to make that kind of money. But they thrive on that. It seems like a lot of them do, that is what their life is, to work.

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[74] Although the order of discussion here is reversed from the chapter relating the men's experiences, the questions were asked in the same order for both men and women as can be seen in Appendix C. Details on the wording of the questions is included in Chapter Eight.

[75] This long hours culture and an expectation of a singular focus to the organization can also be seen in a range of occupations and professions (Bacik and Drew 2006).

Being a “real” engineer, as a number of the committed men described themselves, involved a love of nothing more than their work. None of the women expressed this love and devotion to their profession. The distinction between these norms and the individual’s perception of success was reflected by Patricia who in response to a probe about whether her ideals of good engineering matched what is required for promotion stated:

> Well, that’s different, completely of course! *[laughs]* There, they look at numbers and revenue. To some degree, in some positions, the engineering positions, they definitely do look to things like your ability to successfully complete projects on time and within budget… And of course, the whole corporate networking thing is really important as well, it seems, and being able to self-promote.

In contrast to the uniform image of dedication and efficiency the women believed was desired by the profession, what or who they saw as a successful engineer was presented in a range of different terms. The most common image of success as an engineer was one that encompassed both the technical and the interpersonal aspects of the profession. In Julie’s words, “[t]here could be successful engineers that have built the most amazing technical feat in the world – and I’d still give them high points, I wouldn’t say that they’re failures because they don’t have people skills, but I would say that they are a great success if they are able to do both which is not that common [*laughs*].” In very interesting reflexive moments two of the participants independently identified that success is relative to the individual:

> I think that they’d describe it in a way that they’re strong; so if they’re strong technically, they’d say it’s somebody who knows everything about everything. If it’s somebody who is more management, they’d say they can do the technical stuff as well, as well as the management stuff. That’s what I think *[laughs]*. (Angela)

Similarly Laura emphasized that one's success is personal – it is based on the goals the individual has set for themselves and whether they have met these goals. As these words reflect, participants' representations of success indicate more than just how much one has achieved. They are also closely tied to the goals one has set and their experiences; they are tied to whether one can find something in the profession that they desire to be, that fits their personality or habitus. A significant number of the women, both committed and non-committed, included in their descriptions of a successful engineer that the person was happy, personally satisfied or loved what they were doing. Also identified by two of the women as indicating success was being valued and respected by your colleagues.

The dominant cultural norms of success, in Bourdian terms, are economic and cultural capital, or wealth and recognition. While *money and prestige* were discussed by women, they were typically referred to as elements that the profession broadly ensured: engineering was seen to allow one a certain degree of prestige quickly (you are a professional after only four years) and a comfortable wage (although not as good as other professions). While being wealthy and having prestige were certainly the goals of some engineers, the women were (like the men) more likely to emphasize being happy and enjoying their careers:

> I'm a little bit cynical about the whole process, yeah, but I think that's because — part of me, I look at those positions, and I think, "That just doesn't look like fun. How could that be the best job in the company when it's just stress? Yeah, it's more money, but that's not a lot of fun." You know, you have this image in your head that the CEO's job is the job that everybody wants because that's so cool, but I look at what he does, and I'm, like, "That's boring." (Patricia)

The exceptions were two of the younger women, Tracy and Emma, neither of whom were committed to the profession, but both remained working in it. For both of these young women money was an element of success and who they perceived as successful. For Tracy money, alongside recognition for her work, were seen as what would indicate success:

> I think successful would be, like obviously, well maybe not obviously, but to me, like money is success – like not only money defines success, but I also think to be like well known in your industry as being someone good, you know, like if I work at [*organization*] and if one of our clients specifically said like "I want [*participant*] to work on our jobs" like to me that would be that I was a success. And also to be well-liked by the people that you work with in your company, you know, like your colleagues and stuff. Well-liked and well-respected. Those are kind of the main things.

For Emma wealth was also a key indicator of success, as is reflected in her comments on a past superior who "was definitely a successful engineer. Designing [*type of*] software, sold it and made huge money off the royalties, he's also just a very shrewd businessman as well, but he definitely took the engineering and did very well with it." She continues a moment later to elaborate, "[r]ecognition and prestige I think are almost more important than the dollar value."

For a number of the women, being able to come up with *creative solutions and apply one's training* were deemed necessary for success as an engineer. Laura, who was no longer in the profession nor identified with it, stated: "… they have to really enjoy what they're doing. The other part is, you know, I guess a significant technical background to a certain extent." In Kelly's words:

> Successful engineer …. I guess someone that can do their, perform their chosen - in their chosen discipline, whether it be civil, mechanical, electrical, whether they can do what it is they've been trained to do and

> they can do it well. Someone that can explain to others what they're doing. Why they're doing it. And teach other people, I guess.

As these comments reflect, whenever technical competence and skills were identified it was as one of a range of requirements for success. Technical expertise alone was not sufficient, although for many it was necessary. What made a person successful was their ability to both be an engineer and be more than that – whether that was in terms of the ability to communicate engineering ideas or be a well-rounded member of society.

A multi-faceted definition of success that included both technical and communication skills was the most common given by the women. Angela, for example, defined a successful engineer:

> … as someone who knows their technical knowledge and can communicate it pretty much to anybody; like, if you talk to your mom, you can explain to your mom; if you talk to somebody who knows more than you, you can talk their language. So it's somebody who can communicate well, and they know what they're talking about, as well as they really love what they do *[laughs]*! 'Cause that comes across when you talk about it.

An interesting theme in the way the women discussed communicating was that many stressed being able to explain, teach, and simplify technical ideas, rather than centering on being able to sell one's work or organization. The importance of communication for selling or, in one participant's words "translating the product to a business value", was only mentioned by two of the women. This emphasis on communication to explain, rather than sell ideas, stands in contrast to the men. Related to this, the women did not stress the need for interpersonal skills in order to be successful to nearly the same extent as did the male participants. "Personability" and "very tactful" were each used by one woman to describe an engineer that she admired, but these were much more exceptions than the rule. Rather, the women described an ideal engineer who was more relational and open – an engineer very different from the dominant model of engineer described by either the technicist or heterogeneous men. This difference is clear in the words of Karen, a non-committed engineer who continued working in the field:

> So I'd say a successful engineer, somebody who, in my opinion, is *[pause]* open, open to possibilities, is a good listener, wants to tackle problems, but in a manner that's inclusive... I think a really successful engineer would be a person who has that ability to step back and to truly hear what all the different areas are saying, and to bring it into a meaningful solution. I think to be a successful engineer, too, is exactly that: to get people together and to attempt a common understanding or solution. I think that's what I would define as a successful engineer.

Perhaps the most interesting theme in examining the women's descriptions of a successful engineer was the repeated emphasis on *making a difference* as key to being a successful engineer. Half of the women interviewed identified that to be a successful engineer one needs to contribute to and/or help to improve society. For the women committed to engineering this contribution was to the profession or professional knowledge and expertise in an area. To Patricia, a successful engineer was

> ...obviously somebody who's doing work that they like, that is *[pause]* I don't know if *groundbreaking* is the right word, but that is adding to knowledge for our society, and is able to communicate that back so that others can take advantage of that as well... I don't think it has much to do with money or title or power, but again, I think a successful engineer is one who has done work that's somehow contributed to our knowledge in a particular area.

Julie defined engineering success in a similar vein, drawing on the application of one's technical skills in order to better the world:

> …technical confidence, being able to give back to the community and when you're actually applying your technical skills to think big picture. Not just to drill down to "I'm delivering this component" but I'm doing this to provide greater benefit. And that's what the engineering ring is all about too.

The importance of making a difference as an engineer was particularly important to the women who were not committed and no longer working in the profession. Veronica identified people involved in using engineering in international development work (such as Engineers without Borders and the Light up the World Foundation) as successful engineers. This emphasis on giving back became even more central to the women's responses to the follow-up question: what do you consider personal success?

Personal success

A range of different criteria were identified as indicating personal success: financial success, leadership, enjoyment of career, family, "having it all", and making a difference. Financial rewards and leadership, despite being the forms of rewards that most immediately come to mind as indicating success, were the least frequently discussed. Of the 18 women, only one identified wanting to be in a leadership or decision-making position – and the type of leadership role desired was one that would enable her to make a difference. While a number of women indicated that being able to earn a good salary and "be comfortable" was important, only one stressed that money was critical to her personal definition of success. And even for this woman, the role of wealth had changed:

> *Lisa:* [*pause*] I would have given you a different answer when I was much younger, but now it's finding out what makes me happy and doing it. To me successful means happy. I would never be happy if I was poor. But I really want to focus on what feeds me and start doing it.

> *Interviewer*: And so how would that have been different when you younger?
>
> *Lisa*: I was very oriented when I was younger about – I came from a poorer family … So for me financial security was very, very important. I had no interest at all in anything that didn't provide a very comfortable living.

This new focus, on "what feeds" her, on gaining personal satisfaction and growth, reflects the idea of personal success described by the other women in the project.

For nearly half of the women I spoke to, a critical element of personal success was having a career that they enjoyed and from which they gained satisfaction. In Emma's words, "success would be, I mean to be happy with your job, I mean to enjoy what you're doing. It wouldn't be all the time because realistically you're never going to enjoy your work all the time, but I mean to enjoy it more often than not would be good." For the women still committed to the profession, doing work that they enjoyed and having colleagues that respected and valued them were identified as important elements of personal success. The desire for enjoyment was also clear among the non-committed women, with the difference being whether one could find this satisfaction within the engineering profession. For Danielle, who had returned to the profession after a long period searching for a position she enjoyed, this desire was very clear: "I would love, my goal has always been to have a job I want to go to." At age 45 she had not fulfilled this goal. Among the women who had left the profession, such as Melissa and Veronica, the search for a career that made them happy was being fulfilled in other fields.

Personal success for the majority of the women also included family, with the extent to which this was emphasized being greater for the women who were no longer in the profession. Among the committed engineers both Michelle and Kim, who had younger children, stressed the importance of family. For Kim family were part of "a total package" that indicated success. For Michelle, the emphasis on family was something that reflected a shift for her. As discussed earlier, prior to having children Michelle had been moving up the corporate ladder and working very long hours. With children she "got a new focus in my life". Now she defines personal success as:

> To be content in yourself with your life and the people around you. I think it's um, to me, I mean, my husband and I have gotten great joy from raising our children, from having a good relationship with each other, from making a pleasant home environment for ourselves, for having nice friends in the community, for being involved in the community; I mean, those things all go into what we consider successful. It's made us content and happy…

Enjoying one's work and being respected by colleagues, she continues, are important but have become secondary. Among the non-committed women, particularly those not working in engineering, family was an important element of personal success. For Melissa and Laura, who both had young children, being able to find work that enabled them a schedule where they could be actively involved in their children's lives indicated success. For Heather, Veronica and Amy, their visions of a successful future all included having children.

Tied to these dual notions of personal success as an enjoyable career and a good family, a number of the women identified the desire for balance or, particularly among the younger women, "to have it all". This balance was reflected by Kim: "I like to be respected by my peers, I like to have a happy home life and happy kids, and balance. I feel like I have balance in my life." Among the younger women the range of elements that the individual wanted in her life was considerably greater than what was reported by the older women. Heather, for example, identified a desire to have children, spend more time in the outdoors pursuing hobbies, becoming involved in advocacy groups, and develop her career. The goal, in Amy's words, is "being able to do it all. And have it all, you know what I mean? Travel and have time with family, you know, have a balanced life that would be success…". Whether this difference in what constitutes balance is generational or a factor of life stage is difficult to assess as none of these younger women have yet faced the realities of "having it all". Thus the extent to which they will be able to meet their desired goals, or these goals are redefined as they try to balance work and children, remains an important question in understanding potential shifts in the profession.

Of all the themes identified as personal success the most prevalent (directly discussed by 12 of the 18 women) was a desire to make a difference, either in the engineering profession or in society more generally. Julie and Patricia, both of whom were committed to the profession, described a desire to make a difference *through* engineering. For Julie this was changing the profession; for Patricia it involved using her training to address environmental issues. For the non-committed engineers, making a difference more directly reflected an interest in people and social issues. When I spoke with Angela about her future plans, for example, she reported being somewhat torn between two paths – one where she remained at her current technical position, which allowed her to work on environmental issues, and another in which she would move into the volunteer sector and focus on people "and making people feel better." Lisa, who had started her career with financial success as a primary goal, was in the process of transitioning out of engineering into a role that focused on helping young people.

> … I had specific goals, timelines, etc., and engineering did that for me. I met them all. But at some point you look around and you go “okay” and if money isn’t the issue any more you’ve got to go “okay, well you always said you were going to do this until you had enough money that you could do anything that you want to” and then, I think like everybody in their mid-life you look around, “okay is this how I want to contribute to the world”. And you look around and think, “of all the things that I could do is this it?” And it’s not. So I’m going to choose to do something else.

Later in our conversation she returns to this theme:

> …now I look at it and go, “would I like to make the world a better place for abused children and breaking the cycle of abuse? Or would I like to spend those extra three hours polishing up a powerpoint presentation for the third revision?” You know?

For Lisa engineering had allowed her the financial backing to pursue her interest in helping people. A desire to help – and to connect with people – was particularly salient among the women who were no longer working in the profession, five of whom stressed a desire to make a difference and saw this as something that could best be undertaken outside of the engineering profession. Heather, Veronica, and Amy, had all left engineering for healthcare fields in order to make a difference. Here they had the “one-on-one”, the “smiling faces” they longed for. Making change through engineering was not direct or immediate enough to fulfill their “needs”.

Retention

As outlined in Chapter Eight, when discussing the men’s views on retention it is critical to clarify what one is being retained by: a work organization or the engineering profession. In this section I will first discuss concerns about organizational retention and then focus on professional retention. Overall, the women were more concerned with retention, particularly to the profession, than were the males interviewed. A number also suggested that retention issues were gendered.

Retention by organizations

In comparison to the men, 28% of whom had reported high levels of commitment to their organization, only one of the 18 women (Kim) was similarly committed to her employer, for whom she had worked for 16 years. She indicated that she preferred a "steady" industry and a company that treated its employees well, even if her salary would have been higher in other fields (namely the oil and gas industry). And while she enjoyed the technical work, she stated: "I think one of the reasons why I haven't changed companies or jobs or career paths is that I get a lot of non-technical with it." This organization also demonstrated respect for employees in simple ways that seemed to generate a great deal of admiration and loyalty. Kim, while showing me her company ID card, described:

> This is actually, this is one of the reasons why I love [*organization*], they gave every employee ... a pass to go to Sears and get a family picture done and they paid for the sitting fee and a sheet of wallets and an 8x10. And they said bring in your family picture and we'll laminate it for you and you can put it with your card and it can remind you why you work safely.

