RETENTION OF WOMEN ARCHITECTURAL ENGINEERS IN INDUSTRY

by

JULIA KEEN

B.S., Kansas State University, 1998
M.S., Kansas State University, 2005

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

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Department of Secondary Education
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Abstract

Retention of women in the architectural engineering workforce is important to the diversity and future success of the profession. However, little research has been done on why women leave the engineering workforce, making it difficult for engineering employers to accommodate the needs of women employees as a means of increasing retention. This research study identifies the retention rate of women in architectural engineering and determines why women leave the profession.

The study consisted of a written survey coupled with follow-up telephone interviews only with those who completed the survey and were no longer employed. A mailed survey was sent to all female graduates between the years 1990 and 2005 from a Midwest state university architectural engineering program. Individual telephone interviews were then conducted with these women who had identified themselves as no longer employed in a field related to architectural engineering.

The study revealed a retention rate of 66%. It did not identify one single factor as the reason women leave the architectural engineering workforce but rather many factors that seem to contribute to or influence this decision. The primary factors that surfaced included work environment, family/work balance, and mentoring. These factors influencing retention are consistent with prior research on this topic in engineering and architecture.

Four recommendations specifically promote retention in response to these findings: 1) offer alternate working arrangements to better accommodate family responsibilities, 2) develop mentoring programs to support female employees in their career progression, 3) develop programs to discuss issues that are specific to women in a male dominated workforce to help women be better equipped for obstacles they may encounter during their career progression, and 4) promote and assist women to re-enter the workforce, recognizing that some women will make the choice to take a break from their career.

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Table of Contents

List of Figures

List of Tables

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CHAPTER 1 - Introduction and Statement of Problem

Being a licensed Architectural Engineer, I have many female friends who also have engineering degrees. Over time, I noticed that many have chosen to leave their engineering careers for other work or have left the workforce entirely. Initially, I thought that this was a temporary arrangement for most of them while they were trying to balance the time demands and pressures of motherhood. As a result, I was considering a research endeavor focusing on re-entry programs for female engineers following a voluntary leave from the workforce. However, during a discussion with a small group of women engineers, I was shocked to find out that most had no interest in returning to engineering when they re-entered the workforce. It was then that I decided that before the issue of re-entry could be addressed, one must first figure out why these women left and more importantly why they have no interest in continuing a career in engineering.

Increasing Female Representation

As a result of the feminist movement and increased concerns with diversity in the science, technology, engineering, and mathematics (STEM) workforce, increasing the number of females in the engineering industry has been the focus of research since the late 1970s. At that time, engineering was a male-dominated career path but was regarded as an interesting and well-paid employment opportunity to which women should have equal access (Roberts & Ayre, 2002b). As a result, many programs to encourage women to pursue engineering as a field of study were developed (Bates & Stublen, 1993). Many of the programs began at the primary and secondary school level by introducing girls to engineering. Later efforts actively encouraged enrollment in engineering curricula at the college level by awarding engineering scholarships restricted to females. The most recent developments in programming concentrate on the retention of women who enter engineering programs to increase graduation rates (Tapia, Kvasny, & Trauth, 2004).

Early initiatives to recruit and retain females in higher education succeeded in increasing the percentage of females graduating with engineering degrees. For instance, only 3% of engineering degrees received were awarded to females in 1973, whereas data from the National Science Foundation – Women, Minorities, and Persons with Disabilities' website revealed that

this value had increased to 20% by 2001 (Powell, Bagilhole, & Dainty, 2006, p. 689). As efforts to recruit females to engineering continue, retention of these women once they enter the workforce becomes necessary. A review of professional organizational membership numbers, frequently referenced as an indicator of women in the engineering field since accurate data is otherwise very difficult or impossible to collect (Powell et al., 2006), shows that the percentage of females employed in engineering has increased from 7.3% in 1988 to 10.8% in 2002. In short, the composition of the workforce is not increasing proportionately to the number of females graduating (Powell et al., 2006; Malcom, 2004). An additional issue of concern is the trend that the representation of females within the workforce has leveled out or potentially decreased since 1996 (Hampton, 2000).

Educational efforts have made significant strides in increasing the number of females who graduate with engineering degrees, but as A. Powell states, "Educational progress for girls does not automatically mean occupational progress for women. It is therefore important to examine what happens to women once they enter the engineering profession" (Powell et al., 2006, p. 693). Researchers originally thought that once equal access to engineering degrees was provided, women would eventually establish equal representation within the industry (Hewlett, 2007, p. xi). In fact, engineering has only seen an increase of approximately 5% in female representation in the workforce in the past decade. By contrast, the professions of law and medicine have seen an increase of 40% and 50% in the same time frame (Yates, 2001). This lends strength to the argument that the issue of female retention in engineering goes beyond just equal access (Hewlett, 2007). The low numbers of females suggest issues in the engineering work culture that contribute to difficulties with retention after college graduation (Yates, 2001).

Corporate Interest

Poor retention of female engineers coincides with an increasing demand in engineering for a more diversified workforce. The technical workforce is aging, and there is a concurrent decrease in the size of the traditional white male talent pool (Hersh, 2000). As the number of female engineering graduates increases, many companies have begun focusing on the recruitment of women (Hersh, 2000). Studies have shown that at the time of graduation, female engineers are equally, if not more, academically qualified than their male counterparts, adding to the demand for female engineers (Bates & Stublen, 1993). Women not only resolve the applicant

shortage problem and possess good academic credentials but they "also bring new questions, ideas, and perspectives" to the workforce (Schaefers, Epperson, & Nauta, 1997, p. 173). The diversification of staff has been found to benefit a company directly and allow it to compete as a business more effectively. Some of the identified benefits include better customer match, a greater range of different approaches to problem solving, increased employee retention and morale, greater opportunity for government business, and improved recruiting (Bates & Stublen, 1993).

