Women Engineering Graduates from the 1970s, 80s and 90s: Constraints and Possibilities of a Non-Traditional Career Path*

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This paper is a retrospective account of three women graduates from a Canadian school of engineering whose experiences span a 25 year period from the 1970s, where women's enrolment was sporadically few, to the late 1990s, where it achieved close to 25%—the largest enrolment seen to date. In-depth interviews were conducted with these women focusing on their university and work experiences and the barriers they have encountered. Their profiles reveal that while women's structural representation in engineering improved significantly during this time span, cultural practices and attitudes towards them have been more resistant to change. Key areas connected to career success are touched on, including mentorship, networking and the importance of gaining acceptance into male engineering circles. The author has kept the precise identity of the institution and its locale confidential due to participants' concerns about maintaining anonymity and some events and practices, which although representative of many universities at various points in time, could be seen as damaging.

Keywords: women; industrial experience; sociology

STRUCTURE VS. AGENCY: GENDER AS A SOCIAL PROCESS

THEORETICAL EXPLANATIONS OF social phenomena focus largely on the interplay that exists between social structure and human agency. Sociologists, for example, pay particular attention to the link between the societal constraints within which individuals operate and the creative power they possess to change society [1]. Within the sociology of education, this dynamic is often used in an effort to understand the social processes that take place within schools and how these processes act to both constrain and create possibilities for social change. Proponents of structural theory place a strong emphasis on the relationship between the places individuals occupy in the social structure and the degree to which they achieve social mobility.

Central to the structural or reproductionist argument is the notion of 'cultural capital' first formulated by Bourdieu [2]. Cultural capital refers to the different sets of cultural and linguistic competencies that individuals learn by way of socialization. These competencies are assigned certain social values and status in accordance with what the dominant class labels as the most valued cultural capital. Hence, like economic capi-

tal, cultural capital tends to be controlled by, and serve the interests of, the most powerful class in society. The role of schools, according to these theorists, is largely to legitimize and reproduce the dominant cultural capital, by rewarding students who use the cultural and linguistic capital of the ruling class, thereby ensuring the educational and occupational success of these individuals in society. Thus, the possession of valued cultural capital may be seen as largely influential in affecting an individual's educational and occupational fate within society [3, p. 267].

Those theorists who emphasize the role of agency argue that the human factor in the reproduction model generally disappears amidst a theory that leaves little room for the possibility of self-creation, mediation and resistance. Referred to as critical pedagogy or critical theory, this approach argues that schools do not simply reproduce culture and the social relations of production, but they are also arenas where ideological struggles take place among and between different social groups within society, thereby giving rise to new tensions and contradictions. In possessing a creative function, critical theorists assert that schools are thus capable of changing the structures of society that influence the distribution of economic power and cultural status [4].

While the focus of much of the debate between structure vs. agency is on the role of class within the social structure, similar arguments have been

extended to race and gender and the constraints as well as possibilities that exist to overcome the power of these social forces as well. In an effort to understand the role gender plays as a structural force in influencing individuals' societal mobility, two different interpretations that offer 'macro' and 'micro' approaches to the analyses of social phenomena may be used. The emphasis which reproduction theorists place on analyzing the relationship between social structure and patterns of educational and occupational mobility is generally seen as indicative of a macro-sociological approach, that is, an approach in which large-scale structural processes, such a gender are believed to be significant in accounting for the existence of particular social phenomena [5].

Whereas the term 'micro' refers to an emphasis on the minute details of face-to-face interaction as a means by which events are socially constructed and organized. Hence, while micro-sociologists may agree with the assertion that students are sorted and stratified within the education system in a manner which makes differential opportunities available to them, they would disagree that students' futures are predetermined by their social class, race or gender location in the social structure. Rather, they would argue that it is the accumulated effects of specific interactional events that contribute to the creation of a stratified occupation system [6]. A micro-sociological approach is more agreeable to a critical theorist stance, in that although face-to-face interactions are the site in which larger structural relations are played out, it is also the location in which opportunities for resistance, and ultimately social change, are possible.

This approach has much in common with post-structural theories that offer a framework for re-exploring and re-conceptualising our understandings of gender and engineering. Using this framework, Stonyer [7] argues, engineering education makes certain meanings available to women engineering students, which regulate what women can/cannot do and be. That is, women have limitations on the ways available to them with which they can interpret experiences at a personal or 'lived' experience level. Women, however are not necessarily constrained by these identities and can work strategically to optimize opportunities for changing the range of meanings of 'engineer' [7, p. 394].