In this simple action the organization achieved a number of goals: showing employees an interest in them beyond their work, developing employee commitment, and promoting greater safety in the workplace.

A range of factors were discussed as leading people to leave organizations, including the economy, corporate environments, and individual's contributions not being recognized. The economic climate at the time of the interviews, and the abundance of work opportunities available, were discussed by two of the women as creating issues for organizational retention. In comparison to the men, however, this was mentioned relatively infrequently. Critiques of the corporate environment centered on the need for a more positive workplace culture and the lack of supports for work life balance. For a number of women, a positive workplace culture was one that stressed an enjoyable, social atmosphere. Angela, for example, stated:

> As long as the company has a good reputation and they want to keep their employees happy, they'll retain them. The good companies to look at are ones like Intuit and Dell, companies like that where they look after their employees, they give them time off if they need it, they have exercise facilities within their buildings, and they really emphasize the social aspect and they really — they keep their people interested. It's all mind games, right *[laughs]*!

A very similar sentiment was reflected by Laura, who stated that the companies that retain employees, particularly younger ones, "have a more playful type atmosphere".

In terms of work-life balance policies, a range of positive options were discussed by participants including allowing flexible work arrangements, integrating social activities, providing child care, enforcing limits on work demands, and providing health and wellness programs. The organizations that participants most praised were those that integrated all of these elements. Amy, for example, described how at her organization people are encouraged not to work overtime, that the organization provides money "you can use to join a health club … there's an overall feeling that people want you to be active", flexible work hours are supported, women are given strong support throughout their pregnancy, and parental leaves are respected and supported. Notably Amy's employer was a public sector organization.

Unfortunately, overall the women's assessments of their employers' work-life policies were not complimentary. Three forms of organizational shortcomings in support for work-life balance were highlighted: a lack of policies, but general organizational "respect" for work-life balance; the existence of formal policies, but a lack of respect for them; and a lack of both policies and concern about work-life balance. The idea that an organization respected work-life balance, but did not have explicit policies, was clear in Tracy's reflections. On maternity leave at the time we spoke, she questioned what her organizations lack of formal policies might mean for her when she returned to work:

> *Tracy*: … so we'll just kind of take it bit by bit, but [*organization*] says they're fairly flexible with part time and stuff like that, so hopefully they are, I haven't really put them to the test yet.
>
> *Interviewer*: Do you know if they have formal flex work or part-time policies?
>
> *Tracy*: I don't think they really have policies I think it's kind of a case-by-case basis, like, so they basically told me "you decide what you want and run it by us. I mean you can't bring your baby to work, but other than that we can" – I think they can pretty much work anything out. Hopefully. So they say.

Although she expressed a degree of uncertainty Tracy's words and demeanor indicated a high degree of trust that the organization would be able to make things work the way that she hoped. The potential naiveté and downside to a belief that one's organization will have one's best interests in mind can be seen in the earlier discussion of Michelle's situation. While Tracy's organization is considerably larger and, potentially, has provided more flexible work arrangements previously, the lack of a concrete system in place suggests that she may face difficulties transitioning back from leave.

Perhaps most troubled were the individuals who worked for organizations that ostensibly had policies and programs in place but did not actually follow them, sometimes even penalizalizing those who used the services. As Jennifer observed:

> … it's weird, because you see these posters — and [company E]'s huge; it's a huge company — you see these posters obviously put out by the HR department or whatever, about all this really cool stuff, and these cool initiatives … Well, it's cool, but you don't hear it. It's a whole other little bubble, and nobody's really implementing it. It's like they're trying, but no one's hearing the message, because everything's so ingrained and the momentum's there. But one day, maybe it'll break as those people leave; 5 years.

A lack of respect for policy, including government regulation, was most apparent in Erin's and Kelly's accounts of being "punished" upon their return from maternity leave described above. Kelly, currently on leave with her second child, described feeling she had been directly misled:

> … part of the reason why I'm considering not going back is I do not like working for companies that lie to me. And companies that are deceptive. And going back after my first, I specifically requested part-time or job sharing, or something, and um, I was told, "if you come back you will be doing twice the amount of work and if you do not agree to do it you will be choosing not to be employed by us". So, and the work they wanted me to do would not allow me to keep my designation and I said "no, I will not do that." And they said, "well, then, what?" So that is when I ended up working doing the same position in Manitoba as well as Alberta, because it was the only way I could keep my job…

Kelly was not only denied the opportunity to work more flexible hours, but was penalized for having taken time away and "encouraged" not to return.

As already noted, in some work organizations there were no work-life balance policies and a reluctance to address the issue existed, perhaps due to organizational fear:

> … I've seen a lot of companies in the engineering space not want to open up the box and allow flexibility – so it's not that they couldn't, it's just that they're worried that it's really going to cause a huge impact through their business. However, if this is done with an agreement with their President and they plan for this, you know, so "what's the worst case and the best case" and prepared for the worst case and what would the worst case be? Going from 60 hours per week down to whatever it is – 50, 40 … And that's something they should be planning for anyways because the only way that there'll actually be profit … because they're causing everyone to continually work at that pace – that's not sustainable either. (Julie)

These very long hours and expectations of devotion from workers reflect Coser's (1974) concept of a "greedy institution." Adapted to "greedy organizations", this concept reflects how management discourses have intensified work and made greater demands on workers attitudes, behaviors and time (Burchielle et al 2008; Franzway 2000; Rasmussen 2004). Reduced work weeks, for example, were difficult to achieve because of bureaucratic and organizational rules that dictated a way of working – a way that assumed an unencumbered (male) worker. Karen reflected this in describing taking up an academic position:

> Now, they've been hassling me a lot at the university, like, "Why can't you start earlier? Why can't you start earlier?" and I said, "I don't have child care. But," I said, "this is what I'm willing to do: I'll start April 1 part-time, 2 days a week" — 'cause I can get my mom to look after my youngest — "and I can slowly get some stuff ready, and I'll start full-time in July." They're, like, "It is *impossible* to have an academic contract with part-time work. Never in the history has it ever been done, *ever*." They're, like, "We would have to put you as a sessional for that part-time work, and then you'd become an academic in July." I was, like, "This is crap. This is so much paperwork. This is ridiculous. It's not like I'm being 'Oh, it would be *nice* to work part-time' I don't have child care!

Without policies in place, the possibilities for individuals become very limited. Without policies in place, even when there is organizational support, solutions are left to the individual to negotiate and implement.

Retention in the profession

As I have noted, despite my initial assumptions, the belief that professional retention is an issue was certainly not held by all of the participants in this study. The women were very evenly split on whether or not it was seen to be a problem. Interestingly, there was no clear alignment between the commitment of a female participant and her views on whether retention was an issue. Women who felt that retention was not an issue included non-committed engineers like Angela who responded to my question about whether people leaving the profession should be of concern:

> That people are leaving? I'd say no, 'cause there's still a lot of people coming in, and people switch careers quite a bit, even within engineering. I'd say no; there's enough people coming in, those few who went through it and decided it wasn't their thing, that's fine.

For Angela staying was a matter of individual choice. The reasons that might lead one to discover that engineering was "not their thing" were not of concern. What would be more of an issue would be if people felt they had to stay because of financial needs. But as a number of the women pointed out, with dual income families and a booming economy this was not likely to be the case. This was a time when one could pursue the profession if they wanted to – or other opportunities if that was their choice. Another younger woman, Veronica, stated that those who enjoyed engineering would stay, but some had never really been interested so, not surprisingly, they wanted to leave. This was also reflected by

Karen who explained:

> I think a lot of people go into engineering because they're from farming backgrounds, and their parents say that it'd be a great degree to get, but any concept of really what's involved —. They get that 4-year degree, and then it's a launching pad for something else, 'cause it's a very practical thing to do.

Leaving the profession after completing a degree does not indicate a problem, but a "personal choice".

Among the women who believed that professional retention was an issue, was Karen, who I also classified as non-committed, who noted:

> If they're leaving after their university education, I think, whatever, 'cause that's usually a personal choice. If they're leaving because they've worked 2, 3, 4 years in the workforce, and saying, "I've had enough, because companies aren't paying attention to this, this, this, and this," then I think it's a problem.

A number of women further stated that retention is a particular concern as it relates to women. Amy, who generally felt that retention was not an issue because many people only ever took engineering because it seemed like a safe fall-back, observed that for women other factors may also be at play that did indicate a problem.

> I find it really hard as a woman to have that respect that men get right away, it seems. So the workplace is harder I think and maybe that's why some women don't stay... Because we're having babies, families. Is there a problem? Maybe with workplace, maybe with the way things are set up. ... I think in a lot of work places it's not and you lose your place and that's it. You go here and you're not coming back to the same thing or higher...

Retention, both in organizations and the profession, was further seen by female participants as gendered due to the "male" organizational culture in engineering firms that left women in the position of outsider. For example, Julie described retention as an issue because of:

> ...people who are leaving because of the conditions. And the conditions being, family-life balance, work-life balance and – so many issues are related to that actually. The number of hours that they work, the flexibility of the hours they work, the environment where they're working – where they're – whether it be demanding, but more so not inclusive.

An interesting, albeit problematic, element of retention came through in the experiences of three of the younger women who had all left engineering. They presented that they had been retained as long as they were largely *because* they were female. Veronica, who reported being aware from her first courses that she didn't belong in engineering, was encouraged to complete her studies by external reinforcement that came from being a girl in this prestigious male field:

> ...I think I always took some comfort in the fact that I was in engineering; it was always, like, "Wow! That's really good," and "God, you must be smart!" and "As a girl, you're doing really well," and so I think you take some comfort in that, and, "Okay, I'm on the right track."

Amy also described the positive reinforcement that came from being a woman in engineering as "one of the things that kept me going even when I hated it so much." She described people being impressed and saying "you must be really smart", yet discounted this: "Huh, squeaked in, 76% ... I bet you it's because I was a girl that they let me in, because it's pretty competitive to get in. I bet you they probably made an allowance there because I'm sure there were some people with 80%, 90% in high school applying for engineering ...". In pursuing a field of study that they were not personally interested in or engaged with these young women can be seen to express very traditionally feminine traits of desiring to please and impress.

The women who saw retention in the profession as a problem also proposed solutions. Several stressed the need for reforms in professional education, including more “hands on” opportunities, increased diversity and availability of work experiences, and an emphasis on how engineering is fun. Most common were solutions focused on organizational changes, particularly changes that related to parenting and flexibility. Kelly, who I quote above describing her sense of being punished when returning from parental leave, elaborated:

> I’m female obviously, I see what the issues are in retaining female engineers. Some companies are very good at the concept of the 21st Century family, the not wanting to work every single day, wanting to job share, wanting to be there when your kid goes to play soccer and everything. ... I know personally of a couple of women who graduated with me who bailed. They were more than capable engineers. They were brilliant. And they bailed. And they said, “I’m going to raise my kids”. So the industry as a whole and the profession as a whole lost some very brilliant people because, in a couple of cases, they weren’t willing to bend. ... I heard the other day that companies are starting to invent the “mummy-shift” from 9 until 2 during the day and they’re starting to fill positions that they weren’t able to fill ... so now companies are starting to realize they need to change - the workday doesn’t have to be 8 to 5.

Julie stated that flexibility is key to the retention of engineers, both male and female. Allowing greater flexibility, whether for family, taking courses, or enjoying hobbies, helps to avoid burnout and keeps engineers – particularly younger engineers – in the profession. Doing this, Julie argued, requires companies to become proactive in trying to understanding their employees’ needs.

Conclusion

In this chapter I have drawn upon the work of West and Zimmerman (1987) to explore the ways in which women enact gender and how being female is accepted, or not, in the engineering profession. Can women fit, or find a match, between their individual dispositions and the field? Or is a female habitus inherently at odds with the engineering field? Further, if there is a mismatch what are the outcomes: are the possibilities in the field unseen, does the woman come to question the field and see its dominant values, or does a space develop for new potentials?

The desired characteristics in the field, I have argued, reflect traditionally masculine norms. This is particularly true of the emphasis on confidence and assertiveness. That this attribute is not restricted to males can be seen in the comments of some women, such as Lisa, who present as very confident. In Lisa we see what comes close to a match – a presentation of self that is very much in line with the masculine norms of the profession. Yet even with this match, Lisa is concerned about not being assertive enough. This sense of lacking confidence and having to work to develop it resonated throughout the women's experiences. Some, like Danielle, reflected that if they were male but with their non-assertive personality, things would be even worse. For Danielle there were no possible paths available in the field. Others, like Melissa and Jennifer, recognized that to survive in engineering they would continually need to prove themselves and have a tough skin. The recognition of this mismatch led to clarity about the field, and a recognition that they did not fit.

While the majority of the women, like the men, were partnered and had (or planned to have) children, family roles had a much greater impact on the careers of these women than of men. As Ranson (2005b) explains, with the arrival of children in particular women can no longer be accepted as “honorary males.” With pregnancy, their sex (and in turn gender) become salient. Kim’s experience is, I believe, particularly important in reflecting the important role a work organization can play in creating a fit between the profession and individual. Having supportive policies in place, from flexible work scheduling to simple recognition of the importance of family, enabled a strong organizational commitment to be formed. Without these policies – even when organizations had the “best intentions” or aimed to be supportive – finding this alignment and ability to fulfill work and family commitments became much more difficult. Further the women’s critique of the long hours culture indicates that the gap between habitus and field has allowed them a different perspective on the negative implications of these requirements.

While the differences between men and women created by work-life demands in my study were clear, they were also expected, based on previous research on women in SET. More surprising was the difference in how men and women reflected on success. None of the women emphasized success as an engineer in terms that prioritized the technical. It was not the “love” of the technical and great designs that made one successful; a match with this traditional, technicist form of engineer was not present among the women. That said, the women did align with the heterogeneous ideal, asserting the importance of a multi-faceted approach to success. The women were also more likely to idealize traditionally feminine traits such as relationality and openness. They strongly emphasized being happy (as the men did) and that engineers should "make a difference" (as the rhetoric of the field reflected). These norms were also reflected in their descriptions of personal success, particularly the desire to make a difference and impact people's lives. But for the women, this difference was something that needed to be done outside of engineering. It was not about making more efficient tools or safer bridges, but about working one-on-one with people.