Although many companies have benefited from the recruitment and hiring of female engineers, these companies face difficulties with retention, yet it is in a company's best economic interest to retain employees. The Corporate Leadership Council of 1998 estimates that the cost of down time during job change, recruiting, hiring and training of a new employee can range between 41% and 240% of the annual salary of the position (Hill, Martinson, & Ferris, 2004). There are also the indirect costs of lost leads and business relationships (Hewlett, 2007). Women with degrees in engineering are twice as likely to choose to leave the engineering profession as their male peers and have an increased exit rate compared to women in other professions (Mills, Mehrtens, Smith, & Adams, 2008). Many companies would like to maintain as high a retention rate a possible but often do not know what to do to keep their female engineering employees.

Moreover, the cost to the women themselves is substantial. These women have invested time, energy, and money attaining an engineering degree that they only use for a short time. Furthermore, many engineering programs require more than the four years of study that is typical with other undergraduate degrees, due to the intensity of the curriculum. Female engineering students often encounter obstacles in addition to those faced by their male counterparts including lack of support from friends and family, difficulty fitting into a male dominated field, and lack of role models (Felder, Felder, Mauney, Hamrin, & Dietz, 1995). Recognizing the significant sacrifices and hurdles overcome during their college education, these women presumably would be more committed to their profession and less likely to leave than if they had chosen a more traditional field of study.

There are also the costs incurred by society including the investment of fiscal resources as well as personnel time. Both public and private funds are expended in the form of scholarships, tax dollars supporting the state institutions of higher education and offsetting

student loan interest rates, and grant money allocated to programming to attract and retain women in engineering curricula. Each of these financial investments requires that people invest time and effort in their implementation. If women with engineering degrees choose not to pursue such a career, this investment of time and effort may be better spent on other programs or better yet on determining ways of increasing retention.

Relatively little is known as to why women leave engineering careers. Studies focusing on women's experience and satisfaction in the workforce have been conducted, some limited to women in non-traditional fields such as engineering (Belkin, 2003; Auster & Ekstein, 2005); however, there are two primary omissions in this prior research. Much of the research on females in engineering has been limited to interviews or surveys of women engineers who are still practicing in an engineering capacity (Ambrose, Lazarus, & Nair, 1998; Auster & Ekstein, 2005; Bagilhole et al., 2002; Bates & Stublen, 1993; Dryburgh, 1999; Evetts, 1996; Gale, 1994; Geppert, 1995; Jagacinski & Lebold, 1985; Ranson, 2003). Perhaps this is because, once women leave the workforce, identifying and contacting them becomes nearly impossible (Roberts & Ayre, 2002b). As stated by one researcher, "In capturing the lives of women who are happy working in engineering, we have missed some of the lessons failure can teach us" (Ambrose et al., 1998, p. 3). In addition, most of the studies address engineering as a whole rather than any specific discipline of engineering such as chemical, civil, electrical, industrial, and mechanical. Each of these disciplines provides employment opportunities that vary substantially.

Statement of Problem

Little research has been done on why women leave the engineering workforce. This makes it difficult for engineering employers to accommodate the needs of women employees as a means of increasing retention. Many females do not provide the full reason for leaving if asked at the time of resignation but instead cite family responsibilities as their reason for leaving. They choose to use this reason as they consider it "most palatable to the employers and least likely to close the door to possible re-entry to the profession" (Mills et al., 2008, p. 2). This reinforces the need for research that provides a clearer picture of women's perceptions about their engineering careers and their choice to leave.

Purpose

The purpose of this research was to identify the reasons women leave careers in architectural engineering. Significant time and money is invested in encouraging young women to pursue degrees in engineering, but these efforts are futile if the industry cannot retain these women in engineering positions once they enter the workforce.

Description of the Study

This research study was focused on determining why women leave architectural engineering. In addition to addressing the issue of why they have left, the study addresses a number of other questions to create a picture of the architectural engineering workforce environment and barriers experienced by women employed in this field. The research questions follow:

1. What are the retention rates of women in architectural engineering?
2. Do the women who have left intend to return to a career in architectural engineering?
3. What are the women's perceptions of the architectural engineering workplace culture?
4. Does mentoring affect women's architectural engineering careers?
5. How have issues of family/work balance affected women's architectural engineering careers?
6. What degree of satisfaction did/do females receive from their career in architectural engineering?
7. What family-friendly benefits do women report are offered by the employers of architectural engineers?
8. What needs to change to retain or encourage re-entry of more women in architectural engineering?
9. What can be done to better prepare women for careers in engineering?

Data was collected by a survey coupled with follow-up telephone interviews with a subset of those who completed the survey. A mailed survey was sent to all female graduates between 1990 and 2005 from a Midwest state university architectural engineering program. Individual telephone interviews were then conducted with those women who had identified

themselves as no longer employed in a field related to architectural engineering. The interviews were intended to encourage participants to elaborate on answers to questions asked in the survey. The data collected from the survey and the interviews were analyzed and compared to the results of prior research on retention of females in engineering as a whole.

Significance

The data collected can provide important information to business owners and human resources staff who hire female architectural engineers as well as to those preparing females for the workforce whether in higher education or for re-entry programming. The data can be used to argue for workplace change that better accommodates the needs or expectations of female engineers. Secondly, it can be used to develop programs to attract women back to careers in engineering once they have left. Thirdly, the data can provide insight as to the obstacles perceived by women employees to employers who have a vested interest in retaining women engineers once hired. Finally, the information can identify issues that should be addressed in higher education to help female students prepare for their future career environment. Women are important to the success of the engineering industry, and this research intent is to provide answers as to what needs to change to effectively retain women.

Definitions

Architectural Engineering – "The branch of engineering that deals with the technological aspects of buildings, including the properties and behavior of building materials and components, foundation design, structural analysis and design, environmental system analysis and design, construction management, and building operation.

Architectural engineering differs from other engineering disciplines in two important aspects. Most engineers work with other engineers, while most architectural engineers work or consult with architects. Furthermore, an architectural engineer must not only be fully qualified in engineering, but must be thoroughly versed in all architectural considerations involved in design and construction" (McGraw-Hill, 2005, p. 166).

Climate – "The ways in which institutions and communities shape and are shaped by the individual's perceptions and choices" (Tapia et al., 2004, p. 147).