In what follows, the author offers an explanatory framework which links structure and interactional styles to the examination of gender in engineering. Within this model, the concept of culture plays a central role, in that it represents the point of convergence for both structural and interactional processes. McIlwee and Robinson [8] in what remains one of the most comprehensive and in-depth sociological analyses of women in engineering have described culture as a force that manifests itself through day-to-day activities and interactions:

Culture lies in the rituals of conformity: the forms of talk, styles of interaction, and modes of dress that signal our belief in it. Culture in this sense, is a form of 'impression management': we act in such a way as to create an impression in others that we are adhering to a set of values (p. 17).

An understanding of a culture, however, is incomplete without a corresponding knowledge of the relations of power which provide its foundation. Thus, in describing a culture's values, norms and styles of discourse, one must also examine how it is a function of larger relations of domination. Engineering and engineering education have come to be identified as symbolic of a masculine culture, not only because of the pervasiveness of masculine values and interactional styles, but also because of the male-dominated structure which supports it. Through its analysis of gender as it operates at both structural and interactional levels, this article aims to shed further light on the culture of engineering as it shaped the lives of women in the 1970s, 80s and 90s. It also offers strategies on how engineering educators can improve the prospects for women students in the 21st century.

The 1970s: Isolation, depression and eventual fulfilment through a graduate degree

Being a woman in North American engineering schools in the 1970s was a lonely experience. At that time, women made up generally less than 5% of the student body. University 'X' was no exception. Gwen, a 1975 civil engineering graduate who has since left the profession, remembers that her decision to study engineering was largely the result of a chance comment made by a male high school math and physics teacher who, despite the fact that she was at the top of her class, said: 'You wouldn't do anything radical, like go into engineering, would you?' She recalled that comment as 'all the challenge I needed.' The decision as to which area of engineering to major in was also made in a less-than-calculated fashion:

Electrical was like a nightmare. Who could make sense of that? And geological, with stacks of memorizing, I couldn't memorize my way out of a teacup, so how as I going to memorize my way out of 20 million rocks? And then there's mechanical, and I thought, 'gears and machines?' No. So I thought, what's left? Well there's mud. I understand mud, I think. So I went into Civil. It was the least of the evils.

Coming from a poor, rural family who could not afford to finance her studies, at 18 Gwen made the transition to the city and worked in exchange for room and board to support herself for three years, then relied on bursaries for her final year. The transition was far from smooth. While she had excelled at math and sciences in high school, Gwen saw her marks plummet in the first few months and by Christmas of 1971, was sinking into a depression she would not come out of for six years. The recognition that she was depressed did not come until years later, but she remembers 'going to bed crying, waking up crying, and feeling half-asleep

all day.' Although her marks slid in most subjects, there was one exception:

> The only thing I did well in was drafting. And that should have been a signal to me. It should have said, 'you need more right brain satisfaction than what you're getting.' This left-brain capacity that you've always excelled at isn't all of you. There's another whole side of you that maybe you haven't got great marks for or recognition, that you need to entertain. And it's not going to be entertained here.

While coming from a non-engineering background, with no financial or emotional support, could be seen as a serious obstacle for a woman establishing a career in engineering, especially in the 1970s, Gwen's biggest roadblock was the culture of engineering she would encounter upon arrival. This culture, which is now well documented in the university and professional experiences of women in engineering, was significantly more acute in the early 1970s than it is today [8] [9]. As one of only two women in civil, and four women in the entire engineering program, Gwen's potential for isolation and depression would only worsen.

Two noteworthy traditions characterized engineering student life in the 1970s. One was the annual set of freshmen rituals, which encompassed many activities including the Lady Godiva ride and the freshmen parade. Lady Godiva was the name given to a tradition that began each academic year in which engineering students hired a scantily clad woman to ride on a horse around campus. Beer drinking was a major part of the festivities, which allegedly ended with a male student having sex with the woman. On these occasions, the few women students including Gwen were warned by some men not to attend because 'the guys get loaded up and get all horny and crazy and you're just not safe there.' In the freshmen parade, all new students were taught the traditional song which symbolized their initiation into engineering student life. Gwen reflects on the lyrics she sang in order to be accepted and form 'part of the gang':

> 'We are, we are, we are the engineers, We can, we can, we can demolish 40 beers. Drink rum, drink rum, drink rum, drink rum and come along with us . . .For we don't give a damn for any damn man who don't give a damn for us.'
>
> This is hardly inspirational music or language, or anything that one should aspire to as part of becoming a whole and enlightened person. It's at a lower level. It can be in some respects, considered fun, but it's the lowest form of fun. There's nothing emotionally, intellectually or psychologically uplifting. It tends to pull one down in terms of consciousness.