For women, the key to retention on an organizational level was the company's policies and work culture. Organizations where policies were strong and the culture supportive could retain engineers. But where policies did not exist, or where the culture did not support their implementation, retention became problematic. Indeed, as in Jennifer's and Kelly's experiences, an organization that spoke of being supportive but did not act upon it could undermine the image of the whole profession and show the norms and values that underlie the profession to be arbitrary. On the other hand, as Amy's experience reflects, a good environment is also not enough to sustain one. Without some intrinsic interest in the work, workplace policies and a positive social environment are not sufficient. Retention in the profession was again only seen as an issue by some of the participants. Much as the men related, and the discourse of the field supports, staying in engineering was seen as a personal choice. It was up to the individual to find what fit for them. Where the women did identify that retention in the profession was a problem was when it was gendered.

Chapter 10: Conclusion

This research project began with the goal of explaining the retention of women in the engineering profession. What was it that made women leave the profession in greater numbers than men? And, once those factors were identified, what could be done to address them? The dissertation that has emerged has moved away from these questions, which I have come to see as very simplistic. Rather than explaining staying versus leaving and men versus women, the story that developed was far more complex and nuanced. Using the theoretical work of Bourdieu to address these questions, I have explored the makeup of the engineering profession. I first examined the external factors that impact the profession and the goals and values that are prioritized in the field. I then turned to the dispositions, interests, and beliefs of engineers, examining their "engineering habitus". The fits and mismatches between the field and the habitus were explored and three key concepts repeatedly drawn upon: gender, commitment, and technical versus social interests. Using textual materials and interviews with 36 individuals with engineering credentials, I aimed to create an image of a profession at a very particular historical moment, but even with a narrow focus I have realized there are no clear answers to the questions that started this project.

Instead, I have found complexities. Yet, within the intersections of the gendered habitus, gendered field, engineering habitus and engineering field there are linking themes. In this conclusion, I will begin by briefly summarizing some of the key findings related to the first two research questions which focused on the engineering field and engineering habitus. I will then move into a discussion of the third, and most critical, research question which examined the match or mismatch between an individual's habitus and the engineering field. In discussing this I will detail the following re-occurring themes: the long hours culture and emphasis on having a strong work ethic; being a linear problem-solver and creativity; the dominance of technical skills and perceptions of women as relational; the desire to make a difference; the emphasis on leaders and teams; and the importance of organizational policies. Following a brief discussion of how this work adds to the literature, I will conclude by discussing the policy implications and future research questions that developed during the course of my research.

Responding to the Research Questions

The engineering field

My first research question was: what is the shape of the engineering field and how does it intersect with the broader social field of gender? Developing a profile of the engineering profession became the focus of Chapters Three and Four. I began by describing the limited autonomy of the profession, which is largely a product of the corporate structures in which engineering is undertaken. The limited autonomy of the engineering field is particularly apparent when one notes the strong impact of the economic climate on the profession. Moving to the critical elements that define the profession, the role of APEGGA as the profession's regulatory body was explored and a central tension faced by the field was introduced: the disjuncture between the "bottom-line" pressures of private industry and the ethical principles of a profession. The professional association reflects, through the "Rules of Conduct", a strong emphasis on integrity and upholding public safety, yet little support is provided by the Association to individuals in upholding these standards. Integrity is used as a selling point, but putting it into practice is up to individuals as they "personalize professionalism".

This tension between the financial and ethical, I argued, could also be seen in the values of the profession. On the one hand, engineering is dominated by private firms (either consulting or larger industrial firms) where the financial bottom-line and efficiency are key goals. On the other hand, ideals of innovation and making a difference resonate throughout the profession's textual materials, reflecting an ethical impetus. In profiling the field I also examined other dominant values, in particular the importance of efficiency and innovation in engineering work. The practices and culture of engineering were the focus of the last part of Chapter Three. Here I explored the high pressure and frequently hostile nature of the two predominant realms in which engineering work is undertaken: the "field" and the corporate office. The structure of engineering (both organizations and the career path) was further shown to be typically hierarchical and rigid, despite rhetoric of entrepreneurialism and independence.

Chapter Four revealed that the engineering field has limited diversity, both demographically and symbolically. Demographically women continue to make up only 11.2% of engineers in Alberta and the numbers in post secondary engineering programs are dropping. Engineering is, as John articulated, "a game being played by men". Because men play the game they create the culture. Symbolically, the dominance of a masculine norm is reflected in the harsh, negative, and confrontational culture of engineering and can be seen in the links between masculinity and rationality. Masculine norms are in turn reflected in the idealized images of the profession presented in textual materials: the explorer, the cowboy, the sports star. The masculine nature of the culture can also be seen in the conceptualization of diversity, be it racial or gender, as “good for business”. “Diversity” is pursued for the sake of profits (through better solutions) and maintaining an edge in a global economy, not as a way to challenge existent values and norms. For women, these masculine elements of the professional culture have real negative impacts including a lack of networks, dealing with male “teasing” styles of interaction, and discrimination and sexual harassment.

The engineering habitus

My second research question asked: what is the form of the engineering habitus and how is its enactment gendered? In Chapter Five I explored the extent to which one can see an engineering habitus through the beliefs of engineers that some people are naturally engineers. The ways in which participants described themselves, and other engineers, as naturally having engineering traits and as having interests and approaches (e.g., being hard working or interested in the mechanical processes) “programmed” into them, reflects the belief that normative engineering behaviors are truly internalized. For example, individuals who were highly committed to the profession framed being an engineer almost as a calling – it was something that they had wanted to do from childhood. In Chapters Six and Seven I detailed four dispositions that dominate in the profession and are central to the engineering habitus: having a strong work ethic; believing in individual responsibility; being a rational problem solver; and having technical interests. Each of these dispositions, in turn, became important for answering the third research question.

The (mis)match between field and habitus

My third research question, in many ways the one that this project centers on around, was: what are the impacts of a (mis)match between the dispositions of individual engineers and the structures of the engineering field? Following Bourdieu, with a match, or fit, between habitus and field one's ability to function within the field is maximized, in large part because the majority of what happens within that social world (in this case engineering) "makes sense." In the matching of field and habitus there is the "illusion" of immediate understanding, there is no need to question the basis of the structures of the field or its conditions; rather we have a 'doxic experience' of the field (Jenkins 1992:70). Without a match, however, individuals are 1) unable to "function" and cannot see the potentialities of the field, and/or 2) become conscious of the arbitrary nature of the rules that exist and conscious of their dispositions.

To understand this (mis)match, I should first describe how I moved beyond my initial expectation of a clear division between those who stayed in the profession and those who left. While completing my interviews, it quickly became clear that retention was too simple a notion to capture the complexities of my participants' experiences. What was important was commitment to the profession. Did individuals identify as engineers? Was it something they felt they were? Or was it, as it was for Amy, the furthest thing from who they felt themselves to be? The goal of the research project then evolved to be one of understanding commitment. How did different individuals, with different dispositions, fit into the engineering field? How did particular dispositions reflect gendered and engineering norms so as to enhance, or reduce commitment? In the following discussion I will provide examples of thematic (mis)matches between habitus and field that were observed and the ways in which they impacted commitment to the field and reflected the gendered nature of the field and habitus.

Hard work and the long hours culture

Virtually all study participants described themselves as hard working and as having undertaken what could be seen as Herculean efforts in their studies and professional work. Even those who left the profession presented this goal oriented approach. Participants told stories of always having been dedicated and, given the "long hours culture" that predominates in the field and descriptions of the very rigorous educational process, it is clear that this work ethic was necessary for survival. Thus a match existed for all of the participants between the cultural demand for long hours and the individual belief in being a hard worker. This culture, while very beneficial to clients and those who are the owners or investors in engineering firms, can be highly problematic for individuals who may take on more than they can complete and work themselves to the point of burnout. Work organizations, as Eric described, have little motivation to change this culture as it leads to larger profits and fits with dominant values about the singular importance of the financial bottom line.

Notably, while all participants said they had a strong work ethic, the women I interviewed were more willing to resist the long hours work culture and leave when their hours were done. In some cases this was due to child and caring demands, but not in all. Emma and Tracy, for example, described doing their work during their work hours and leaving, even when working in very high stress organizations that had strong long hours cultures. A willingness to set these boundaries suggests that, among these women, the engineering habitus which frames commitment as hours spent was not fully internalized. It further suggests that a feminine gendered habitus may not align with the norm in the engineering profession of the unencumbered worker, a misalignment that becomes particularly salient with the arrival of children.

Rational Problem-Solvers

Probably the most common skill related by participants when reflecting on what makes an engineer is that engineers are "problem solvers". While problem solving in itself does not demand a linear trajectory or a particular approach, the way that it is taught and enacted in engineering, according to the participants, is very rational and linear. Indeed this linear rational approach to problems was something that applied not only to finding engineering solutions but also to planning otheir life paths. Engineers planned their lives on spreadsheets, kept good financial records, researched their car purchases, and did not get divorced.

This linear approach to problem-solving, which is an important element of the habitus, appears to largely fit with the profession as it is currently practiced. Many of the positions engineers hold, particularly early in their careers, require a willingness to complete tasks and solve problems in pre-established ways. The extent to which this alignment was required is apparent in the experiences of participants who did not identify as linear thinkers. Laura and Ben both identified that they were more creative than average engineers and were unable to find a space for their creativity in the profession. This lack of an opportunity to be creative became a central element that undermined their commitment to the field. While the textual materials produced by the profession stress innovation, the training of engineers, as Michelle described, pushes creativity down. This disconnect can be seen as both problematic for retention and commitment, as people are leaving when they are unable to express their creativity, and for the profession itself, as more creative responses and innovation are inadvertently limited. An emphasis on rational decision making is also an issue because being rational, like being hard working, is not sufficient for finding enjoyment or a fit in the profession. This can be seen in instances where engineering was selected, as Veronica and Heather did, because it was a good career. Studying engineering because it is a rational choice, when there is no interest in the field to back it up or experiences in the program to affirm that it is a good path, is not sufficient to keep one in the field.

Technically and Mechanically Oriented

Tied to the rational problem-solving emphasis of engineering is the expectation that engineers will be technically and mechanically oriented. This emphasis on the technical can be seen in the textual materials analyzed. In advertisements by the professional association, the images used are frequently of people working in the field, hardhats and safety glasses in place. The scientific – particularly the applied scientific – accomplishments of engineers are highlighted in the profiles of successful engineers. Historically, this connection to the technical, and even the trade orientation of the field should be expected. Engineering as a civil (non-military) profession arose out of the trades and has involved working, often as the middle-*man,* between tradespeople and business owners.

Yet engineering, as much as the technical is stressed, is also a field in which being a leader and having social skills are increasingly important. Texts reflect this in the identification of successful engineers as technically skilled *and* as business leaders. Engineers presented this in their discussions of what makes a successful engineer – it is someone who has both hard and soft skills. This tension in engineers' self-definitions can be seen to play out in the multiple narratives of what it is to be an engineer. Faulkner (2007) described this through her identification of two dominant narratives: the technicist and the heterogeneous engineer. Expanding the work of Faulkner (2007), I have extended the continuum to include a non-technicist category. Technicist engineers, in my study, reflected the highest level of commitment to the profession and were all male. These men emphasized loving the technical and reported very little interest in the "politics" of management. Heterogeneous engineers, as I operationalized this term, were people with varying degrees of interest in the technical who also embraced the social sides of engineering practice. At the non-technicist end of the continuum were those individuals, the majority of whom were female and were not committed to the profession, who had no interest in the technical. Instead these individuals emphasized either the desire to be successful in business or to help people.

This technicist / non-technicist continuum became a critical element in understanding the mis-match between individuals' habitus and the engineering field, as the parallels between technicist interest and commitment were very strong. That said, this relationship was not determinant (not committed engineers were technically focused) nor was having the technical engineering orientation sufficient to ensure commitment. As Eric's experience reflects, repeated negative experiences in the profession could replace this love. On the other hand, without any interest in the technical, engineering was just "a job" and while it did not necessarily mean individuals left the profession, their commitment to it was as a job – not an element of their identity.

This continuum is also critical in understanding the role of gender in the field, as that which is technical is culturally understood to be that which is masculine. This was clearly reflected in participants' words, such as Jacob who expressed never having met a female as interested in the technical as he was. It can, as Phipps (2005) describes, even be seen in the "Women in SET" discourse, which continues to be based on and reinforces "a binary between femininity and masculinity in which women are domestic, passive, and emotional while men are rational, individualistic, competitive, confident, and technically skilled" (p.780-781). This difference between an engineering habitus and field that emphasizes the technical, and a gendered field and habitus that defines the technical as masculine, sets up an inherent tension for women entering the profession. Thinking back to Bourdieu's (2004) writing about the scientific habitus and the difficulties faced by the female scientist, one can see that the challenge women engineers face "lies in the fact that a double effort is required in order to master the knowledge theoretically but in such a way that this knowledge really passes into practice, in the form of a 'craft', 'knack', an 'eye', etc" (p.40).

Making a difference

In reflecting back on my interviews, one of the themes that came up repeatedly, which I had not anticipated, was the role of engineers and the engineering profession in "making a difference". Following Sally Hacker (1990) I recognized when beginning the research that engineers are agents of radical social change (via the development of technologies) yet they often hold the most conservative beliefs about society. Despite the conservative approach to society (and general support of the status quo), "making a difference" was an ideal reflected frequently in the Association texts and the words of participants. That said, this desire to have an impact appeared to exist more in rhetoric than reality. Indeed, the lack of real opportunities to be involved in change created a mismatch between field and habitus for a number of participants. This was clear in Amy's words when she described selecting environmental engineering out of a desire to make a difference, but discovering that this was a naive understanding of the field as it did not provide these kinds of opportunities.