Culture - "Describes the unique way in which people act and interact within an organization" (Agapiou, 2002, p. 699).

Discrimination – "treated differently, ignored, undermined, unfairly criticized, taken advantage of, not receiving equal access to opportunity, based on characteristics such as gender, race, age, disability, marital status or pregnancy" (Mills et al., 2008, p. 38).

Engineer – "person employed in technical work for which the normal qualification is a degree in engineering" (Ismail, 2003, p. 60).

Family-Friendly Benefits – employment benefits offered to all employees in an attempt to allow better work - life balance. These benefits include flexible working practices (part-time, job sharing, flexible work hours, work from home), childcare, and eldercare (http://dictionary.bnet.com/definition/family+friendly+policy.html).

Linear Career Path – "an uninterrupted career path, with continuous skill upgrading to cope with technological change" (Ranson, 1998, p. 27)

Leave - time off work beyond allocated vacation and sick time allotted. The FMLA (Family and Medical Leave Act) was passed in 1993 and requires employers with at least 50 employees in a 75 mile radius to provide up to 12 weeks of unpaid leave for either the birth or adoption of a child or for a serious medical condition affecting an employee or a member of the employee's immediate family (http://www.dol.gov/esa/whd/fmla/).

Mentor – "an experienced manager or employee who guides and advises new employees and managers about the dynamics of an organization and its procedures" (http://www.allbusiness.com/glossaries/mentor/4954889-1.html).

Non-Linear Career Path – "Career paths that allow employees to take long periods of time out from work without hurting their chances for advancement" (http://wfnetwork.bc.edu/glossary_entry).

Part-time – "working 30 or less hours per week" (Dex & Walters, 1989, p. 206).

Re-entry – "returning to professional activity following an extended time lag after one has been trained or certified" (Mark & Gupta, 2002, p. 1091).

Retention – "concentrates on keeping employees in the organization and also in their upward mobility within the organizational structure" (Tapia et al., 2004, p. 153).

Retention Rates – the total women graduating with engineering degrees compared to the total employed in engineering occupations over a defined period of time. For the purposes of

this study, retention rate is defined as the number of women graduating compared to the number of women employed in the engineering workforce who are alumni of the Architectural Engineering Program at a Midwest state university between the years of 1990 and 2005 and have participated in the administered survey.

Sexual harassment – "any unwanted sexual advances or unwelcome conduct of a sexual nature" (Mills et al., 2008, p. 38).

Workforce Retention Rate – the total number of women who enter the engineering workforce following graduation compared to the total employed in engineering occupations over a set period of time. For this study, workforce retention rate is defined as the number of survey participants who began a career in engineering compared to the number employed in the engineering workforce that at the time of the survey. The survey was administered to female alumni of the Architectural Engineering Program at a Midwest state university between the years of 1990 and 2005.

Limitations

As with any study, there are limitations. The primary limitation of this study concerns its generalizability. The sample of women involved in this study was limited to graduates of the Architectural Engineering Program at a Midwest state university between the years of 1990 and 2005. Given that the sample consists of women from a single land grant university who are graduates from a single program during a 15 year segment in time, the results might not generalize to the population of all women architectural engineers. Despite the limitation, there were also advantages to restricting the sample in this way. The fact that the architectural discipline has not been studied in prior research and has a proportionately large number of women graduates compared to many other engineering disciplines was important in this study. Limiting the sample to women graduates between 1990 and 2005 was a result of prior research identifying that women most often leave their engineering career while in their 30s. Finally, limiting the sample to graduates of a single academic program ensures a similar preparatory background for their career. Additional discussion of the sample and its justification is included in Chapter 3 Methodology.

CHAPTER 2 - Literature Review

Since the 1970s, significant research has explored how to attract more women to career fields that provide better earning opportunities and, in turn, more financial independence than traditional female occupations such as teaching, office work, and nursing. Fields of particular focus in past research include medicine, law, business, science, architecture, and engineering (Atkinson & Delamont, 1990; Blackstone & Weinreich-Haste, 1980; Bostic, 1998; De Graft-Johnson, Manley, & Greed, 2007; Dex & Walters, 1989; Evetts, 1996; Gale, 1994; Gill, Mills, Franzway, & Sharp, 2008; Hewlett, 2007; Hill et al., 2004; Jagacinski & Lebold, 1985; Malcom, 2004; Phillips & Imhoff, 1997; Schwartz, 1996; Wynarczyk & Renner, 2006). The expectation was that attracting a larger number of women to these fields would change the culture of the workforce, enabling these occupations to become more female-friendly. This has become a reality in many of the professions during the past 30 years but not to the same extent in the STEM fields. This is attributed to the fact that the women entering these professions are not retained long enough, nor have they made it to senior positions influencing the company culture (Evetts, 1996).

The question of how to retain and advance females in STEM professions has become the focus of research more recently (Ellis, 2003; Emerson, Williams, & Kieley, 2002; Haupt, 2005; Mills et al., 2008; Powell et al., 2006; Ranson, 2000; 2003; Roberts & Ayre, 2002a; 2002b; Tapia et al., 2004; Wynarczyk & Renner, 2006; Yates, 2001). Studies have identified the following as primary factors affecting retention of women in male-dominated STEM fields: cultural fit, mentors and role models, career satisfaction, organizational commitment, role ambiguity, and role conflict (Tapia et al., 2004). More specific research in engineering conducted by the Career Review of Engineering Women (CREW) Project sponsored by the National Women in Engineering Committee of Engineers Australia (Mills et al., 2008) has offered these additional reasons women leave engineering: sexual harassment, discrimination, and visibility. The CREW project consisted of an online survey administered to 8,214 engineers (3,214 females) investigating issues of retention, satisfaction, and progression of women engineers. Because of its relevance and timeliness, the CREW Project and its survey were

closely referenced and used in this study. Moreover, the remainder of this chapter examines the factors influencing retention of women in engineering as identified by past research.