She describes the engineering students' newsletter of the time in less than favorable terms:

> It was a rag, worse than a rag. And while I was still at university one of the young men who had contributed heavily to it, was actually charged for the crap that was in there. It was that bad. It was foul, it was like a diatribe against women, very misogynistic and it was very sexual. But it was a minority of students, I can't stress that enough. This would be less than 5% of the

engineering student body who devoted any kind of energy to it. Who had the time? Most of the students were interested in passing and getting the heck out of there.

Despite being in the midst of a culture which was clearly male-dominated, and in which the few women present did not always feel comfortable, Gwen maintains that she was never openly discriminated against or harassed by male students or professors. She does, however, recall that it was not uncommon to walk down the hallways and hear comments about 'rockets' being aimed at a female. Although these were not personal comments, they were nonetheless disturbing. Similarly, she vividly remembers one instance where she walked into student council chambers and was greeted by an off-putting gesture:

> Some guy was sitting there with his fly undone, and a carrot sticking out of his pants. And this is supposed to be funny? It's not funny, it's like yes, little boys have penises, so what? This is news? This is supposed to be humorous? I don't get it. This is the level of jocularity that we were supposed to enjoy.

These incidents support Bagilhole et al.'s findings that women constitute an audience for men's sexual displays and are tested to see how they would respond to the male culture. By defining women as 'outsiders' men could unite and reinforce their dominant group solidarity. In their case study of women engineers' experiences on British construction sites, it was found that by reducing women to sexual objects of ridicule, the dominant male culture reproduced and even reinforced itself [10, p. 427].

Dryburgh [11] offers a more detailed and indepth account of many of the male-dominated traditions and rituals which characterized student life in Canadian engineering schools as recently as the late 1990s. Such analysis is helpful in contextualizing University X as being not unique, but rather representative of long-standing practices and traditions found in engineering schools across the country.

Gwen completed her degree within four years with a C+ average, far below what she knew she was capable of achieving. She was still depressed by this time and remembers not attending graduation or even having her class picture taken. One thing she did remain adamant about however, was acquiring and wearing her Iron Ring. The tradition of the Iron Ring dates back to 1922 when at a meeting of the Engineering Institute of Canada, it was argued that an organization was needed to bind all members of the engineering profession in Canada more closely together. Rudyard Kipling, who had made reference to the work of engineers in some of his poems and writings was asked for his assistance in developing a suitably dignified obligation and ceremony for its undertaking. Kipling promptly responded with 'The Ritual of the Calling of the Engineer.' The Ritual is administered by a body called The Corporation of the

Seven Wardens Inc. and takes place at the end of the students' final semester in a private, and in many ways, 'secret' ceremony. Each student receives a ring as a constant reminder to him or her, as well as a sign to others, of their oath.

The Iron Ring is traditionally worn on the little finger of the working hand and is associated with a 1920s bridge collapse in Quebec which resulted in 85 deaths. The original rings were taken from the wreckage of the bridge, and thereafter the engineering rings have symbolized the heavy responsibilities carried by engineers in their work [11, p. 676]. Gwen, at the time, was acutely aware of the tradition associated with the ring and its resulting status:

> Every time I lost it, I'd get it replaced. That was kind of funny. That did represent for me the blood, sweat and tears part, the ring. I worked damn hard for this, harder than anybody will ever know. I will bloody well wear it 'till I drop dead.

She has since lost the ring on more than one occasion, and in the last instance made no attempt to replace it.

Her entrance into the workforce in 1975 offered no respite from the engineering culture she was by now well exposed to. Gwen, along with twelve other engineers in training was hired by a major utility in the province. She recalls the initial screening and interview:

> I was subjected to a medical exam although I was not going to be a lineman or a construction worker. I was subjected to a medical examination, which included a breast exam. And I've run into other women from that time who have had the same kind of physical. Just scary. And then, in the interview, they asked if I was married. I said, 'what's that got to do with anything?' 'Well, married women get pregnant, and then they leave with all that training we give them.' And a year and half later, they gave me a layoff notice. Me and ten others.

It was actually one of the few times in the utility's fifty year history that engineers were laid off due to financial hardship. This period also preceded the adoption of human rights legislation and sexual harassment policies. Gwen remembers the license male employees were given to express themselves at the time:

> There was a boss who used to make jokes about making the secretaries stand on his credenza to pin up notices on his bulletin board, so he could look up their skirts. Everybody had a pinup girl on the back of their door. If they weren't brazen enough to put it right on the wall, they had it on the back of their door. So when they closed their door they could look at it.