The desire to make a difference was reported by members of all groups of participants: male, female, committed and non-committed. What differed between the groups, and reflected the extent to which a match was found, was the form of change emphasized. For engineers committed to the profession, particularly those with a technicist orientation, change was seen as something to be made from within the profession, whether that resulted in developing tools to aid in development or implementing new policies for organizations. For those who were not committed, particularly those who were non-technicist and interested in helping, making change was typically framed as something that needed to be undertaken from outside the profession. The ways in which one can make a difference also reflected differences in the gendered habitus of engineers. While the males discussed making a difference as something that indicated being a successful engineer, the females were more likely to emphasize a personal need to make a difference and be change-makers. The women were also more likely to identify their desire to make a difference as something that had to be done outside of the profession

Leadership

Throughout this dissertation, leadership in the engineering profession has come to the fore. As I have discussed, ensuring that engineers develop leadership skills, which are often presumed to be underdeveloped as engineers are characterized as being less "social", is something the professional, academic, and alumni associations are highly concerned about (based on the texts analyzed). What is less emphasized, but from the perspective of a mismatch is critically important, is the relationship between gender and leadership. Within the profession, leadership continues to be almost solely the domain of men: "If you're going to have women in the management role, it'd probably be in the smaller firm, it wouldn't be in the larger ones; I've just never seen it, to be honest. But I have seen them in mid-sized consulting firms" (Michelle). According to participants, the reason women did not make it into upper management and leadership positions, in addition to a lack of mentorship and "choosing" to have children, was due to their lack of the personality traits required for this type of role. To be a leader means to be assertive and aggressive. It was a role that, particularly male participants, seemingly automatically connected with masculinity. Joseph used masculine pronouns to describe leaders; Matthew emphasized a "shop floor" approach; and James reported that colleagues at school who had been the best leaders were those who had been in the military: "I guess I felt jealous that the guys who had come out of the military had been taught to be leaders." Furthermore, the form of leadership that participants presented as typical in the profession, which was described as "drive-by leadership" and "sink or swim", is one that reflects a non-relational masculinity. For some participants this worked well, particularly the participants who had gone on to find a good fit in the profession, but for others, particularly the women and some of the younger men, this approach was problematic. They wanted more support and mentorship – factors more often associated with traditionally feminine relational forms of leadership.

This point requires further elaboration, since a closely related theme appears in the broader management discourse (Benschop and Doorewaard 1998; Metcalfe and Linstead 2003), namely, that women have something special to bring to large work organizations. The idea of incorporating what Metcalfe and Linstead (2003) describe as "feminine capital" - the communication, teamwork, interpersonal and support skills traditionally associated with women - into business and management practices has gained a great deal of support in recent years. In "The Inherent Personality of Women as an Asset to the Engineering Workplace", Allyson Lawless (2001) argues that, for women, the need for hierarchies is unnecessary. According to Lawless (2001), women are natural negotiators, multi-taskers, and hard-workers. As organizations "move from 'order and obey' to empowerment, people must place greater reliance on persuasion. Which gender model is this?" (p.38). Her answer is women. She describes "the biggest survey ever carried out of female bosses has found that they are far better at their jobs than their male counterparts. Not only are they more sympathetic and caring towards their staff, they also emerge as clear winners in the supposedly 'male' skills of planning and teamwork. And when it comes to difficult technical tasks, they usually outshine men" (Lawless 2001:39).

These new management principles are further seen as potentially creating patterns that are beneficial to women's careers (Peterson 2007:334).

The problem with this rhetoric is that it continues to essentialize gender differences and does not critique the norms that dominate in the engineering field. The idea that bringing more women into the field will transform the field is clearly essentialist as it "fails to challenge stereotypical constructions of femininity and masculinity or to acknowledge that these constructions are not just different but unequal" (Faulkner 2000b:101). The incorporation of "women's ways" reinforces the dichotomization of masculine and feminine norms, without challenging the stereotypes of power relations. The second critique, that the embrace of these new "feminine" norms overlooks the underlying dominance of masculine norms, builds upon this issue of essentialism. Metcalfe and Linstead (2003), in their examination of the gendering of teamwork, write that how team work has been theorized and implemented within the management field does not bring into question the underlying masculinism that exists. This is reflected through a textual analysis of the leading text in team theorizing which is shown to "reflect masculine and masculinist team behaviors" (Metcalfe and Linstead 2003:102). Emotional sensitivities and relations are downplayed; performance is the goal.

Work Organizations

A final area of mismatch I wish to address is the role of engineering work organizations in creating commitment to the profession. As I have described, the participants with whom I spoke worked for a variety of organizations and in different industries. And between these organizations and industries there are large differences. Within the engineering profession – which can be understood as masculine – the extent to which an organization is masculinised can vary extensively (Britton 2000). The impacts of the degree of masculinity in an organization can be seen in Ely's (1995) study which demonstrates that organizations are notably less masculinised when there are more women in positions of power (e.g., at the partner level).

These differences in organizational culture, which can be seen at least in part to reflect organizational leadership, created large differences in the support and work-life policies that were available to these participants (see Chapter Nine for a detailed discussion of women's comments on work-life policies). The availability of supportive leadership and strong policies were very important in the retention and commitment of both younger individuals and women in this study. Unfortunately, with the exception of a few cases, participant's comments on the provision of work-life policies were not in praise of employers. Individuals spoke of working for organizations that ostensibly had policies and programs in place, but these policies were not actually followed or, if one used the services, one was penalized. Participants observed that some companies did not have policies due to organizational fear of the unknown; that flexibility was feared because it would "cause a huge impact to their business" (Julie); and that reduced work weeks were difficult to achieve because of bureaucratic and organizational rules. Without policies in place, even when there is tacit organizational support, solutions are up to the individual to negotiate and implement. While work-life balance policies and active recognition of employees' contributions do not ensure that one will stay with an organization or be committed to the profession, they play an important in the retention equation. They do not guarantee retention, as can be seen in the experience of Amy who praised her organization's policies but was leaving engineering because she was not interested in the work, but they do ensure that people like Kelly who are interested are not lost to the profession due to very negative experiences that foster distrust and anger.

Contributions to the Research Literature

In Chapter Two I identified a set of gaps in the literature that this project was attempting to address. The first gap was that the vast majority of past research exploring gender in SET fields has focused on experiences during professional education. While this work has been undeniably important in increasing the numbers of women studying in these fields, it does not address gendered experiences in the workforce which past research has indicated is where gender discrimination and differential treatment are most likely to occur (e.g., Carter and Kirkup 1990a; Hanson, Schaub and Baker 1996; McIlwee and Robinson 1992). The present research supported those findings, showing that women experienced few issues with being female during their studies and that gender became a much more important issue in the workplace. The research on retention in SET education also identified a number of themes such as individually confronting challenge, self-perception of ability, fitting into the culture, and self-esteem. This project examined these themes within professional experiences and found that they continue to play a major role in women's (and men's) workforce experiences and commitment to the profession. That these factors carry over, and are relevant in the lives of both women and men, is an important addition to understanding the career experiences of engineers.

The second gap was that few studies have examined the specific experiences of engineers; rather they have typically been grouped with scientists, in particular within the academic realm. The present research reflects the importance of examining engineers specifically. The distinctiveness of engineering is reflected in the professions ties to the trades, a historical connection that continues to this day and creates some of the most challenging experiences that my participants reported. As an engineer one was in charge of unionized trades people whose respect for a young university trained engineer was often limited. The distinction between engineering as conducted in the private sector and academic forms of SET can also be seen in the limited autonomy of the profession, as discussed in Chapter Three. For engineers the bottom-line is a critical factor leading to very high work demands and the "long hours culture".[76] These demands in turn place engineers in positions whereby they are faced with finding cost effective solutions, even if they are not the most creative or ethical. The study of engineers working in the corporate sector is also methodologically significant because few projects are undertaken from a critical sociological perspective that focus on the experiences of elites. Understanding the experiences of people who are among the decision makers in our society is of importance if the status quo is to be challenged.

The third, and in many ways most important gap was the lack of literature examining in depth the careers of people who have left the profession or pursued non-traditional paths following their education. Through these individuals'

[76] While in the academic realm long hours are also the norm, the motivating factors and forms of capital acquired (publications, respect) are different from what the engineer seeks and gains (continued employment, promotion).

experiences, an image of the engineering habitus was developed and the ways it was gendered explored. The inclusion of people in this study who have left the profession also allowed a greater understanding of how the structures of the engineering field push out those who are creative, leave little space for a caring or relational perspective, and demand acceptance of the professional norms and of one's individual responsibility to meet them. By recruiting interview participants on the basis of training in engineering rather than employment in engineering, and examining the factors related to commitment rather than retention, this research also adds strong evidence for the need to move beyond linear or pipeline models (Berryman 1983) of career commitment and retention. The findings reinforce the non-linearity of career paths and that rather than *a* decision that is made and followed career decisions are revised throughout the life course and are impacted by a variety of work and non-work experiences (Madill et al. 2007; Mainiero and Sullivan 2005; Nash and Stevenson 2004; Super 1980). Further, it is important, to move beyond seeing the paths that are followed as individual "choices". While individuals do make and act upon decisions, the present research indicates that the choices and paths available – both in a concrete form and those that the individual is able to perceive as possible – are shaped by structural arrangements of power.

The final gap that the research has tried to address is developing an understanding of gender within the engineering profession that goes beyond simple male/female dualisms. Drawing upon the work of West and Zimmerman (1987), Lorber (1994), and Connell (2002, 2005) I have explored a range of masculinities and femininities that are enacted in the engineering profession. Rather than accepting that engineering requires a certain set of inherent personality traits, I have explored how these factors reflected the norms aligned with a *particular form* of masculinity which is not available to women nor is it available to or enacted by all men. Taking a social constructionist perspective on gender, in particular using the work of Connell (2002, 2005), alongside Bourdieu's theoretical perspective (as I have discussed in Chapters Two and Eight) can be seen as problematic. Bourdieu's work, according to Connell (Connell and Messerschmidt 2005), is deterministic and does not allow sufficient space for change. I agree, in part, with this critique. Agency is something that Bourdieu's work greatly limits. That said, Bourdieu did not deny agency or change. Rather his work reflects, in my reading, difficulty theorizing agency and change. Reading gender as constructed alongside Bourdieu provides a way to imagine change without denying broader structural trends.

Connell's (2002, 2005) work has been particularly important in this project in understanding men's gendered experiences in engineering. Using his ideas I have argued that it is in part because of the different ways that masculinity is enacted that the "fit" with the engineering field varies between individual men. Furthermore different ways of enacting femininity exist, some of which "fit" in the profession more readily than others. Indeed the inclusion of men's experiences as gendered, and the differences between individual men's experiences, is in itself an important contribution to the literature because so much of the research on gendered careers in SET has focused solely on the experiences of women. Even though "men" remain the numerical and symbolic norm it is still important to understand the patterns that exist for men – and how the practices that dominate impact men in different ways. As Connell's work reminds us: "Men no more than women are chained to the gender patterns they have inherited. Men too can make political choices for a new world of gender relations. Yet those choices are always made in concrete social circumstances, which limit what can be attempted; and the outcomes are not easily controlled" (2005:86). Throughout I have tried to argue that rather than engineering being a good fit for men and bad fit for women, the fit is dependent on much more. Gender plays a role, but so do organizations, interests, and life circumstances which vary immensely between members of each gender category.

Connell's concepts of gender regimes and crisis tendencies are also important in continuing to examine gender within engineering (and other professions). "Gender regimes" (2002, 2005) provide a way to see the field specific expectations of gender that exist. This is important in two ways: 1) understanding the gender regime in engineering helps to elaborate why a mis-match exists for women generally and the double bind that women face; and 2) in relation to Connell's notion of masculinity as multiple it sheds light on why some men do not "fit" within the profession. The concept of "crisis tendencies" (2002:71) can be used to address the potentially static image of a field that develops out of Bourdieu's work and enables a way to understand change. Unlike a post-structuralist approach to gender that emphasizes gender as based on unstable meanings, Connell (like Bourdieu) recognizes that change is not quick or easy. Rather at particular moments change is more likely to occur, with the contemporary era's contradiction between continued patriarchal relations in the home and workplace, and the rhetoric of equality providing an important example of a crisis tendency (p.72). This understanding of change as more likely due to crisis tendencies also provides an important way to imagine change in the engineering field and see the contradictions between a rhetoric of the "best and brightest" and a very traditional gender regime as creating the potential for crisis and change.

Policy Implications

In undertaking this project one of my initial research questions asked whether a better understanding of (mis)matches between habitus and field could be used to inform policy that would enable individuals to have more fulfilling careers and lives. In reflecting on my findings, perhaps the most important observation is that there is no "one size fits all" approach or policy that will "fix" the engineering profession. However, I do have a number of suggestions for changes that I believe could help to re-shape the field to enhance the experiences of individual engineers and also improve the products of the profession.

Once again, I will be turning to Bourdieu to help articulate my primary recommendations, which emphasize challenging the doxic or "taken for granted" in the field. Before doing this, however, I want to place these suggestions within the broader social context that I believe is critical to understanding the mindset of engineers, in approaching changes to the profession, and to creating an environment where change can be fostered.

This context is the emphasis, both in engineering and society more broadly, on being individually responsible for one's choices, careers, and life paths. Individual responsibility can be seen in participants' observations on retention: whether people choose to stay or leave the profession is seen as a reflection of their interests, not of something that needed to be changed or addressed in the profession. Hostile, even abusive, treatment in the workplace was something the individual needed to develop a copy strategy, a "thick skin", to face. Facing demands to balance work and caring responsibilities was something for which people (usually women) found their own solutions. When difficult times were faced, such as a slow economy and poor employment prospects, people talked of their individual actions to address these public problems; when asked about success in the profession they described individual skills that lead to success; when responding to questions about diversity few saw the need for systemic or organizational changes. If women wanted to go into engineering, they could. That they didn't indicated that they were not interested. Throughout the conversations and textual materials the systemic nature of power and inequalities were very rarely identified.

This emphasis on individual responsibility reflects the broader social trends related in the work of Ulrich Beck, Elisabeth Beck-Gernsheim, and Zygmunt Bauman (Bauman 2001; Beck and Beck-Gernsheim 2002). These theorists conceptualize individualization as a transformation of the relationship between the individual and society. Risks continue to be produced socially; what has shifted is that it is now the duty of individuals to cope with these risks (Bauman 2001:47). Although risks may be created by class/gender/ethnicity, they are shifted onto the individual and must be "explained" by the individual in the narrative they construct of their biography; a biography that is actively constructed and therefore not necessarily reflective of actual events (Beck and Beck-Gernsheim 2002:25).

The extent to which individualized discourses are prevalent among engineers has serious implications for the profession since it means that opportunities for creating change are greatly limited. This can be seen in the words of Danielle who, as I have described, found her career within engineering to be very difficult. In describing her first job, where she worked under a "very abusive boss", she talked about assuming that she was the problem. In reflecting on a later position with a high degree of responsibility she stated:

> I'm the kind of person that tends to [*pause*] bring my work home, I can't, I worry about it, I get stressed out about it. So the first two years I was with the company I did a lot of overtime and then I started a family, so I can say that realistically I didn't put in much overtime. We worked a 40 hour work week and I didn't put in overtime, but I sure brought my work home. It was there, I'd start to fret Sunday afternoon, not the people, my boss was great, but I had a lot of responsibility and I carried it…

The organization and the demands of the workplace are excused in reflecting on the difficulties she faced because it was her personality that caused the problems. Describing a recent job, she stated, "this was very non-stressful, it was fun, it was good, I thought I had an aptitude for it, [but] had a horrible manager. Knew that going into the job, thought I could deal with it, thought I could handle it, couldn't. I couldn't". In each of these instances the details of the work places, expectations, and managers indicate organizational dysfunction. Yet, while these are recognized, Danielle turns the blame on herself. As she told me about her experiences of having changed jobs she would laugh uncomfortably and say "I quit". She had internalized the problems she faced as something she needed to deal with better. As such the need for organizational and systemic changes was denied. In discussing the ways in which engineering could be reformed, I am starting from a place where Danielle and others stand, where self-blame and individualization of responsibility are at the forefront.