Factors Affecting Retention

Cultural Fit

The little research that has been done on retention of women in engineering and career satisfaction suggests that women are not leaving engineering because of lack of interest or ability, but because of the male-dominated culture (Powell et al., 2006). The work culture of male dominated fields such as engineering is different from the work culture in female-dominated fields and is often considered female and family-unfriendly as research documents (Roberts & Ayre, 2002a). The work of theorist Carol Gilligan (1982), *In a Different Voice: Psychological Theory and Women's Development*, was used to support arguments of gender differences in management style (Evetts, 1996). Related research established that female work culture accentuates collegiality, caring and sensitivity in relationships compared to male work culture that is competitive, hierarchical, and authoritative in nature (Evetts, 1996; Gale, 1994). Roberts & Ayre (2002a) argue that this is because male dominated work cultures are founded on long standing male defined priorities, values and life choices.

The traditional pattern of the male in the family maintaining the only paid employment within a household encouraged specific masculine characteristics to develop in the work environment. For instance, one characteristic of a man's career is continuous linear development and advancement. Such a path could be established because there was no need for interruptions in response to family obligations. By contrast, women desiring children, at the very least, would have the interruption of childbirth.

Another characteristic of the male dominated work environment is full-time employment with an emphasis on face time. This evolved into commitment to one's job being expressed through significant hours spent in the office. This was possible given that men's only responsibility was employment and increased income through promotion. With the engineering career path originally developed by men, who typically generated the only outside income of a household, significant time dedicated to work became a standard expectation. Responsibilities outside of work were handled by their spouse, and so all of their attention and time was

dedicated to increasing the income brought home. From this, a culture developed in which working long hours in the office, working on weekends, traveling for business were expected, and often little or no advanced notice was provided (Hersh, 2000). The time individuals spent at the office became a way of showing dedication and commitment when competing for promotions and raises (Schwartz, 1996). This time commitment to the office has not changed with the increase in dual profession households. Women who enter engineering find their commitment questioned when they do not spend as many hours in the office as their male colleagues, yet women are often more responsible for family and household and feel a greater need to be involved in family commitments than their male counterparts, resulting in greater stress and decreased opportunities for advancement (Tapia et al., 2004).

Directly related to the time committed to work is the money associated with promotion, also identified as a characteristic of a male-dominated work environment. This financial incentive is the primary motivator within a male-dominated culture. The greater a man's income was, the more successful he was perceived to be as he could better support his family. However, the satisfaction attained from increased pay is not the same for women as for men (Tapia et al., 2004).

The final important characteristic of a male dominated work culture is that an employee's career potential is defined early based on the linear path of progression. The ability to reach the top of a corporate ladder is typically established in one's thirties within this system (Hewlett, 2007). Many women feel they are forced to make the choice between having children during the biological window of opportunity and maximizing their opportunities for career advancement, given that both occur in one's thirties.

The norms of this male culture and what is considered acceptable behavior results in an environment that is not only uncomfortable but one in which women are discriminated against and marginalized (Hersh, 2000). Of the women participants in the CREW Project, 42.3% reported they had been discriminated against, and 22% reported having been sexually harassed while working in engineering (Mills et al., 2008). This combined with the lack of official recourse, indications of indifference, and isolation all contribute to women leaving engineering as a career (Hersh, 2000).

The transition from the academic environment to the engineering work environment is a challenge for all engineers, but women employees also struggle with adjusting to the masculinity

of the culture and identifying their role in this culture (Dryburgh, 1999). As students within engineering colleges, women have not been prepared for or trained to handle the masculinity of the professional engineering culture. This is problematic as their ability to fit in becomes equally as, if not more important to their success than their academic preparation and strength (Dryburgh, 1999).

A small percentage of women have broken the glass ceiling in engineering. These women who have 'made it' often deny that they had to overcome additional obstacles compared to their male counterparts. They fear that if attention is brought to these issues, it would devalue their accomplishments. Others might assume that these women were provided with special privileges rather than having earned success based on merit and hard work (Powell et al., 2006). Such an assumption leaves the obstacles and barriers in place (Mills et al., 2008). The culture of the workforce remains the same because the system appears to be equitable to women. Another problem this denial creates is a lack of awareness of gender bias by younger women. As these young female professionals encounter difficulties in their career development, they assume it is specific to them as an individual rather than an issue of gender bias (Ambrose et al., 1998).

Visibility

Females in engineering have to respond to issues of visibility, given that they are a minority in a male dominated work environment. Visibility is being in the position of being more easily identified or recognized because being female makes one different from the majority. Visibility does provide the advantage of being more likely to be noticed earlier in a career, potentially leading to quicker promotions, but there are also disadvantages associated with this recognition (Hersh, 2000). Visibility often results in increased performance stress -- if a mistake is made, it will be difficult to conceal or may be perceived as damaging opportunities for other women in the workplace (Tapia et al., 2004; Bostic, 1998). This stress is further compounded by evidence that "women's mistakes are judged more severely," and a female new hire is often expected to prove she was not hired simply to fill a quota (Roberts & Ayre, 2002a, p. 416). This issue of capability is a concern of male colleagues who often fear they will have to take on additional work to compensate for a female hired based primarily on gender (Bostic, 1998). Beyond the stress directly related to capability, women in this minority position will actually be asked to take on a greater workload than their male counterparts because they are

appointed more frequently to committees, boards, and projects in an attempt at inclusion (Bostic, 1998). This may satisfy client desires or improve the diversity of ideas generated within a group or team environment but is often disregarded when considering time expectations and distributed workloads.

The issue of visibility is one that is difficult to resolve without an increase in the number of women in the engineering workforce. Powell et al. (2006) found that a critical mass of 15-20% is needed to change the culture of an organization. But it has been suggested that a larger value, 35%, may be needed in the construction industry (as cited in Kanter, 1977; Gale, 1995). Clearly, the 2002 value of 11% representation of females in the engineering workforce is less than what is needed to influence the workplace culture (Powell et al., 2006).