From the utility, Gwen then moved into provincial government for eleven years, where she continued to work in engineering but more in a planning capacity. And while she still describes the existence of pinup girls and rude comments during this time frame, she notes that by the late 1970s equal opportunity legislation was being introduced and the government was becoming the most proactive employer in this area, and thus the best place for a woman engineer. This supports research findings which argue that the larger, and often more bureaucratic the employer, the less power the culture of engineering is capable of exerting on women [8]. Nonetheless, Gwen had reasoned that she would never be eligible for the kind of advancement and promotion she sought:

> Opportunities were given to men who excelled as engineers, and were clearly men. Survivors of that system, whatever that meant. Whether that meant not making waves, whether that meant towing the company line, whether that meant being a good old boy, whether it meant thinking like everybody else and talking like everybody else—whatever that meant, I knew I couldn't do it. First of all, I was constantly at loggerheads with somebody. When they were talking about the regulation of one of the northern lakes, I was interested in the native Indian rights. This was in the early eighties, and I was told firmly that it was not my business, that was for the politicians to sort out. And I said 'yes, but if I'm doing an economic study, that factors in doesn't it? What about the economics of these people? And their livelihood?' Well, that was a political decision. So I knew there would be no peace for them or for me.

The prospect of earning a graduate degree outside of engineering became increasingly attractive to Gwen, who began to see this as a way out of engineering once and for all. She pursued it vigorously on a part-time basis, while still working in government. By the time she earned the degree in 1989, she had manoeuvred herself into an analyst position with the provincial government. Gwen was finally at peace with the scope of her job, the independence she had gained for herself and the organizational level she had achieved. She continued on with that position for four years, and then moved into another department, for a total of 20 years in government. When asked to reflect back on her educational experiences in engineering and the graduate degree, she made a stark contrast between the two programs:

> In the engineering program, there was a continuous stream of sexual innuendo and degrading, derogatory, or sexist remarks about women, mostly about women's bodies. In the graduate part-time program, there was nothing of the sort. In the engineering program, there were four women in the entire bachelor-level program. In my picture of my graduating class in the other program, 17 out of 36 students were women.

In summary, the 1970s, like the decades that came before, were characterized by the dominance in engineering education of traditional male values and behaviors. Men's overwhelming structural representation at the professional, faculty and student level was embedded in cultural practices that had the effect of intimidating the few women involved and in some cases led to their eventual exit from the profession.

The 1980s: The importance of gaining engineering experience, networking and acceptance into male engineering circles

By the mid 1980s, significant progress had been made in instituting human rights legislation, employment equity and sexual harassment policies within the Canadian social structure. As a result, many of the overt displays of male behavior which typified engineering schools up until the late 1970s had fallen by the wayside, with government and universities becoming more sensitized to discrimination against groups such as women, racial minorities and handicapped persons.

It was this environment into which Denise entered when she began engineering school at in 1984. She also came into the program with a more personal connection to engineering. Her father was a math and physics teacher, but also held a Master's degree in electrical engineering. From an early age, she understood the nature of what engineers did, and had a firmly entrenched plan to start electrical engineering by the time she finished high school, although she later decided to pursue mechanical. For men and women alike, the presence of a significant other (for example, parent, teacher, classmate) is critical to choosing an engineering career path. For women it is even more pivotal, as they typically lack the 'tinkering' background from childhood and adolescence that helps make the choice even more natural for young men [8], [12], [13].

The representation of female students in engineering had also improved, albeit marginally from the 1970s. In Denise's graduating year, there were eight women out of 51 in her mechanical class. This number formed enough of a critical mass to enable a women engineering students' network to emerge. At the time most engineering schools were built, women's washrooms were generally not planned as part of space allocation, apart from the needs of the small secretarial staff. Thus, these washrooms remain at a premium, even today. Denise refers to one such space as a hub for the women engineering students to congregate:

> There used to be a study table on the outside of the lecture room. There's the women's washroom and sort of an anteroom, about 8'x 12'. It's closed up now, but there were desks there. About four people could fit in. Very quiet for studying. So if you were studying there, chances are the people that you were going to meet were female. It was actually inside the door of the washroom. We had our own space, there were no guys there. Studying together, having coffee together, just meeting each other in class, and knowing that they [women]were there made a huge difference.