Notably, in a project that uses Bourdieu's work as an organizing theoretical tool, an emphasis on making change can be problematic, as his work does emphasize the impact of the field (Bourdieu and Wacquant 1992:107) and has been critiqued as deterministic and restricting agency (Chambers 2005; Everett 2002; Fowler 2003; Jenkins 1992; Phipps 2005). As Wacquant notes, "The rigid determinisms he highlights are for him observable facts that he has to report no matter how much he may dislike them" (Bourdieu and Wacquant 1992:80). Similarly for this project, as much as I may desire that women hold an equal number of positions of power to men, there are factors that limit this becoming reality. Ignoring these factors and stressing individuals' options is what, I would argue, has hampered past research on this topic. Indeed, following McNay (1999), I would hold that the value of Bourdieu's work is the extent to which he shows the difficulty of change. That said, I firmly agree with Bourdieu that individuals within fields are not merely mindlessly conforming (Bourdieu and Wacquant 1992:107).

Three major ways in which change can occur are outlined, albeit in somewhat contradictory ways, in Bourdieu's work: reflexivity, collective action, and consciousness-raising. It is in terms of consciousness-raising that I want to outline the first policy suggestions. The importance of consciousness-raising, while not seen as sufficient for creating change, was discussed by Bourdieu in relation to the ability of the feminist movement to bring attention to the constructed nature of "common sense" gender (Bourdieu 2001:88). Building upon this, Chambers (2005:334) reads Bourdieu's work alongside that of Catherine MacKinnon, a radical feminist who views consciousness-raising as fundamental to change. In doing so, Chambers (2005) makes a very persuasive argument for how the habitus presents a way for individuals to understand the social structures that surround them: "if we start to think about the way in which we act and the preferences we have, the wider institutions of gender inequality begin to be revealed" (p.335).

In examining the potential role of consciousness-raising, I want to begin with potential changes to the education of engineers and then move to the careers of engineers. Clearly, interventions to reform education in SET fields have been influential. That said, I would argue that the education of engineers still has spaces for improvement in equipping engineers for the professional world. I am not referring to hands-on skills or leadership skills (although improvement in both would probably have beneficial outcomes), but rather the development of critical thinking skills among engineers. In engineering programs we are training some of our brightest and most dedicated students, but we train them in such a way that extreme dedication to work and a focus on the technical is internalized. While being able to solve problems, being willing to work very long and hard, and having technical expertise are important in the field, these skills do nothing to reform the profession. What could help alter the profession, raise consciousness, and enable critiques of the constructed nature of both the engineering field and habitus, is understanding of power relations in society and the extent to which individualizing discourses distract and discourage us from challenging such relations. Reflecting upon the students I teach, it is clear that being able to critique individualization as a discourse that benefits particular groups – to take up a sociological imagination - is often the most challenging element for them to master. Yet it is also one of the most important. And it is during an engineer's education that we are presented with one of the few opportunities to teach these future builders of the world about the importance of power relations in society and the impacts of individualized understandings of the world.

Linked to this were comments about the particular form of problem-solving participants had learned during their engineering education. Participants discussed how during their education and work experiences, rather than being encouraged to engage creatively with problems, linear and rigid ways of dealing with problems dominated. In a profession that emphasizes innovation, creativity is something that should be embraced and both students and qualified professionals encouraged to explore. Whether this encouragement is through the study of art and design, or working in teams that involve people with multiple forms of training, engineers who hold more creative and diverse perspectives will benefit the profession. The benefits of this diversity will not only be found in the development of the best tools for the future, but also through perspectives that are able to question the status quo.

Moving from the educational context to the workplace, I believe that consciousness raising plays a critical role in setting up a context where change is possible. Through my research, the extent to which participants believed people are naturally engineers and that males and females are inherently different became clear. At the same time as these common sense notions were identified, the diversity of participants' experiences challenge these ideas and show the multiple ways in which people enact "engineer", "masculinity", and "femininity". Looking at the field from a distance, it seems that if engineers, particularly those who are committed to the field, were more able to see the constructed nature of the elements they identify as natural, then openness to diversity would increase. While my research does not identify "the problem" or "a solution", I believe the greatest potential it holds, for the profession and for individuals, is recognition that gender and professional identity are enacted and lived in multiple ways. In turn, moving to understand that engineer (and male) are not singular, nor attached to particular bodies and personalities, could enhance the inclusiveness of the profession to diversity, be that in race, gender, approaches to problems, or hours of work. I believe that an increase in consciousness could be particularly important in two areas: reforming the aggressive and hostile work atmosphere in engineering, and improving work life balance in engineering.[77]

One of the most problematic aspects of the culture of engineering was the often hostile and aggressive work environment reported by a number of participants. This was particularly true for people who worked closely with trades people. While in itself not surprising, what is interesting is that the negative ramifications of this type of environment were reported by both women and men. While for some men and some women a very aggressive environment worked well, for those who were younger or less confident in their abilities, an environment where yelling and swearing in the office were the norm was often too challenging. While I can envision some resistance to changing this environment, for example labeling it as "political correctness," the benefits to all workers – and the benefits beyond the engineering profession to the even more male-dominated trades are easy to imagine. The "old boys club" may work for a few, but this overtly hostile, assertive and aggressive leadership style functions as a barrier to a range of people including women, visible minorities, newly-trained

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[77] It should be noted that I do have some trepidation in placing my hopes of how my findings could alter the engineering field in increasing awareness. Having attended conferences and talked with many engineers I certainly have some serious reservations about whether increasing an individual's consciousness of gender as constructed is a realistic goal, never mind that it could transform the field. That said, drawing on Connell's (2005) notion of "crisis tendencies", it seems that continuous attempts to bring attention and understanding to the constructed nature and impacts of gender in the profession could lead to increased awareness of the contradictions that exist and their change-able nature. With this continued tension a point of "crisis" may be reached where transforming the gender regime in engineering is possible.

engineers, and some more technically-oriented engineers. Reforming this type of interactional style is neither expensive nor demanding – the fact that these types of behaviors would be unacceptable in the majority of work environments reflects this. And with a better understanding of the culture's implications for a range of people and support from organization leaders, it could be broadly accepted.

The second critical element of the culture that demands reform is the long hours culture. Throughout the interviews engineers reported facing a culture of extreme work pressure. Long hours, commitment to one's organization above all else, and a dedication to efficient and cost-effective solutions dominated. While being very productive and profitable for employers, this culture also creates stressed workers on the edge of burn out. In engineering, the ideal of the unencumbered worker remains alive and can indeed be seen to be becoming increasingly pervasive. As Anthony, the oldest participant, observed, workers no longer go home at five or six for an evening free from work. Rather they are tied through technology to their work in the evening, on the weekend, and on vacation. Despite notions that younger workers are challenging this with greater demands for work-life balance, I posit that what they may indeed be demanding is a return to the balance of a slightly earlier generation when one was, at least sometimes, free from work. Related to this, I am quite concerned by the dominant rhetoric that theyounger generation of engineers will transform the field. Repeatedly, I heard engineers talk of how younger engineers had different values and priorities so that as the older engineers retired and younger engineers moved into positions of power the field would be transformed. Given that the field is increasingly dominated by the bottom line and the long hours culture, it seems improbable that a new cohort will challenge the status quo. Rather, as

Kelly suggested, it is more likely they will enact the same behaviors as their mentors. To truly challenge this culture, attention needs to be brought to it as *a* way of working, not the only and certainly not the best way. And it cannot be assumed that change will happen on its own as older engineers retire.

Although policy was not a central focus of this study, both the hostility of work cultures and the need for work life balance are two areas where implementing workplace policies could play an important role. These policies, as my study demonstrates, also need to be clear and to be followed. A positive sentiment toward work life balance is not sufficient, nor is having policies in place that are not respected or which people are penalized for using. Commitment, particularly for women and younger men, was noticeably enhanced by organizational policies that supported work-life balance and a positive, social work environment. It is interesting that the policies participants called for often did not involve radical changes. Participants typically did not demand flex work, longer holidays, or childcare at work. Rather they talked of yoga and exercise classes being offered, support of socializing outside work hours, birthday cakes and coffee, free parking, and expectations of working "only" forty to fifty hours a week. That these concerns were the participants' focus is important because it points to the fact organizations could take relatively small steps to enhance employee satisfaction greatly. It also highlights that, particularly the long hours culture, is so deeply engrained into the field and habitus of engineers that expectations, even hopes, of more radical changes are beyond the scope of imagining at the current time.

A final policy implication suggested by my research is the need for the professional engineering association to continue to build in ways to protect its members as they speak out as professionals and, potentially, in conflict with corporate interests. Within the professional association there is a clear emphasis on the ethical responsibilities of being an engineer, yet no whistleblower or other protection is offered – nor being rallied for – by the professional association. A number of engineers reported frustration at the limited voice engineers hold in society, such that they are not respected or called upon to speak on the topics where they are experts. As debates about global warming reflect and the recent British Petroleum oil spill in the Gulf of Mexico exemplify, engineers' need to be protected and supported as their expertise is needed by society and policy makers. In order for engineers to be willing to speak out, however, they need to be protected to ensure that they are able to give their professional opinion, even when it stands in opposition to corporate interests, without fear of punishment. The profession's lack of autonomy due to its close links to the corporate world has created a system in which the possibility of being an ethical engineer is severely curtailed. Overall, participants, even those who left the profession, reflected very positively on the code of ethics and the importance of the engineering ring, and embraced the profession's dedication to safety and making a difference. It is now up to the professional association to use this commitment to spur change and reform in the profession. The professional association has the ability to work for legislative reform to protect engineers who are whistleblowers, to encourage universities to emphasize ethics in their courses, and to incorporate into professional development requirements that involve ethical responsibility. By moving beyond "personalizing professionalism" to integrating professionalism as a broader field-based goal, the profession may also begin to play a role in changing society.

Future Research

Having reached the end of this research project, I find myself faced with many new questions to pursue related to the professional context, sample selection, and policy implications of my study. In terms of the professional context, as described, the time and location in which this research was conducted was very specific. Alberta, Canada with a booming economy was certainly not representative of all engineering. This context meant that if one wanted work it was available – and that the demands of employers were extreme due to the "crisis" that was occurring.[78] The availability of employment at the time of the study, and the regions natural resource reliance, reinforce that the field as it exists in this study should not be taken as representative of the profession broadly. While this context was very helpful in understanding factors other than unemployment that lead engineers to leave the profession, the ways in which engineers (or professionals in any field) deal with and re-shape their professional and gendered identity in the face of a recession and declining job market is needed to gain a fuller picture of the engineering field and habitus. A follow up study in Alberta today, where the unemployment rate has increased to 6.6% (May 2010, Government of Alberta Employment and Immigration 2010a) and the 12-month moving average unemployment among professional occupations in natural and applied sciences increased to 4.7% by March (Government of Alberta Employment and Immigration 2010b), would serve as an excellent comparison and bring more light to the impact of the fields limited autonomy. Comparative

[78] The one caveat to this was the case of immigrant engineers who, based on anecdotal evidence, continued to be limited in finding employment.

studies in different industrial contexts (e.g., a manufacturing region) could also shed important light on the generalizability of these results. Further, they could assess the validity of research indicating that during periods of economic expansion opportunities for gender equality are enhanced (Chiu and Leicht 1999 cited in Demaiter and Adams 2009:46). A related research question is whether the entry of women into the profession is changing, perhaps even feminizing, the profession. Following work conducted on medicine, pharmacy, and dentistry (see Adams 2005) understanding whether men and women differ in their ways of practicing engineering and if the entrance of women has changed the profession could yield important insights into how the field is changing.

As examining engineering in a different economic context could create important insights, so could comparative studies that either focus on a particular organization or that compare engineering with other professions. Following Britton (2000) and Ely (1995) important differences exist between a profession being masculine and the degree of masculinity of a particular organization in that profession. Case studies of engineering organizations that compare gendered experiences by the gendered make up of management or the extent to which work-life balance policies are embraced are therefore needed. On the other end of the spectrum, work that compares engineering as a masculine profession to other professions would provide important insights. What factors into different professions becoming more diverse, while others remain firmly masculine? As described in Chapter Three, engineering consulting firms reflect many of the characteristics of professional services firms (see Greenwood, Suddaby and McDougald 2006), thus analysis of the connections between these fields could potentially be very enlightening.

An area where further research is greatly needed is in understanding the experiences of visible minorities in the field, as identified in Chapter Four. Linked to this is the need to develop an intersectional analysis (Hill Collins [1998] 2007) that examines the ways in which interconnected constructions of gender, class and race lead to multiple experiences of professional identity and impact the likelihood of finding a fit in the engineering profession. While gender was the focus of my study, future research is needed that emphasizes how gender is shaped by cultural and social contexts. Do men's subjective experiences of leaving engineering differ by ethnicity, for example? Do individuals' ways of coping with engineering cultures vary by their class background or ethnicity?

While the cross-sectional and qualitative nature of the design used was necessary to develop the idea of commitment to engineering as conceptualized in this project, future research is needed that is both longitudinal and larger scale. Development of a survey that examines the extent to which the key elements of the engineering habitus generalize across engineers and are more broadly related to commitment and retention is critical. Linked to this a future examination of the connection between my conceptualization of commitment, which arose from the data, and the existing literature on professional and organizational commitment would allow for important insights into how commitment can be measured, and if commitment is understood differently by men and women (see Singh and Vinnicombe 2000).

Longitudinal research that examines careers in progress is also needed. The single point in time nature of this data collection forces one to work with people's reflections on their past work experiences and explanations for having left the field. Research that allows us to see the transitions and experiences while they are in progress would allow the development of a fuller picture of retention. Of particular interest are the younger engineers (both male and female) who are believed to be entering the profession with different values. Through a longitudinal study the degree to which these values are different could be studied and the ways in which they are revised over time examined. With transitions into family partnerships and caring commitments, are goals and priorities changed? Are personal goals changed by the professional organization? Are younger engineers really more likely to remain committed as a result of gestures of recognition from their employers? All of these questions need to be addressed in order to gain a more complete picture of what impacts commitment, improves work and life experiences, and can be done to reshape the engineering field.