Mentoring

Role models and mentors have been documented as being important to women's career advancement as well as to their "self-assessment of competency, aspirations and self worth" (Paludi, 1990, p. 163). They have also been identified as "one of the most important criteria for retaining non-traditional engineers" (Yates, 2001, p. 42). The effectiveness of mentors is increased when the gender of the mentor and individual being mentored are the same. Female mentors for female engineers are important because women are looking for others who have accomplished similar professional goals to relate to and be sensitive to issues specific to women in the engineering field (Paludi, 1990). The problem, however, is that the limited number of women professionals in engineering translates into a lack of women mentors for young female engineers. For the few senior females within engineering, the mentoring role becomes substantial additional work (Hersh, 2000). This inadequate opportunity for mentoring often results in young females becoming disillusioned and leaving their engineering career, creating a cycle that is difficult to break (Sasser, Lineberry, & Scheff, 2004).

Career Satisfaction

Career satisfaction is found to be different for men and women, which is likely tied to their different definitions of success. Females use terms such as satisfaction and balance to describe success while males identify money and power (Belkin, 2003). Studies have found that women engineers enjoy the everyday tasks of engineering and find the process of problem solving challenging, varied, and interesting (Evetts, 1996). This suggests that dissatisfaction

with their career is likely due to the work environment and culture previously discussed. This culture contributes to the lack of recognition and opportunity for promotion for women in engineering (Roberts & Ayre, 2002a). In a study of women's vocational development, Paludi (1990) found that women receive lower recognition and monetary rewards than their male counterparts for the same work accomplishments. There are two reasons given for this. First, promotions are awarded for achievements earned by ability, and male success is often attributed to their ability while female success is attributed to luck (Paludi, 1990). The second is that the woman's income is often perceived as secondary in a dual income household and therefore not as important when compared to that of the male colleague whose pay is the only source of income for his household. The lack of recognition through advancement and promotion may contribute to women's job dissatisfaction and result in their leaving the workforce early in their career (Evetts, 1996).

A study by Auster and Ekstein (2005) examined job satisfaction of 125 women engineers with 15 years' experience and found that stress and job factors were related to women's mid-career satisfaction. In this study, stress factors were defined as the following four variables: time pressure, job and life outside of work balance, organizational politics, and support from colleagues. The job factors considered were opportunities for growth and social interaction, opportunities for individuality, recognitions and support, and job security. Balancing work and family was identified as the primary obstacle facing women in engineering, and the authors recommended that engineering firms address this issue to improve retention. The authors also recommended further research within specific industries, given that this study included women from many different disciplines of engineering. This is considered valuable as some disciplines of engineering are more time intense and less structured than others, potentially affecting job stress and satisfaction (Auster & Ekstein, 2005).

Role Conflict

Women have a much more difficult time finding their place in a male work environment and must also determine an appropriate balance between being a professional and the other aspects of their life. Stress is experienced as these roles make demands on energy, effort and time that often conflict with each other (Tapia et al., 2004). The concern and feeling that finding a suitable balance between career and family is not possible leads more professional women to

not get married or have children relative to their male peers (Paludi, 1990). It is not uncommon that when forced to choose how to allocate time between family responsibilities and career, women will often relegate career to second place, at least temporarily.

The choice between career and family is reinforced in studies that find that in dual career households, the male's career interests take priority (Evetts, 1996). This priority is exemplified by the majority of the household duties taken on by women. Hewlett and Vite-Leon (2001) found in an on-line survey of 1168 high achieving career women that only 10% of men take prime responsibility for household responsibilities compared to 52% of women (p. 36). This survey included women ages 28-55 years working in a variety of professional careers including academia, business, law, and medicine. This notion of the distribution of responsibilities is carried over from years past when women were not expected to work outside the home and were accountable for supporting their husband's career success. As children came along, this same disproportionate distribution of household work was transferred to the care of children. This creates a conflict for women as to how to divide limited time between career and family, ultimately impacting women's career progression and making it difficult for them to compete with the men who often have the support of an at-home spouse (Paludi, 1990).

Females who have assumed the role of fitting into the male culture of engineering by being 'one of the guys' are inclined to become wives and mothers in their out of work environment as a way to assert their femininity (Evetts, 1996). Apparently, gender identity conforming to society's perceptions of the feminine role is "critically important to the women's sense of satisfaction and feelings of self worth" (Evetts, 1996, p. 10). This is further supported by Hewlett and Vite-Leon's (2001) survey of high achieving women that reported that "66% of women believe that society values women for being good mothers much more than for being successful in their career" (p. 3). It is not a surprise, then, that many women choose to have children even at the sacrifice of their career. A study of female scientists where women encounter similar barriers and obstacles as in engineering found that women with children primarily work part-time or take leave from the workforce. "Only a quarter of women with children are employed full-time, compared to 93% of those without children" (Fielding & Glover, 1999, p. 358). The fact that women have children and take prime responsibility for child care resulting in days missed days from work when a child is sick, less time spent at the office,

and leave from the workforce for child birth are all perceived as a lack of commitment to their career and therefore detrimental to career progression (Hewlett, 2007).

Lack of Awareness

Women may not leave a male dominated industry for just one of the issues described but rather for a combination of issues. This has been coined by Yates as "lack of awareness syndrome" (Yates, 2001, p. 42), meaning most of the issues could individually be resolved. However due to a repetitive pattern or more than one issue occurring simultaneously, these issues become more difficult to address and lead to dissatisfaction. This has been described as "water torture" because it occurs slowly and repetitively. For example, a woman feels that her suggestion at a meeting was ignored. If this were an isolated event, it would not be considered significant. But when this occurs multiple times at different meetings or her suggestions are unfairly criticized, the effect is compounded. This is further complicated if other issues such as being treated differently or feeling isolated occur at the same time. This compounding of issues makes it difficult to pinpoint the problem, so female employees often attribute their unhappiness or lack of satisfaction to the job as a whole rather than to specific causes (Geppert, 1995). This inability to truly identify the cause of dissatisfaction is what is meant by "lack of awareness."

Choosing to Leave

As discussed in the prior section, many factors encourage women to leave engineering as a profession. This section will explore issues specific to retention and leave as applicable to career choice as well as how these decisions impact a woman's career progression in engineering.