She refers to the existence of this network almost twenty years later, and maintains that it played a major role in sustaining many of these women in the profession:

> We formed an engineering women's advisory committee through the engineers' professional organization in the province. We had the opportunity to email, phone and talk to each other no matter how far off we ended up from each other. So when one of us went on maternity leave we all saw how that went. We could console our bosses, when they had hissy fits about us having a family. And this was a huge thing.

Despite these improvements in terms of increased numbers of women and networking opportunities, once she graduated in 1988, Denise still faced similar roadblocks as Gwen did on the job over a decade earlier. At her first manufacturing employer where she stayed for six years, she also battled the 'pinup' culture. She was interviewed for the job by the plant manager who had a picture of a topless woman on the back of his door. When he closed the door for the interview, she remembers him directing questions to her while he was able to view the photo behind her. Within a year or so, many of these practices were put to an end, although she remembers the maintenance department being more resistant to change:

> The maintenance area, which was quite a separate area in the shop, was all closed in and stuff, the guys still had them [pinups] in their toolboxes, and were quite quick to display them for you and make comparative references . . .which spoke to their level of intelligence. But I would refuse to go to maintenance. So if they needed me for something, or if I needed them for something, they had to come to my desk. And they had to come to my desk, because I would have blown the whistle on them if they didn't come to me. My desk was on the opposite side of the shop. It's a long walk to get to my desk.

She remained the only woman in the company's engineering department. However, her career with the company came to an abrupt end, when one year after returning from her second maternity leave, Denise resigned. She had continued to work at least one day a week during the six months, but when all the other engineers in the department received a raise except her, she reasoned that it was due to her leave. Denise went on to an automotive parts manufacturer which offered a much higher salary and better benefits, and with whom she stayed for 10 years. She rose to the position of quality management system engineer, with responsibilities in both Canadian and American plants. Reporting directly to the president, she describes the experience as a positive one in which she was able to achieve what she set out to, and set the tone for the company in a few key areas. As her responsibilities grew, she traveled more frequently often as much as one week out of four, mostly to conduct internal audits. The company became increasingly progressive in terms of meeting its employee needs:

> If we stayed in a hotel, you would get paid by the company to see a movie outside like, if you went to a movie theatre. But not if you ordered one in your room. Janice [woman engineering colleague] actually pointed out to them that if she's traveling by herself, she's not going to go out in the evening. So they actually changed that policy. And most of the time, they would ensure that I didn't travel by myself. I

ended up doing it toward the end but they were pretty good about it.

She eventually developed a chronic illness which necessitated that she go on part-time disability in 1999 and finally the disease became too demanding to continue work. Once again, the company proved flexible:

> When I went on part-time disability, I basically did a full-time job in part-time hours. It was a win for everybody. I just didn't have to be at the shop as much. I did have to travel still, which was sort of a downer, but they made sure that I was always taken care of. I never had to travel too early in the morning; I never had to travel too late at night. They really let me create my own sort of job description and activities, so you just have to make a point of having them know that you're holding their interests as finely as your own.

Looking back on her 15-year career in manufacturing engineering, which remains one of the most heavily male-dominated fields in Canada, Denise hypothesizes as to possible reasons for her success. As mentioned earlier, the network of women engineers she stayed in touch with, and who had their genesis in university, was a major factor in terms of providing support and knowledge about navigating workplace culture. She also cites the fact that after her first year of studies, Denise took a summer job working on a manufacturing shop floor, which gave her 'glimpses of what really went on in the world.' Furthermore in that job, rather than doing the 'more delicate, picky work' that women employees were typically assigned, she built window frames, something normally considered men's work. The importance of summer and cooperative work placement programs can not be under estimated in terms of providing women students with much needed confidence early on in engineering [14]. Denise continued to spend time on the shop floor as her career progressed, where she maintains that much of the politics and networking with key people takes place.

Lastly, while she realized the significance of a female network, Denise was acutely aware that engineering culture remains mostly male and that isolating herself from her male colleagues would prove detrimental to her career success:

> In the office environment, quite often, if you're the only female in your department, women from other departments think that they need to be your friend, because you must not have any friends. It's easy to get whisked away, every coffee break and separated from the group. Definitely, you want to be friendly, and open to those friendships, but you have to go for coffee with the guys you work with. Otherwise, they don't know who you are. And I think that's really disconcerting for them. They think you're not there full time or you're off with the ladies, and then you come back. Lots of work gets done over coffee, you talk about ideas, you bounce ideas off each other.