In line with the call for longitudinal work, a study that examines the historical transitions that have occurred in the field in relation to gender would help to contextualize these findings and understand what changes have occurred and the contextual factors (or crisis tendencies) that lead to them. Due to the cross-sectional nature of this work it is easy to see the field as static – historical sociological research would lead to understanding this moment within a historical context.

A final area for further research is in relation to the policy implications I discussed earlier. I am particularly interested in taking the findings from this project and the potential policy reforms back to engineers to gain their perspectives on the validity of these findings and plausibility of these changes. In addition to being an important way to gain further data and distribute the findings, I believe this process could be a very important piece in consciousness raising in the profession.

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Appendix A: Methodology and Research Methods

In the following discussion, I begin by outlining the methodological standpoint that I have taken in my doctoral research and the ways it was operationalized through textual analysis and individual interviews. The first section will address how feminist and critical theory perspectives on research have influenced my methodological choices, emphasizing the importance of reflexivity to feminist research and the theorizing of Bourdieu. Following this, I will describe how I conducted my textual analysis and individual interviews, and how I analyzed my interview data. The final section of this Appendix contains my reflections on conducting research with engineers and a brief profile of participant demographics.

Feminist and Critical Research Methodology

In this research I have been guided by feminist and critical research methodologies, which intersect in their emphasis on challenging power relations. In particular, I have approached the project from a position that emphasizes the deconstruction of positions and language through context, ideology, and power, but I reject postmodern relativism (Mackenzie Davey and Liefooghe 2004). Central to this, I have aimed to recognize and respect (Reay 2007) the diversity of individuals' gendered experiences within the field of engineering. While some of the women in my study have similar experiences and some of the men have similar experiences, this does not mean that all women or all men "share the *same* experiences" (emphasis in original, Stanley and Wise 1990:22). Rather many differences exist between men and between women that combine in multiple and complex ways. I have therefore worked to keep differences between individuals, and the ways in which these differences are related to broader relations of power (Reay 2007), in mind throughout the collection, analysis and reporting of data. That said, I would emphasize Reay's (2007) position that openness to difference does not require abandoning the notion of gender. Indeed it is, in part, the extent to which constructions of gender are so salient within engineering that make it an ideal research site.

Epistemologically I have taken a position between realism and relativism, as can be seen in some feminist and critical approaches. Feminists Stanley and Wise (1990) introduce the notion of "fractured foundationalism" as an epistemological position that exists between a realist and a relativist position. This notion is based on Gross's (1987) argument that "there are truths, which speak to the existence of different, overlapping but not coterminous material realities" (as cited in Stanley and Wise 1990:41). This fits my own sense that, while there may be a real world "out there," we can only ever reach it through the experiences of individuals; experiences that are multiple and varied. This conceptualization of "fractured foundationalism" also fits well with Bourdieu's epistemological position of substantialism, which attempts to work between realism and relativism.

A significant tension, however, between Bourdieu's work (as an example of critical theory) and feminist epistemology is the extent to which individuals are understood to be able to accurately report on their experiences. Bourdieu's writing, and critical theory more broadly, has been heavily critiqued as presenting a world in which individuals are “blinded” by ideology. The researcher, in contrast, is able to see the truth. In contrast, the work of feminists, such as Dorothy Smith (1987, 2007), emphasize women’s viewpoints as the origin of research. This tension is critical for many feminist researchers. Lather (1991), Code (1995) and Reay (2007) each discuss this tension, this “wrestling” with how one can identify structural barriers, while respecting the realities of participants’ lives. Smith (2007) addresses this eloquently in her discussion of participants as “experts in our everyday lives” (p.411), with researchers as cartographers who map “how translocal relations organize and shape what we do and experience and what we participate in without knowing more than those strands that come within our scope” (p.412). As a researcher I see my role as one of trying to draw a map of the relations between positions but, in line with Bourdieu, I have remained critical of the extent to which participants are able (or willing) to see and critique existing relations of power. I am hesitant to call this “false consciousness,” but simultaneously see few other ways in which to explain certain understandings of the world, in particular the emphasis on individual responsibility.

Reflexivity is central to acknowledging the constructed nature of this research, a position which is stressed in both Bourdieuian and feminist methodologies. As Reay (2007) describes, reflexivity requires:

> …attention to differences within as well as without. We need to pay attention to the internally complex nature of subjectivity and how this is worked through at the level of self-understanding and practice. … reflexivity is about giving as full and honest an account of the research process as possible, in particular explicating the position of the researcher in relation to the research (P.610-611).

Reflexivity is also central to a Bourdieuian analysis, wherein the "reflexive sociologist" must examine their own position and perspective as a researcher *and* the foundations of the sociological method (Webb et al. 2002:75). As Wacquant (1992) describes, for Bourdieu reflexivity is an "intellectual practice" and "a necessary condition of a critical theory of society" (p.36). This is not just a reflexive analysis of one's own past, but an examination of the "*social and intellectual unconscious* embedded in analytic tools and operations" (italics in original, Wacquant 1992:36). The second of these steps, that in which the researcher steps back from the sociological method, is termed the "objectification of the act of objectification" (Jenkins 1992:47) and forces examination of the sociologist's point of view and the constructs and values they bring to the object of observation (Jenkins 1992:48).

The importance of reflexivity for this project becomes clear in Bourdieu's (2001) introduction to *Masculine Domination*:

> Being included, as man or woman, in the object that we are trying to comprehend, we have embodied the historical structures of the masculine order in the form of unconscious schemes of perception and appreciation. When we try to understand masculine domination we are therefore likely to resort to modes of thought that are the product of domination. (p.5)

These words force, if not agreement that one's views are structured by patriarchy, at least an awareness of the role patriarchy plays. As a woman investigating gender in a male dominated field, Bourdieu's words remind me to be aware of how my gender and my sociological background shape my reading of the field, my empathies, and the categories and schemas I use to explain individuals' lives and dispositions. As Hesse-Biber and Piatelli (2007) observe, reflexivity should occur throughout the project, and should remind the researcher to be aware of what is built into her research assumptions and the stories that she tells.

Sample Frame

The focus of this project is individuals trained in engineering who were living in Alberta in 2007 and 2008. This moment and location reflect a very specific context. Alberta, a resource dependent province that is rich in energy reserves, was in a stage of very rapid economic growth at the time. The unemployment rate in Alberta in 2007 (when the interviews took place) was 3.5%, the lowest in Canada (Alberta and Canada Unemployment Rates, 2005-2009 n.d.). Among professional occupations in natural and applied sciences, the 12 month moving average unemployment rate between April 2008 and March 2009 was 1.3% (Government of Alberta Employment and Immigration 2009). This high demand for engineering talent enabled me to assume that trained engineers who were no longer in engineering careers would not have left due to a lack of employment opportunities.

Mixed Methods

This research project has been conducted at both the level of the structures and organization of the field of engineering and at the subjective level of individual engineers. I collected data from multiple sources, and used both discursive and qualitative techniques. As Reinharz (1992) argues, combining methods not only enables one to cast a wider net in exploring an issue, it also increases the likelihood of understanding the topic and of being able to convince others of the veracity of the findings.

Content Analysis of Engineering Texts

To better understand the field of engineering in Alberta I examined texts produced by the professional association for engineers in Alberta (APEGGA), the Consulting Engineers of Alberta (CEA) organization, the University of Alberta Engineering Alumni group, and the Schulich School of Engineering at the University of Calgary. In designing the content analysis section of this project I drew upon cultural studies research on advertising and gender, and organization/SET research that utilizes analysis of texts. The cultural studies literature (e.g., Dyer 1982; Goldman and Papson 1996; Hall [1980] 2001; Marchand 1985; McFall 2004; Williamson 1978) has been important for framing the cultural role of texts and for developing an analytical perspective. Notably, few projects on gender in organizations or gender and SET have explicitly examined textual materials, despite the "naturalistic" and non-interactive qualities of these artifacts (Reinharz 1992:147).

In examining texts, I am drawing upon their role in shaping norms (Reinharz 1992:151) and as objects that link and coordinate people (Smith 2007:413). Texts play an important dialectical role within fields, both reflecting the ideals of a field and shaping the views of those within the field. I am not arguing that organizational newsletters are "representations" of the field. These materials are constructed products that reflect the goals and values of their respective organizations, particularly the goals and values of those in positions of power within the organizations. At the same time, while not holding that organizational materials create a view of the world among readers, or the "hypodermic needle" theory of media impact (Dyer 1982:6), I do feel that media have an impact, albeit a mediated impact (Schudson 1986). A newsletter is not going to create a corporate or professional culture, as there are other powerful factors at play. That said, what these materials include and exclude, how they address the audience, and what values they promote offer important insights into the field's culture and what values are being propagated.

Annual reports are more frequently analyzed corporate materials. Benshop and Meihuizen (2002), Helms Mills (2005) and Wilson (2002) each used annual reports to examine organizations and gender, framing these reports as under-researched cultural products of organizations (Benschop and Meihuizen 2002:161; Helms Mills 2005:250). The dilemma with using annual reports for this project, however, is that the audience of annual reports includes current and prospective investors; employees are not the main audience and may rarely read these reports (Wilson 2002:90; Benschop and Meihuizen 2002:162). I therefore made the choice to focus on materials produced by professional associations, university faculties, and alumni groups. To date, I have not located any studies that analyze these forms of texts, but as they are produced for engineers by engineers these materials have provided useful information on the profession (e.g., membership numbers) and the dominant / idealized culture of the profession. The materials analyzed were (Please see Primary Sources for a full list):

- Issues of *The PEGG*, the monthly newsletter published by APEGGA from June 2007 to January 2008.
- Issues of the monthly *Bullet* from August 2007 to January 2008 and the annual *Alberta Innovators* (2007) published by CEA.

- The *UofA Engineer* magazine, published by the University of Alberta engineering alumni association from the Spring 2007, Fall 2007, and Winter/Spring 2008.
- The *Schulich Engineer* magazine, published by the University of Calgary Schulich School of Engineering from Spring 2007, Fall 2007, and Spring 2008.

These materials were selected to provide an overview of the profession at the time of the interviews. In selecting the above materials, rather than organizational annual reports or more specialized professional group publications (e.g., Society of Petroleum Engineers, Canadian Society for Civil Engineers), my goal was to gain a broader view of the field and to explore dominant themes in the profession. The APEGGA materials were particularly important as they reflect a legitimated view of the profession (even though this view is not one agreed upon by all engineers). While I attempted to include a range of materials from the time, these publications should not be seen as comprehensive. A broader temporal sampling of materials would be useful in developing a historical image of the field, while including organizational materials would allow for a greater representation of the corporate norms of engineering. That said, while the view of the field is certainly partial, a saturation point for the themes surrounding this time was reached with these materials wherein important new ideas were not being uncovered through analysis of additional publications.

Analysis of textual materials

Quantitative and qualitative details of content were collected from the corporate and association textual materials. The quantitative data ensured that I had a consistent overview of the purpose and predominant images for each piece. For each story and advertisement published, I recorded in an Excel spreadsheet the purpose of the item (e.g., advertisement, story, table of contents, funding request) and, if applicable, what was imaged (e.g., person, technical, building, nature). If the image was of a person, I recorded the gender of the individual shown, whether they were a person of color, and the type of role / attire they were imaged in (e.g., suit, field worker, scientist, student). These tallies were used to enable some comparison between materials of different groups and compare representations to demographics in the field.

Taking a position that images are not representative, but constructed and containing latent as well as manifest content, the qualitative component of the analysis examined the underlying messages and themes presented in the materials. Again, both the text and the images were analyzed. Where possible, texts were imported directly into NVivo; otherwise detailed summaries were written. For images, both the denotative elements (e.g., who is shown, where they are, what type of clothes are worn) and the connotative elements (e.g., individualism, authority, submission) were described. Examining the connotative elements was particularly important, as images can be seen to reflect unconscious biases held by the materials producers. As Helms Mills (2005) argues, "actions do speak louder than words and the culture of the organization is best understood through what is being portrayed and how this portrayal differs from what corporate policy states" (p.249). In my textual coding, I employed the same thematic codes that were used to code my interviews (to be described below).

There are limitations to this and any content analysis. First, I recognize that the views presented in these materials are idealized and constructed, and therefore the ideas of the field collected from these texts cannot and should not be taken as directly representative of the profession. Secondly, undoubtedly my research goals and perspectives shaped my reading of the materials. An engineer encountering the materials may very well have different interpretations of the themes. Thirdly, with this analysis I have selected particular texts, those created by professional associations and University Engineering groups, which may present a different view than would be found in the annual reports and corporate materials of engineering firms. I have selected these in order to understand the norms of the field – at least the idealized norms - but as a number of participants shared, they are not dedicated readers of these materials. Thus it may be that these publications only reflect the views of a select portion of the profession.

Interviews

Qualitative interviews were my primary means of data collection. Interviews were also used in a number of the studies discussed throughout the dissertation that examine the gendered culture and professional identity of scientists and engineers (e.g.,Carter and Kirkup 1990a; Dryburgh 1999; Evetts 1996; Hacker 1989, 1990; Henwood 1996; Miller 2004; Phipps 2006; Ranson 2003; Robinson and McIlwee 1989; Shih 2006; Taylor 2005; Watts 2007, 2009a).

Sample

My interview sample included men and women living in Alberta who had completed undergraduate degrees in engineering. Details on the 36 participants, 18 males and 18 females, are provided in the final section of this appendix. The primary recruitment strategy was an advertisement placed in engineering association materials and distributed by organizational email lists. A recruitment advertisement was placed in *The PEGG* from October 2007, the November and December 2007 CEA *Bullet*, and distributed via email by WISEST at the University of Alberta. I also distributed project information at the APEGGA mentoring conference in October 2007. A secondary strategy was to ask participants, along with colleagues and personal acquaintances, to forward information on the study to individuals who they thought might be interested in participating. This secondary strategy was particularly important in trying to recruit individuals who are no longer working in the engineering field, as they may not be receiving materials from other the sources. The recruitment information read as follows:

> Are you an engineer working in Alberta? Have you been trained in engineering, but decided to pursue other options? If so, your experiences and opinions are critical to a dissertation research project being undertaken at the University of Alberta that is examining engineers' career experiences and perceptions of the engineering profession. Te purpose of this research is to explore the factors that impact career retention in the engineering field. Seeking individuals who have trained as an engineer, are currently living in Alberta, and either: a) are not currently working as an engineer, OR b) are currently a practicing professional engineer.