Research by Fielding and Glover (1999) indicates that the percentage of women in STEM occupations decreases as women approach their thirties. This is much different from the more traditionally female occupation of teaching, where the percentage of women in the field does not change with age. Fielding and Glover (1999) suggest this "confirms that the domestic and professional areas accommodate each other in education" and the reason engineering sees a drop in females in their thirties is connected to family formation and the conflict that arises with the male culture of engineering (p. 358). The STEM fields have also been found to be different from other professional occupations such as bankers, lawyers, and physicians in that professional

women in these occupations are likely to remain in full-time employment after having a baby and in the same position as before their pregnancy whereas women in the STEM careers are not (Fielding & Glover, 1999). More than in the past, women, especially those in higher level non-manual professionals, are taking no more than the time provided with paid maternity leave because it is more socially acceptable (Evetts, 1996). McRae (1991) found in her study, "Occupational Change Over Childbirth," that nearly one half of professional women return to work within nine months of having their child, and 60% with children under five are employed. Professional is defined in this case as occupations requiring education and licensure such as doctors, lawyers, engineers, and architects (National Statistics, 2000). In STEM occupations, the number of working women with children is much lower (Evetts, 1996). A study conducted in Britain by Fielding and Glover (1999) found that women in the sciences and applied sciences, including engineering, "with children primarily work part-time or are out of the labor market. Only a quarter of women with children are employed full-time compared to 93 percent of those without" (p. 358). Another study in Canada found that the 18% of women left engineering "almost always as a consequence of having children" (Ranson, 2000, p. 3).

Engineering is also different from other professions in that one's career takes longer to develop, and advancement is still a fairly linear progression. A linear, uninterrupted career with continuous skill upgrade commensurate with technological change is expected for career progress because this is how it has always been in engineering (Ranson, 1998). In addition to this expected path for career development, an engineer's work during his/her thirties is recognized as having the greatest payoff and impact on promotion to the highest levels within a company (Hewlett, 2007). This is problematic for women who desire to take a break for family. Women are left with limited options in this situation, either to focus on their career by delaying their family or give up expectations for advancement to the highest levels of within a company. As observed by Ranson (2000), women in engineering tend to begin a family later in their career because of this linear career path. This issue affects even those women who choose not to have children because there is an assumption that women employees are at greater risk to leave the workforce to begin a family, affecting both hiring opportunities and promotion for women. This assumption is particularly outdated since few employees, independent of gender, remain in their first position more than two years. Nonetheless, even for those women do not have children, this stereotype influences their potential for advancement (Hersh, 2000).

Women may also balance motherhood and a career by taking leave, working part-time, taking a different position within the company, or changing occupations. Hewlett's (2007) on-line survey of 2,443 high-achieving professional women shows that two-thirds have discontinuous or non-linear careers while 37% voluntarily take leave from their career for a short period of time. The women included in the sample for this survey were considered high-achieving because they graduated from college with honors and were employed in occupations of business, law, and medicine. Meanwhile, a number of women consciously choose to prioritize life outside of work, choosing not to strive for the most competitive top or managerial positions within a company (Hind & Baruch, 1997). Some women also choose to take a part-time position, recognizing it that does not have potential for promotion (Evetts, 1996; McRae, 1991). One of the difficulties with women choosing these options within engineering is that many companies do not accommodate part-time employment or job sharing. This is primarily due to the fact it has never been done before. It can also be attributed to the nature of the work of a consulting engineer. The consulting engineer has a client driven schedule and is expected to be available to answer questions and solve problems as they arise, making part-time availability difficult. The lack of accommodation for alternate work schedules is a reason some women leave the workforce completely (Roberts & Ayre, 2002b).

If women choose to take leave from their engineering careers, it is not uncommon for them to experience difficultly reentering the workforce and getting back on the path for advancement. One obstacle is employers' perception of their career commitment, given that they were willing to take leave, a part-time position, or 'temporarily' opt for a practitioner role in lieu of management. This non-traditional, non-linear route may be perceived as demonstrating a lack of commitment to their work and therefore often minimizes their likelihood for advancement (Ellis, 2003; Fielding & Glover, 1999). The second obstacle is the extent to which engineering technology changes rapidly. Even a short leave from the industry can result in an employee becoming out of date and no longer qualified for the same position (Haupt, 2005; Ellis, 2003). A temporary leave from the workforce can result in women being offered entry level positions and salaries despite the many years of experience and knowledge such women have acquired. Facing the difficulty of finding a balance between career life outside of work and the obstacles of returning to an engineering career, many women choose to pursue careers other than engineering.

Although "engineering has been identified as among the top five most lucrative potential occupations for women," women still make the choice to leave for other professions in higher proportions than men (Schaefers et al., 1997, p. 173; Emerson et al., 2002). This can be attributed to the fact that women are not motivated by money (Tapia et al., 2004). Instead, women are opting for work that utilizes their technical education and skills indirectly in occupations that are more flexible or accommodating to balancing family such as publishing, information services, technical writing and teaching (Ellis, 2003). Women are also exploring the option of self-employment as a means of accommodating their desire to work as well as allow time for family. This arrangement allows them to dictate their own schedule and workload (Evetts, 1996; Ellis, 2003).

Proposed Solutions

Prior research on retaining women in engineering has proposed potential solutions to retention issues. Given that changing the culture that currently exists is very difficult, the solutions to date primarily address helping women within the existing culture (Yates, 2001). The proposed solutions fall in one of two categories: preparation or benefits.

Preparation focuses on providing young women who are in or are preparing to enter the engineering workforce tools to better handle situations as they arise. Women engineers need to be exposed to how to resolve difficult situations related to gender differences as well as specific hurdles associated with being a female in a male dominated field. Being a female in the engineering field is isolating. Without a trusted female mentor who can relate to female-specific issues such as discrimination and harassment, the situation may become overwhelming (Yates, 2001). Bagilhole, Dainty, and Neale's (2002) work suggests that the best way of preparing females for these experiences is to incorporate courses in the undergraduate curriculum that provide awareness and strategies for survival. The researchers suggest that providing accounts and reflections from practicing female engineering professionals may be the most effective method of conveying this information (Bagilhole et al., 2002). Fewer women may leave engineering careers if they felt they were not alone and had methods for handling specific situations as they arose.