In summary, the engineering environment of the 1980s began to provide opportunities for glimpses of social change and human agency that critical theorists argue is possible. Structural changes at both the societal and institutional level paved the way for more women to choose engineering as a career path. And while some traditional male behaviours persisted, it was now possible for a critical mass of women to forge the kinds of interactions and networks at a more micro-level which slowly lead to culture change.

The 1990s: More Women, More Changes, But Have We Made Progress?

As this decade began, the stage was set for further political and social changes in Canadian society, due in large part to the Montreal Massacre. On December 6, 1989 an enraged gunman roamed the corridors of Montreal's Ecole Polytechnique, killing 14 women. He separated the men from the women and before opening fire on a classroom, screamed 'I hate feminists.' Of the 14 women killed, 12 were engineering students.

Many changes ensued, including the enforcement of stricter gun control laws, more scrutiny of engineering school traditions on Canadian campuses and overall, less of a public tolerance for sexist jokes and behavior. Universities invested greater efforts to recruit women into engineering and more outreach programs were established through public schools to attract women into science and engineering careers. To this end, University X hired an individual to oversee such initiatives on campus. A former graduate of the faculty, she was responsible for other strategies including methods to help retain women students, such as mentoring programs and study support groups. This was the point in time when women's enrolment in the faculty swelled, and eventually peaked at 21% in 1997–98. The position was ultimately terminated in the late 1990s due to structural reorganization and budget cuts. Since this time, women's enrolment in engineering at University X hovers at around 16%.

Lisa came into engineering in 1991 with a similar kind of support and encouragement that Denise experienced. In fact, Denise's father was Lisa's math and physics teacher. Once in however, she admits to having less of a passion for engineering than she did for other subjects such as women's studies and criminology. Her discipline and persistence enabled her to forge ahead, but similar to other women's rationales, Denise expressed some trepidation about her 'tinkering' capabilities and choice of major:

> I was a little frightened of computer engineering because the only computer we had at home at that time I think was a Tandy 1000 that you could do word processing on and I had never even turned it on. I had used it before, but I had never turned on a computer before I had my computer science course in first year engineering, and I was deathly frightened of breaking something. And then I realized it's kind of hard to break computers and I really liked computer science, but I still felt that there were people around me that were talking computers in ways that I just wasn't

understanding. I just felt, 'I can't go into that area because I don't have the vocabulary.' So computer and electrical, I discounted for that. Mechanical and civil seemed like big programs, I was afraid of getting lost in them, that if I need help, would anyone notice if I was floundering? Would anyone notice, would I have access to profs.?

She thus decided on biosystems engineering which at the time was still known as agricultural engineering. Her reasoning was much like another biosystems female student, Melissa who formed part of an in-depth study conducted by the author in 1997 on gender in the engineering classroom [15]. The department is smaller than others, and boasts a higher percentage of women students. This had a strong appeal, in addition to its reputation for international development and improving the livelihood of communities overseas. Despite the challenging workload and some uncertainty both women experienced in their first year, they went on to achieve successful academic records. In fact, Lisa received the gold medal in biosystems in her graduating year which consisted of a record six females out of eleven students overall.

She describes the engineering program and biosystems professors in the 1990s as offering a supportive environment. One incident that does stick in her mind however, was the time conflict she had between writing a final exam and her wedding, which had been planned several months in advance of the exam schedule:

> The exam was from 2:00 to 4:00 and the wedding was supposed to start at 4:00. So, I was telling the prof. that I had a bit of a conflict that day. He seemed to think I should move the wedding, not make arrangements for the exam. The best they came up with was that I wrote the exam from 12:00 to 2:00 and then the wedding started at 4:00. It worked out okay. I'm not the kind of personality that needs to take four days off before the wedding to do the manicures and pedicures and hairdos and so on. That's just not me, so I was fine with this in the end.

Lisa describes pockets of the kind of traditional male behavior Gwen spoke of in the 1970s, including belching contests and exchanging pornographic videotapes in the student lounge, along with explicit mugs and posters. Her response to these practices was at times confrontational:

> There were some women who had a feminist approach, I guess, for lack of a better word, and I was one of them. Saying, 'smarten up, and act like human beings, don't ignore us, like if I asked you do you want to work on this lab together, don't say no, I've already done it, when I know for sure that you haven't. Because the next afternoon I see you working on it.' I never felt really threatened by them or unsafe with them at all, because I knew that they were mostly just talk, and I knew again that I didn't depend on them for anything. I was still achieving on my own basis. They didn't control me in any way. But I never stayed on campus longer than I had to. I always went home and studied there.