The sample was a combination of convenience and snowball (Marshall and Rossman 2006:71) within a quota. Initially I had aimed to oversample women and to have equal numbers of individuals who stayed and left the profession. As the interviews proceeded I realized, however, that this goal meant limiting the variety of men's experiences (which were underexplored as gendered in the literature) and did not align with the more complex issues of commitment to the profession that I was uncovering. Therefore I adjusted the recruitment quota to ensure equal numbers of males and females and to speak with people who expressed a range of forms of commitment. Potential interviewee's fit with the project goals was established through a telephone or email pre-screening. When I found, as Rubin and Rubin (2005) described, that in a group I was hearing the same information repeatedly, I concluded that I had reached a saturation point (Glaser & Strauss 1967 as cited in Rubin & Rubin 2005:67) and stopped interviewing individuals in this group. Notably, this was a point reached much more readily with people who remained in the profession and were not contemplating leaving.

Limitations to this sampling do exist. Differences in the field of engineering (e.g., civil, chemical, mechanical) and industry sector (e.g., oil & gas, utilities, non-profit) that might impact the culture of the organization, and also the number of years of work experience, could not be explored given the limited scope of this project. Furthermore because of the convenience nature of the sample, and because my Research Ethics Board approval required that participants had to contact me, the people whose experiences are reflected in my study are arguably those who are more interested in changing the profession or were otherwise motivated to give of their time to talk about the profession. However to help enhance the credibility of the results, and to allow some generalizability, I did attempt to include within the sample individuals from a range of fields, industries, and years experience as assessed through the pre-screening. I have also tried to ground the results through comparisons of the findings to other studies in the literature.

Interview protocol

Each interview involved two components: a short survey with standardized questions and open-ended questions. The survey was loosely based on that developed by Hughes (2005) for interviews with women entrepreneurs. As Hughes (2005:30) describes, the survey ensured that basic demographic information was collected in a consistent and expedient manner for all participants. The survey items asked about education, career history, and current workplace arrangements (see Appendix B).

The main data collection tool was the open-ended interview. Initially different protocols were developed for individuals who were working in engineering and those who had left engineering. Both substantively covered the same topics, but in slightly different ways. In the protocol the questions are written out as a formal conversation guide with extensive probes, but the actual implementation depended greatly on the flow of a particular interview and the participant's comfort / discomfort with particular items (Rubin and Rubin 2005). Protocols were initially developed based on the literature with revisions being made as the interviews proceeded (see Appendix C for the final version of the protocol). The more important changes included: addition of a short overview of the research at the beginning of each interview; removal of questions probing into engineering education and career path (due to time constraints); addition of questions about whether participants had ever questioned being in the profession; probes into whether diversity and retention were perceived to be issues in the profession; and items asking whether interviewees would remain in the profession if money were no object. The protocol was, therefore, both iterative and interactive.[79] In addition I worked to follow guidelines culled from the work of Rubin and Rubin (2005) and King (2004a), for organizing interviews, ensuring clarity, and probing into topics.

Analysis

Interviews lasted from 45 minutes to two hours. Each interview was audio recorded and transcribed. I completed approximately half of the transcriptions with a paid transcriber doing the others (following signing a confidentiality agreement). An important component of the interviews was taking detailed notes following each interview, which addressed the location of the interview, the demeanor of the participant, and my reflections on any issues in the interview (either in the form of unclear questions or respondent/interviewer discomfort). These notes were used to revise questions and as a component of subsequent data analysis. Following transcription, each interview was reviewed for accuracy. Detailed notes were also created to summarize sections of the interview, and to record theoretical insights and connections between participants. Following the transcript review a one page contact summary form was completed for each interview. This form was developed based on the template provided by Miles and Huberman (1994:53) as a way to identify the main themes in each interview, summarize information collected on key ideas and research questions, identify particularly salient or

[79] Detailed notes of the changes made and multiple iterations of the interview protocols are available.

interesting observations and comments, and list new questions or ideas raised by the contact. The blank template is included in Appendix D.

Analysis for the project occurred alongside data collection through the process of note-taking and summarizing. Thematic elements distilled from the interviews, along with themes derived from the literature and the research questions, formed the start of the coding framework. The framework was developed in line with what King (2004b) describes as "template analysis", wherein a priori codes are combined with codes derived from the interviews to form a hierarchical coding scheme.[80] Key higher level codes were aspirations, capital, diversity, engineering field, engineering habitus, gendered habitus, organizational factors, and success. For each participant the transcript, field notes, summary notes, and contact summary form were coded to ensure that both detailed responses and theoretical ideas and connections were captured. This framework was also used to code the textual materials, as described above. Coding was conducted using NVivo, a qualitative software program.

Research Ethics

In line with the University of Alberta's ethical standards for conducting research with human subjects, I strove to minimize potential harm to participants, guarantee confidentiality, and acquire informed and voluntary consent. Details of the project, the assessment of potential harm, and the guarantee of confidentiality were outlined in the information letter (see Appendix

[80] Hierarchical coding refers to a framework with a few higher level codes, each of which encompasses numerous lower-level codes – which may also include further divisions (King 2004b:258).

E). No study participants reported discomfort or distress during or following the interviews. To guarantee confidentiality, all identifying details (e.g., names, company of work) were removed from transcripts. When quoting study participants, pseudonyms have been used and I have taken care to remove details that might lead to identifying a participant. Informed and voluntary consent was gained from all participants at the start of each interview.

Participants were advised of the general goals of the project at the beginning (e.g., learning about the culture of engineering, ideas of success in engineering, the career paths of men and women with engineering backgrounds), however detailed discussion of the research questions and motivations behind the project was limited. In making this decision, I recognize that, to some extent, it contradicts my feminist, constructivist standpoint. But following Ranson (2005a), I believe that identifying my research as constructivist and feminist would have been at best confusing and at worst led to a situation in which participants were not willing to talk openly with me. The theoretical language of sociology, like the technical terminology of the engineers, is something that is part of another culture. The "bad rap" surrounding feminism and the rejection of feminism by female engineers reported in past research (Ranson 2005a:109) are sufficient reasons to avoid the term "feminism", particularly as it may be versions of feminism rather than the spirit of equity that has been rejected. And, while I had some concerns about this "limited disclosure" I am comforted by Daniels (1983) statement that "deception is an ever present part of fieldwork – if only because one plans to examine findings from a social science perspective rather than one exclusively sympathetic to the values of those studied" (p.196).

Interviewing "elites" and reporting "sympathetically"

In addition to the formal ethical requirements of research, this project also involves ethical and normative issues that are more specific to my topic. These concerns were brought to the fore for me in reading Ranson's (2005a) chapter, "'I'm looking forward to hearing what you found out': reflections on a critical perspective and some of its consequences". Here she explores a number of issues involved in doing research with individuals whom one, at moments, finds unsympathetic. In this final section I will reflect upon working with elites and reporting ethically / sympathetically / honestly.

The study of engineers is important methodologically because so few projects are undertaken from a critical sociological perspective that focuses on the experiences of elites. Within sociology, as Thomas (1993) identifies, the majority of research does not focus on "elite" individuals. While individuals trained in engineering do not fit typical definitions of "elites", such as the CEO's interviewed by Thomas (1993) or the society ladies interviewed by Ostrander (1993), many of the issues that both of these researchers identify in interviewing "elites" apply to interviewing engineers. As Thomas (1993), Ostrander (1993), and King (2004a) all discuss, confidence and control over the situation in interviewing elites is critical and different from interviewing other groups. Thomas (1993) and Ostrander (1993) both present interesting strategies for "taking back" some of the control in these situations, such as asking participants how *they* felt about an instance (Thomas 1993:89), organizing the space around the tape-recorder, and not acting as a "guest" (Ostrander 1993:20). These actions are presented as ways of disrupting the elite's taken-for-granted sense of reality and indicating that the interview is not a "normal" social interaction (Ostrander 1993). King (2004a) furthermore points to the role of confidence when interviewing elites. While acknowledging that participants are the experts, King reinforces the importance of not being overly submissive.

Although I entered the interviews armed with this knowledge, in reflecting back it is clear that here, as in previous projects, my presentation of self was non-confrontational. When encountering views about visible minorities, women, and the social sciences that I was uncomfortable with, I did not challenge study participants or try to correct them. In retrospect, there are certainly moments in which I wish I had been more assertive, but my own habitus of sociological distance and self-effacing femininity always came into play. Rather than accepting that sociology is "basket-weaving" or agreeing that I am "so lucky that I just talk to people as research", these were opportunities for me to assert my expertise and the value of what I do, even if that required a moment of discomfort. Yet in the moment – and for the sake of rapport and research – I did not.

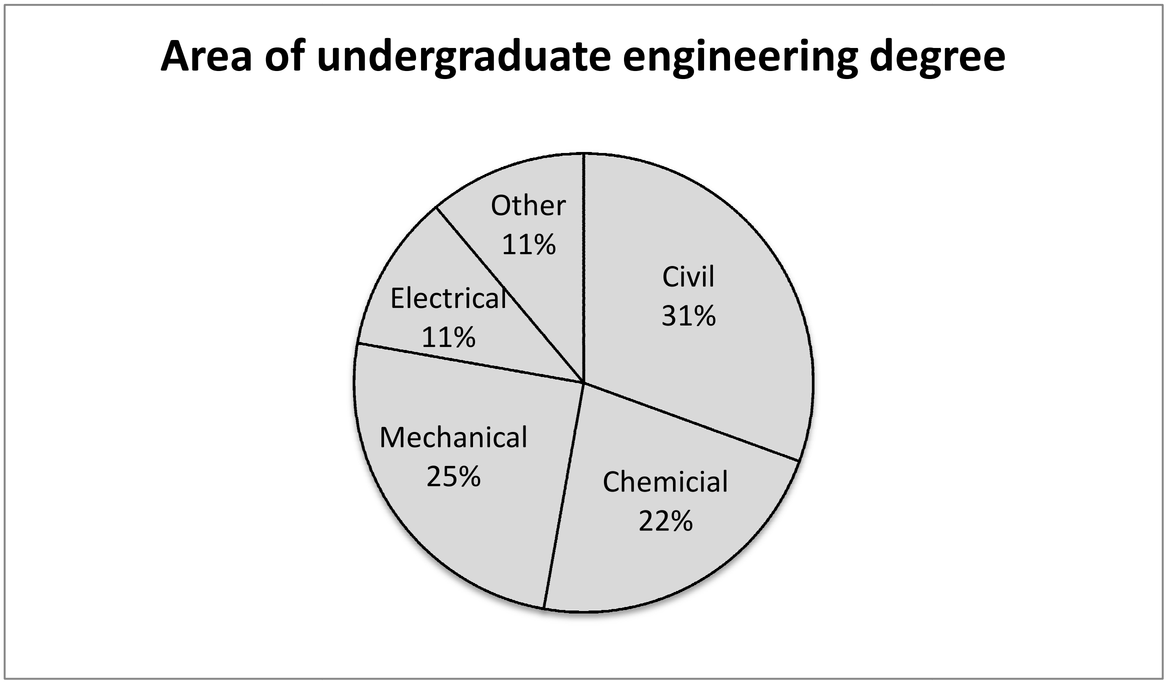
A final ethical issue is that research findings reported are necessarily partial, and how they are relayed is always shaped by the researcher's perspective. To what extent do I need to be sympathetic to my respondents and concerned with "the ideo-epistemological, ethical and interpersonal implications of using the words of their informants against them" (Springwood & King 2001 as cited in Ranson 2005a:111)? In attempting to write in a manner that is enlightening *and* respectful of my participants' experiences, I have used two strategies: reflexivity and multiple / comparative voices. These two strategies are based, in part, upon Gusterson's (1993) discussion of dialogical and polyphonic approaches to writing research. Both approaches are based on the work of James Clifford (1983) and reflect ways to move beyond privileging the perspective of the writer; with a dialogical approach, one "celebrate[s] the particularity of their own perspective as a partial but hospitable vantage point from which to analyze others' perspectives" (p.73). Gusterson (1993) cites Cohn's (1987) research on defense intellectuals in which she tracks changes in her own perspective through her relationship with informants and presents her analysis in terms of the contradictions between perspectives (p.73-74). In highlighting the tension between voices, one allows the words of the participant to come through, yet the tensions and difficulties that the researcher has with these views are not hidden. Andrew's (2002) interviews with non-feminists address these tensions through recognition that "not only are the views of her respondents historically and culturally situated, but so are her own" (as cited in Reay 2007:609). In this way the constructed nature of the text is not hidden, which may enable a more honest presentation that invites dialogue and positioning from the reader. A polyphonic approach, as described by Gusterson (1993), presents diverse perspectives through the voices of different participants. By conducting interviews with individuals located both in and outside engineering, both males and females, I have tried to examine the issues that come up through the differences between their voices / experiences / perspectives, rather than through my own notions of what is "best".

Sample Profile

In this final section, I provide a brief overview of some of the demographics of the study participants. I contemplated providing a description of each participant with their pseudonym, but given the small sample and potential links between participants, I was concerned that this might make individuals too easily identifiable. I should note that the same pseudonym for each participant has been used throughout the analysis and discussion to allow readers to begin developing a sense of individual participant's experiences.