Benefits are a commonly attempted solution to keeping women in the engineering workforce (Evetts, 1996; Paludi, 1990). This is a solution that can be applied by an employer as

the need is identified. The different forms of benefits that have been incorporated include part-time work, job-sharing, flexible schedules, family leave, re-entry programs and childcare. Although these benefits are often specifically considered when trying to attract and retain female employees, they are benefits that contribute to a family-friendly culture that benefits all employees. These benefits also have positive implications for business as a result of lower absenteeism, higher morale, decreased turn over, and positive publicity (Paludi, 1990). The counterargument against job sharing or part-time work is that it results in lower pay and opportunity for women because it leads to a practitioner role instead of a managerial path. However, other research has suggested that although this may be true in the short term, part-time employment or job sharing does provide a greater opportunity and easier transition back to full-time employment and the traditional advancement path than does a short leave from the workforce (Evetts, 1996; Schwartz, 1996). The reason that the transition between part-time and full-time is easier is because it allows women to maintain their professional skills and career identity while attending to family responsibilities (Schwartz, 1996).

However, problems are associated with these benefits. First, female employees feel they are discouraged from utilizing these benefits since their male counterparts may not participate. By taking advantage of family-friendly benefits, women perceive they further distinguish themselves as different and needing assistance even though benefits are offered as official corporate policy (Hewlett, 2007). It is critical for the success of these programs that employers encourage all employees to use these family-friendly resources and reinforce there is no penalty for doing so (Evetts, 1996). Second, these benefits are costly for small firms, where benefits taken advantage of by only a small percentage of the employees proportionately consume a large portion of personnel costs. The cost in this case is often prohibitive especially as companies look to cut money from budgets in tight fiscal times.

Beyond Engineering

Nearly all the work published on increasing retention has focused on engineering in general rather than on specific disciplines within engineering, with the exception of information technology (Stephan & Levin, 2005). However, architectural engineering is different from other disciplines of engineering in that the employers are typically small to medium in size. In some respects, most architectural engineering workplaces are more similar to architectural firms than

traditional engineering companies when comparing company size and their affiliation with the construction industry. For this reason, the study also reviews research specific to the profession of architecture. Architecture maintains a similarity to architectural engineering in regards to firm structure and size as well as interaction with the construction industry and the notion of specialized client driven interaction. The review of this literature revealed many of the same concerns of low female representation in the workforce and male dominated workplace issues previously discussed for engineering (Anthony, 2001; Caven, 2006; De Graft-Johnson, Manley, & Greed, 2005; De Graft-Johnson, Manley, & Greed, 2007). For example, specific research was commissioned by the Royal Institute of British Architects (RIBA) in 2002 related to retention and reasons why women leave the profession of architecture (De Graft-Johnson et al., 2007). A survey was administered to a sample of 170 females followed by 11 interviews with women who had left the profession. The results of the RIBA study did not identify a single reason women left the profession of architecture but rather a "multiplicity of factors" including "low pay, poor promotion prospects, discriminatory attitudes and sexist behavior" (De Graft-Johnson et al., 2005, p. 1035). The similarity between architectural engineering and architecture as well as the common issue of retention within the professional realm make the review of architecture literature also important.

CHAPTER 3 - Methodology

The purpose of this study was to identify why women leave the field of architectural engineering. The specific sub-questions used to answer this question and to create a picture of architectural engineering workforce included the following:

1. What are the actual retention rates of women in architectural engineering?
2. Do the women who have left intend to return to a career in engineering?
3. What are the women's perceptions of the architectural engineering workplace culture?
4. Does mentoring affect women's architectural engineering careers?
5. How have issues of family/work balance affected women's architectural engineering careers?
6. What degree of satisfaction did/do females receive from their career in architectural engineering?
7. What family-friendly benefits do women report are offered by the employers of architectural engineers?
8. What needs to change to retain or encourage re-entry of more women in architectural engineering?
9. What can be done to better prepare women for careers in engineering?

This chapter outlines the methodology used. Specific items covered in this chapter include the study design, a description of the sample, explanations of the instruments used, procedures for data collection, and methods of analysis.

Study Design

The study was mixed method using both qualitative and quantitative techniques. "The purpose of mixed methods research is to build on the synergy and strength that exist between quantitative and qualitative research methods to understand a phenomenon more fully than is possible using either quantitative or qualitative methods alone" (Gay, Mills, & Airasian, 2006, p. 490). Therefore, this study collected data from a purposed sample of convenience using mailed surveys as a quantitative method followed by individual telephone interviews as a qualitative collection method. A mixed method study was appropriate for this research as some of the

research questions, such as retention rates, are quantitative in nature, while discovering why women have left engineering can be better explored using qualitative data collection techniques. The mixed method of data collection is particularly effective for the study of retention as the qualitative data can help explain the quantitative results. Accordingly, the written survey posed the same questions to both the women still practicing engineering and those who have left, allowing comparisons between the two groups. Meanwhile, the individual telephone interviews were limited to those women who have left engineering, permitting further exploration of issues that influenced their decision to leave.

Ultimately, the data collected in the survey was both quantitative and qualitative while the interview data was strictly qualitative. Although considerable time is required to analyze all the data, there were significant advantages to using two instruments to collect data. The largest advantage was ability to triangulate information gained from the two instruments. Another advantage to using a second technique is the ability to ask probing questions and gain greater clarity on responses than what was possible with the survey alone.

Utilizing two different instruments requires that each instrument be developed with the intent of collecting data to answer the defined research questions. Therefore, this chapter has been configured to first discuss the sample, then to address sections specific to the construction and implementation procedures of each instrument. The final section is the analysis, which looks at the data in its entirety rather than specific to each instrument since the value of the instruments comes from the fact that together they create a more complete picture.