For Lisa, achieving on one's own merit and moving ahead academically turned out to be a drastically different frame of reference from what she later encountered in the engineering workplace. She was hired after graduation by a consulting design company whose role was largely municipal engineering, then laid off nine months later due to a winter work shortage. She was later re-hired, but the company had since been bought by a multinational company and significant restructuring had occurred. After 18 months, Lisa left the company, feeling that she was not doing the agricultural engineering work that she sought.

What followed next would affect her view of engineering, her self-esteem and her place in the world for some time to come. Lisa went on to work in another consulting office, this time a much smaller and family-owned one. She was finally able to do agricultural engineering work, including designing livestock housing and vegetable storage facilities. The job was both diverse and stimulating. For approximately two of the three-and-a-half years she worked there, Lisa was project coordinator of a large project and she worked almost exclusively with the senior engineer, who was also president and general manager of the company. His wife was both office and human resources administrator and this is where the problems began. According to Lisa, she was subjected to workplace bullying by her supervisor's wife, and the best she could determine as to the reason was that the wife perceived a potential threat to her own marriage because Lisa worked so closely with her husband, the senior manager:

> She'd put policies in place that would make it impossible to actually have a ten minute meeting with her husband, because she'd have a policy that all communication with her husband had to go through this other person and that [other] person would communicate with him directly and it would get back to me.

Despite increasing tensions, Lisa was extremely cautious and heavily motivated to stay with the company long enough to get her engineering license, which requires four years of on-going work under the supervision of a senior engineer. She and her husband were also anxious to begin a family. She was able to put in the necessary time towards licensure and gave birth one week later. Through her pregnancy and later a return to work on a part-time basis, Lisa observed strange twists in her relationship with the boss's wife:

> While I was pregnant, it seemed like the relationship with the boss's wife was a lot better, and I don't know if she felt that the pregnancy confirmed that I wasn't interested in her husband, or whether she just hoped that I would have the baby and never come back again. She was really quite nice to me during my pregnancy, but then as soon as I got back, she was nasty to me again, and basically told me that—I remember asking her—I had been written into two very significant proposals that they had sent out for jobs. I had been written in as the project coordinator, and they had won those jobs and were starting to

work on those contracts now, but I wasn't the project coordinator for either of them. I remember asking her 'Am I going to become the project coordinator, what will my role be?' And she said, 'Well you have to know Lisa, if you're part time, we can't really give you any actual responsibility.' And I was really surprised at that, because I had fully intended to carry responsibility. I understood that I would have to, and so I said 'Well, what do you think I would be doing?' and she said 'Well, I think you can expect to do the work that other engineers don't want to.'

Lisa resigned not too long afterward and spent the rest of the summer with her baby son. After this, she went on to complete a graduate degree in post-secondary education with an emphasis on engineering education, and returned to the university to coordinate a program to assist a targeted demographic in achieving provincial licensing requirements. Despite the intensity of a full-time graduate degree program and giving birth to a second child part way through, she found the experience uplifting and therapeutic, partially restoring her sense of well-being which had been seriously eroded in her last job. Lisa left the workplace doubting her own abilities, questioning whether she could be a successful engineer and even her own personality:

> The last two years, I said to my husband, sometimes daily, 'this could well be the day I get fired because it's clear to me and to my coworkers that she doesn't like me.' My coworkers were acknowledging this, they were empathizing with me, saying, 'we can see that she doesn't treat you fairly. We're really sorry about this, I wish there were something I could do to help you, you should quit, you should find yourself a better job', that kind of thing. I was too stubborn, I was like 'no, I need to get the P.Eng. license.' So I stuck it out, but there was such uncertainty about the last two years, I never really had confidence that I could count on this job beyond the week.

Although Lisa currently has job security for the foreseeable future, she continues to question her next career move. Given that she is over 30 and has been out of technical engineering practice for five years, she feels that if she ever wants to return to technical engineering work, she needs to do it soon. On the other hand, the academic environment of the university allows her to 'test-drive' the faculty role and she is finding success there as well as encouragement to consider an academic career. In addition, the workplace policies of the university allow for flexibility of schedule that for her are unprecedented and extremely valuable while her children are still both under six.