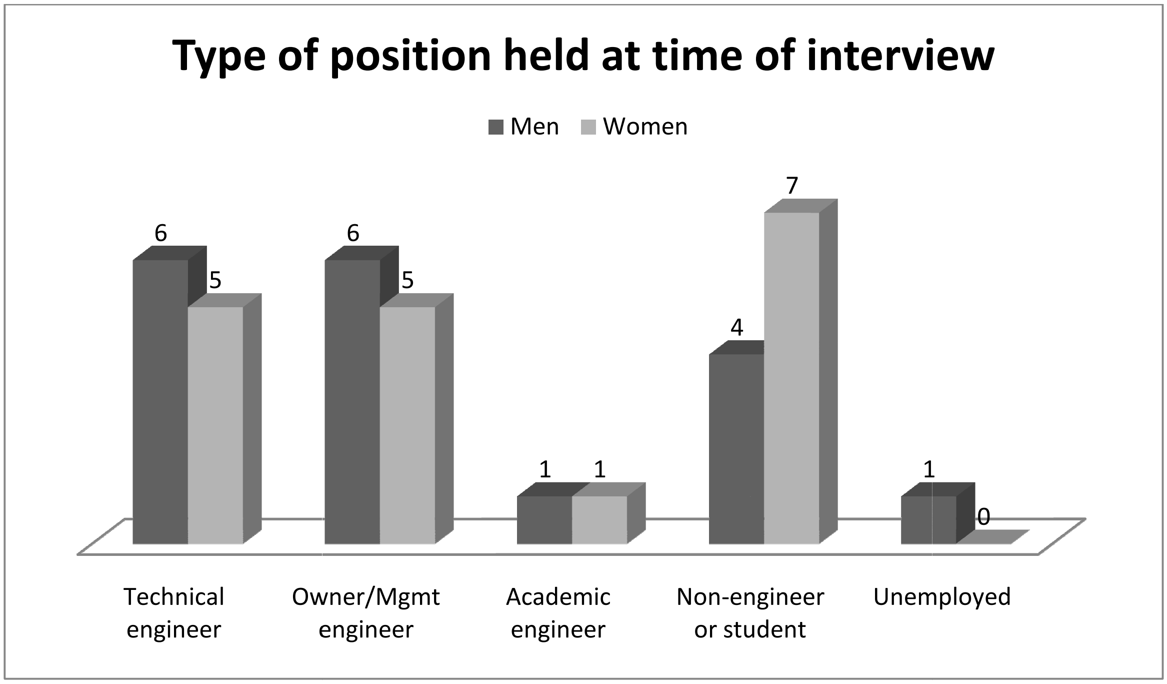
Interviews were conducted in Edmonton and Calgary between September 2007 and January 2008. The majority (28) were conducted in Edmonton, seven were conducted in Calgary, and one was done over the phone. Participants ranged in age from 25 to 86 years of age. Among the males, the average age was 46 (range from 29 to 86). The average age among the women was 35 (range from 25 to 45). The vast majority (78%) of participants were married or cohabiting at the time of the interview. Another 17% identified as single. Although participants were not asked about their sexual orientation, during all of the conversations the participant (indirectly) identified as heterosexual. Over half (56%) of study participants had children living in their household at the time of the interview. This number was slightly (but not significantly) higher for women, with 61% having children at home compared to 50% of the men.

Figure 1:



As reflected in Figure 1, participants had received undergraduate engineering training in a range of areas, with the largest number being trained in civil engineering (n=11). This was followed by mechanical (n=9), chemical (n=8), and electrical engineering (n=4). There were no significant gender differences between the fields in which people were trained. All of the participants had completed an undergraduate degree, but six (five women and one man) had not received their professional status (P.Eng.). Of these six, two were in the process of pursing their professional status, while the other four had left engineering prior to completing their time as an Engineer in Training and/or completing the professional application process.

Figure 2:



As Figure 2 reveals, the majority of study participants were working in engineering at the time of the interview. Thirteen of the men and eleven of the women worked in engineering-related positions, while a total of eleven participants were working outside of engineering or were students. The women had spent from zero to 23 years working in the profession, with a median of 5 years experience. The men had a higher median number of years (12.5). Although sizable, this difference makes sense given the older average age of the males, which in turn reflects the fact that women have only entered the field in sizable numbers in the past twenty years.

Appendix B: Demographics Survey[81]

Career Retention and Professional Identity in Engineering

Study

In order to know about the background and career paths of participants in this study, I would appreciate if you could provide some information on yourself, your education, and your career to date. This information will be kept strictly confidential and will only be reported in aggregate statistics (e.g., means, range of values).

1. Gender: Female ______ Male ______
2. Year of birth: _________
3. Country of birth: ________________________________
4. Please describe your ethnicity:

   ____

   _____
5. Would you consider yourself to be a visible minority?
   a. Yes _____ No______
6. Year of Graduation from University/College:
   a. Undergraduate Engineering degree: ________
   b. If applicable: Master's: ________ and/or Doctorate _______ and/or Other ________

____

[81] Adapted in part from Hughes 2005, 199-202.

c. If other, please describe:

____

7. What area did you specialize in during your undergraduate education (check as applicable):

Chemical Engineering _______ Civil Engineering ______

Computer Engineering _______ Electrical Engineering ______

Environmental Engineering _______ Industrial Engineering ______

Mechanical Engineering _______ Petroleum Engineering ______

Other (please describe) _________________________________

If you completed a Master's and/or Doctorate please describe the field of study:

____

8. University graduated from:

a. Undergraduate: _______________________________________

b. Master's:

____

c. Doctorate:

____

d. Other: -

____

9. Living Arrangements (check one):

Living Alone/Single ______ Married/Cohabitating ______
Separated/Divorced ______ Widowed ______

10. Do you have any children living with you? Yes _____ No _____

a. If yes, how many? _______

11. If you have a partner / husband / wife what is their occupation?

____

12. When you were in high school what was your father's occupation(s) (if you were living with a step-parent or other guardian, please answer for that person)?

____

13. When you were in high school what was your mother's occupation(s) (if you were living with a step-parent or other guardian, please answer for that person)?

____

14. For how many years were you employed as an engineer? _______

15. Did you receive your professional engineering designation?

    a. Yes ______ No ______

        i. If yes, in what year? _______

16. In how many organizations have you been employed as an engineer?

    ______

17. Are you currently (please check one of the following):

    a. Currently working in engineering ______ (CONTINUE to Question #18)

    b. Employed, but outside of engineering _______ (CONTINUE to Question #18)

    c. Not currently employed, but looking for work ______ (SKIP to Question #21)

    d. Not currently employed and not looking for work ______ (SKIP to Question #22)

18. What type of industry is your current organization involved in?

    ____

    ______

19. What is the title of your current position?

    ____

20. When did you begin working with your current organization?

_______/______ (year/month)   (SKIP to END)

21. How long have you been actively looking for work? _________

22. When did you leave your last paid position? _________________

(year/month)

23. What was the focus of the last organization you worked with?

____

______

24. What was the title of your last position?

____

Thank you very much for completing this questionnaire.

Appendix C: Interview Protocol

Revised: November 18, 2007

Preamble / Description given prior to interview:

Thank you for your interest in participating in this interview. This interview will be part of the data collection for my dissertation project, which is focused upon the factors that affect the decisions of individuals to either remain in or leave the engineering profession. In pursuing this research I will be examining the organizational cultures of engineering workplaces, individual work histories, and engineer's personal impressions of their profession. I will be asking questions today about your career, perceptions of the engineering profession, and future aspirations. I am also interested in your suggestions of how the engineering profession and organizations could be changed to improve the experiences of individuals trained in engineering.

A. Choice of Engineering

To begin I would like to discuss your choice to pursue engineering.

- Can you tell me a bit about what led you to choose engineering?
- … to choose your field of engineering?
    - Probes: important individuals; experiences (volunteer, co-op); role of family – views on postsecondary, support of choice

B. Work History

- Can you briefly overview your career (organizations, length of time) following graduation to today?
- At the current time, if someone asked your occupation, how would you respond?

If "engineer":

- Have there been any times when you questioned being in engineering?
- What were the issues involved? How did you resolve them?

C. Current Position & Organization

1. If working:

- What are some of the most and least satisfactory aspects of your current position?
- When you were studying was this the type of work you expected you would be doing at this point in your career?
- Do you consider this to be "engineering work"?
- Have there been any periods where you were not employed (unemployed, parental leave, additional education?)
- How would you describe your "working style"?
  - Do you think other engineers have similar "working styles"?

Organization

- Thinking about the two most recent organizations you have worked with – can you compare the environment / work culture of these organization? Pluses? Minuses?
  - Probes: size? ethnic diversity? Gender breakdown? Generational? what are some of the dominant values? What are the goals of the organization? How are you encouraged to interact with co-workers? What style of work is encouraged? Work/life policies?
- In what ways does this environment "fit" for you?
- Are there aspects of the culture that you would change? Why? Why not?

2. If looking for work:

- What type of work are you looking for?
- Is there a particular industry you are focused upon?

- Are there particular aspects of the organization that are important to you? (e.g., benefits, flexible work hours, promotional opportunities)

3. If not looking for work:

- Do you have plans to look for work in the future?

- Are there particular aspects of the organization that are important to you? (e.g., benefits, flexible work hours, promotional opportunities)

D. Reflections on engineering for those out of profession [if continuing to work in field, skip]

I would now like you to think back to your time in engineering:

- Can you tell be about your last engineering position?

    - What did you enjoy / not enjoy about this job? Was this they type of work you had expected when you were doing your engineering degree?

- Can you tell me about the last engineering organization you worked for: Approximate size? Number of engineers? Breakdown of men versus women?

- Can you describe the environment of the last engineering organization you worked in?

    Probes: what were some of the dominant values? What were the goals of the organization? How were you encouraged to interact with co-workers? What style of work was encouraged?

- In what ways did you feel this environment "fit" for you?

- Were you actively involved in APEGGA? What services / opportunities did you use?

- How did the shift out of engineering come about (active, chance)?

- What were some of the **major factors** in your decision to change your career path? **PROBE**

E. Non-work factors [all participants]

- Are there aspects of your life outside of work (e.g., family, hobbies, location) that have important implications for your career?
    - Probes: Are there ways caregiving has impacted your career (e.g., choice of position, location)? Has your involvement with [volunteer organization] lead you to pursue different career options? Have your *spouse* / children impacted your choice to stay with / leave a position or organization?

F. Aspirations and Expectations for future [all participants]

- Looking into the future, where do you expect to be in 5 years from now?
    - Career?
    - Other aspects of life (family, travel)?
- If you did not need the money would you continue to work in engineering? [In an ideal world where would you "love" to be in 5 years from now?]

G. Engineering profession [all participants]

Now, I would like you to think about engineering more broadly.

- What do you see as the best reasons to become an engineer?
- Are there aspects of the career that, had you known about them during university, may have altered your decisions?
- Can you describe someone you view as a "successful engineer"?

- Probe the terms used, e.g., How would you know that a colleague was "committed"?
- Within your organization (or most recent engineering organization) what is/was required for promotion? Are/were the criteria clear? Are there changes you would make?

- Do you think your career as an engineer would have been any different if you were a man / woman (opposite sex)?
    - In what ways?
    - Do you think this/these difference(s) are important?
- What does success mean to you more broadly?

H. Issues in Engineering

Two of the major topics that this project is examining are retention and diversity.

- How would you define retention?
    - Is it an important issue? What are the major factors involved? [Probe: retention within engineering? Within organizations?
- How would you define diversity?
    - Gender, ethnicity, generational? Is diversity important to engineering? What are the major factors involved? H*ow can these be addressed?*

I. Recommendations for Change

- Are there any aspects of the engineering profession that you think need to change?
- Are there any aspects of engineering organizations that you think need to change?
- How might these changes be made?

J. Conclusion

- Are there any issues or topics that I have not addressed that you think are important to understanding the retention of engineers? Understanding their career paths?
- An aspect of this project involves exploring the current environment in which engineering takes place in Alberta. Are there any materials (magazines, websites, etc.) that I should examine to understand this?
- There is also the possibility that, when the preliminary results are compiled, focus groups will be held to discuss their relevance. Would you be interested in participating in a group of men / women engineers / individuals pursuing alternate career paths? If focus groups are not possible, would you be willing to provide written comments on the preliminary findings?
- If in reviewing the transcript I have questions can I contact you for follow up?

Appendix D: Contact Summary Form[82]

Interview ID Code:
Contact date:
Today's date:

1. <u>What were the main issues or themes that struck you in this interview?</u>

2. <u>Summarize the information you got (or failed to get) on each of the target questions</u>

Question	*Information*
Success	
Professional identity	
Dominant values in field	
Engineering habitus	
Gendered habitus?	
(mis)match between habitus and field	
Inform policy	

3. <u>Anything that struck you as salient, interesting or illuminating in this contact?</u>

4. <u>What new questions, speculations or ideas were raised by the contact?</u>

[82] Adapted from Miles and Huberman (1994:53)

Appendix E: Information/Informed Consent Letter

Career Retention and Professional Identity in Engineering

This study is examining the factors that have lead individuals to either remain within or leave the engineering profession and how these factors may vary by the gender, ethnicity, or social background of the individual. This project is being conducted by Rachel Campbell, a PhD Candidate in the Department of Sociology at the University of Alberta, in partial fulfillment of the requirements for a doctoral degree. The study has received approval from a University of Alberta Research Ethics Board.

For this study I will be conducting individual interviews with approximately 45 individuals who have been trained in engineering. In the interview I will ask questions about your work history, the organizations you have worked in, and your views on the engineering profession. I will also ask about work/life balance and your future aspirations. During the interview I will also ask if you might be willing to be contacted about participating in a follow-up phase of the study.

This interview will consist of two parts, a short questionnaire to collect demographic information, and a face-to-face interview. In total the interview and questionnaire will take approximately one hour and can be completed in your office, home, or other private location. I will arrange a time and place that is convenient for you.

The interview will be audio-recorded and transcribed. Upon transcription all identifying information (e.g., names, company names) will be removed. If I do not personally transcribe the material, the person who does will sign a confidentiality agreement. All questionnaires and recordings will be stored in a locked cabinet. When all phases of data collection are completed, all personal identifiers will be removed from the recordings and questionnaires. All voice recordings and paper questionnaires will be destroyed five years after the completion of the research. The data (e.g., transcripts, SPSS dataset) will be retained for future research and analysis. All identifying information will be removed from the data retained.

Please understand that your participation in this study is entirely voluntary. You are free to withdraw at any time prior to any publication of the findings or, if no publications have been completed, the completion of the follow-up phase of the study (or your decision not to participate in the follow-up), since at that point I will have removed all identifying information from the transcripts and it will not be possible to identify your data. You can choose not to answer any questions. All information will be kept confidential. There are no known risks associated with participating in this study. However, if you find the process too difficult or wish to withdraw, please inform me at any point. The goal of this study is to enhance the career satisfaction of individuals trained within engineering through a better understanding of career-decision making and the engineering profession. Findings of this study will be presented at academic conferences, published in Sociology journals, and may be reported to interested parties (e.g., professional associations). No identifying information will be included in any of these instances.

If you have any questions about this interview or the project you may contact the investigator, Rachel Campbell at rachelc@ualberta.ca or 780-264-7280, or the supervisor of this project, Dr. Harvey Krahn at Harvey.krahn@ualberta.ca, phone 780-492-0472.

Consent:

I agree that I have read and understand the above information. I have been given the opportunity to ask questions as well as have questions answered. I understand that the information given by me will be kept in strictest confidence by the researcher. By signing I am indicating free consent to participate in the survey and questionnaire on engineering career retention:

____

Participant Name (Please print)

____

Date

Signature