Nonetheless, reflecting back on her level of awareness and preparation for a career in engineering, she makes frank admissions about information she did not have which could have been vital to her success. Such information is non-academic but one could argue equally important in establishing a successful engineering career:

> I got the gold medal from the program, and I guess I was just led to believe that employers would look for me, but nobody did! And I had really poor job-hunting skills at that point, really poor networking skills. I think I could have used a mentor in fourth year, to give me some very practical job hunting strategies. For example, I didn't know at that point, that [provincial utility] employed engineers, other than electrical engineers. I didn't know that for women, larger bureaucratic or more established organizations were safer—like that had already dealt with issues of maternity leave and flex time and things like that. I didn't know that maybe these were the places I should think about. I actually didn't really know that there was an engineering industry outside of the consulting world. I felt like, that's all I knew where engineers found themselves were in consulting offices. I didn't have a clue about the job market or how to position myself. And there's really no point in being upset about that now, but it's kind of a nagging issue. That I just feel that if somebody had taken me under their wing, I could have done this. I could have been a really good technical engineer. I could have developed my technical expertise, whereas now I see myself as a general—almost everything, and I'm really unsure.

CONCLUSION AND RECOMMENDATIONS

IN SOME RESPECTS, this paper is a positive portrayal of women in the engineering school and workplace. It is an account of three bright, determined and highly motivated women who entered a male-dominated and at times, hostile environment, resistant to change, and to their acceptance. They achieved academic success in engineering and became practicing professionals—something unheard of only a few generations before. Canadian society and the workplace structure they found themselves in, continues to evolve to meet the diverse rights and freedoms that our modern democratic world demands.

This paper is also an account in some cases however of frustration, bitterness and unfulfilled dreams which have not necessarily been remedied through the passage of time or societal changes. In the organizational structures which they found themselves, these women remained to a large extent powerless—one whose career was even at the mercy of her supervisor's wife. In this instance, Lisa's sex was more of a defining feature in the company than her expertise and potential as an engineer. While it can be argued that male engineers are equally subjected to politically damaging relations at work, their gender is seldom a contentious issue and one that can result in job loss. A gold medalist, even one as recently earned as the 1990s could do little to mitigate such powerful cultural forces regarding the role of women in society. It is also a further example of the greater vulnerability of women engineers who work in consulting companies, where there is seen to be considerably less protection for their well-being as opposed to manufacturing or government sectors [8].

These accounts illustrate that while structural forces loosened their grip on the paths of women

engineering students and professionals in recent years, other, more resilient cultural practices have been slower to diminish. Although the focus of this article has been on the more damaging aspects of engineering culture, there are equally significant cultural components which need to be nurtured, namely mentoring and networking strategies. Faculty must embrace the realization that cultural knowledge is as significant as technical knowledge in being equipped for a successful engineering career and that:

> Organizations at least in part, are constituted by relationships between people. Individuals who can manage these relationships well—who are able to impress others with their abilities and talents-are in possession of a resource every bit as valuable as an academic degree or technical expertise (8, p. 16).

Thus, it is the preparation for the culture of the engineering workplace which now requires the greatest investment. While recruitment and retention programs are still vitally important for women in engineering, what is the point of emphasizing high academic achievement when women are destined to feel so powerless and poorly equipped once on the job? There is a randomness to many of these women's decisions ranging from choice of engineering major to knowledge of potential employers that suggests a more systematic response is required. The one exception is Denise whose personal connections to engineering early on in life, as well as her summer job experiences in manufacturing helped place her at a level commensurate with many young men pursuing the field. The female network that helped guide her through many employment obstacles as well as solid relations she established with male colleagues cannot be underestimated in propelling her to become a success in her field.

This paper makes the case for maintaining the focus on formal mentoring and network programs in engineering schools to better prepare students before they make strategic decisions regarding their engineering futures and as they make their way through their chosen career path. These programs tend to be the most vulnerable when institutional budget cuts take place, yet their value cannot be minimized. While it is clear from these accounts that women would be some of the greatest beneficiaries, all students could derive satisfaction from knowing that their decisions are informed and appropriate for them. Without this avenue, there remains no other way of showing less traditional groups such as women and minorities 'the ropes' when it comes to a profession that was designed, organized and put in place by one segment of society. Lisa sums up the importance of attitudes and values keeping in step with structural changes designed to be more inclusive:

> You can develop all these great recruitment strategies and retention strategies, but in my view, what the problem is, is with the culture of the profession. I feel like they've come to the step where, they're not harassing women openly anymore, at the university, or in the workplace with female colleagues but they're saying 'you can play in our playground as long as you play our games by our rules. But don't you dare bring in any of your girlie games, or change the rules, or want to do something different from how we've always done it.' But we haven't got to the step of saying, 'okay, you're here, you're different, you have strengths that you bring and insights that you can bring, so how can we change the culture of the profession to make it better for you, and hopefully some of us will learn from that and will find it better too.' That's the step that has to happen.

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