Sample Selection

The sample selected for this research study included female graduates from a Midwest state university's architectural engineering program between 1990 and 2005. This sample was expected to include women who were still practicing engineering and those who had chosen to leave the workforce completely or changed careers. This study limited the sample to only graduates of architectural engineering enabling the results to be discipline specific. The discipline of architectural engineering is different from other fields of engineering in that it focuses specifically on the design of buildings including the structural, electrical, mechanical, and plumbing systems. This area of engineering requires close interaction with both architects

and contractors, and the primary employment opportunity for graduates is with small to medium consulting firms consisting of less than 100 employees.

The names and addresses of the 126 individuals included in this sample were obtained from the Midwest state university's Foundation database. The sample included individuals from 27 states and 2 countries outside the United States. Concentrations of sample participants were from three primary metropolitan areas: Kansas City, KS/MO; Dallas, TX; and Houston, TX as illustrated on the map located in Appendix A.

Architectural engineering has been overlooked in prior research on women in engineering because only eighteen accredited programs exist in the United States. One may initially conclude that the results will not influence a large enough portion of the engineering population to make the research valuable, but some significant attributes to this population increase its importance. First, architectural engineering has maintained substantially higher graduation rates of women than has engineering in general. Based on information attained from the Midwest state university's Foundation data base, women comprised 27% of the graduating class in architectural engineering between 1990 and 2005. This is considerably greater than the 13.4% of the College of Engineering's average at the Midwest state university and the 18% national average of women graduating in all engineering disciplines during this same time period (Registrars Office, Shannon Castleberry, personal communication, February 15, 2010; Malcom, 2004, p. 186). The higher female enrollment and graduation rate in the field of architectural engineering has not been studied but may be attributed to the more creative or artistic element of the discipline. Another advantage of this particular sample is the outstanding employment opportunities for graduates from this program. Based on records from Mary Ewing with the Midwest state university's Career and Employment Services, the architectural engineering program has maintained greater than 90% placement of its graduates either in industry positions or advanced education programs between 1990 and 2005 (personal communication, May 9, 2009). During this time interval, only four persons were still seeking employment or were not placed at the time of graduation. These four individuals were not placed in 1991 likely due to the recession of the early 1990s. Thus, no individual within the sample, except potentially those four in the graduating class of 1991, were forced into employment outside of architectural engineering because of lack of opportunity. The data from Career and Employment Services did

not distinguish the gender of graduates; therefore, it was not possible to say whether the four individuals without jobs were male or female.

Although the fact that all the women were from the same engineering program at the same land grant university limits generalizability, it also decreases the number of confounding variables. The individuals in the sample had similar backgrounds and educational exposures prior to entering the workforce. Thus, differences in individual perceptions could more likely be attributed to the work environment or climate than to differences in academic preparation. It was also expected that participation in the study would be higher because both the researcher and the participants were alumni of the same program. This relationship was clearly articulated; therefore the participants likely identified the research as legitimate, which established trust for the researcher. This trust was critical for participation as one must believe that "the benefits of completing the survey outweigh the costs of doing so" (Dillman, 2007, p. 19). Lastly, the current contact information for female graduates, whether they were still within the engineering workforce or had left, was available for this particular sample.

The sampling range, undergraduate graduation dates between 1990 and 2005, was selected based on the review of prior related research. Most participants were between 27 and 42 due to the years of graduation encompassed for this study. According to research completed by Jagacinski & Lebold (1985), female and male engineers with less than five years' experience responded similarly to career questions and received similar compensation for their work; therefore, themes of interest may not surface. Other research suggests that many women leave engineering in their thirties, which is often attributed to the fact that this is when high performance expectations and work/life tradeoffs collide as well as the time when women begin to view their career satisfaction and opportunity more negatively (Auster & Ekstein, 2005; Hersh, 2000; Roberts & Ayre, 2002b). This age range also included participants who had been exposed to initiatives and programming designed to encourage females to pursue and/or maintain careers in engineering. Prior research supports the fact that concentrating on women who had been in the industry more than five years and those women in their 30s would likely provide the data pertinent to current workforce issues (Hersh, 2000; Jagacinski & Lebold, 1985).

Additionally, the study anticipated that this population had been employed in similar size corporate settings. The most common career for graduates of architectural engineering programs is with small to medium sized design engineering firms that may not have the same gender

equality policies or programming as larger corporations or government funded entities. This limitation was recognized and could be seen as an advantage of this research. Prior research related to women in engineering, as reviewed in Chapter 2, used samples of women engineers without considering or controlling for employer size. This had potentially created a bias in the data, given that it was more likely that participants in these earlier studies came from larger businesses or corporations. This limitation was problematic in that graduates of some disciplines of engineering are employed nearly exclusively by small consulting engineering firms and are not adequately represented in past research. Finally, small firms, especially those with fewer than fifty employees, may not have the same resources nor the same federal mandates as larger corporate employers. These differences may be important since likely the availability of items that influence retention such as programming, training, benefits, and environment could be affected by company size.

Use and Protection of Human Subjects

This research was conducted in compliance with the Midwest state university's Institutional Review Board (IRB) policy on the use of human subjects. An IRB Informed Consent Form was provided and signatures were required for participation in either the survey or the individual telephone interview. These forms can be found in Appendix B. Subjects were informed that they could decline to participate prior to the beginning of the study or could withdraw from the study at any time. It was not anticipated that this research would cause harm to those involved. Participants were notified that they may provide input or ask questions at any time during the research. Those who participated in the study were sent a thank you as well as a copy of the final results when the research was complete, if requested.

The confidentiality of all participants was protected through the use of identification numbers for tracking data instead of individual names. The consent forms mailed back as part of the survey were separated from the survey, and each survey was assigned a corresponding tracking number. The key that connects the names and the identification numbers was kept in a separate location than the data and remains accessible by only the researcher. At no time was the data directly linked to the participant's identity. All data will be stored for a minimum of three years per the requirements of the IRB.

Survey Instrument Development and Implementation

The first data collection method implemented in this study was a mailed, self-administered survey (Appendix C) sent to each of the individuals in the sample. A survey was selected as the instrument for data collection because it is a "useful method of gathering information about the current status of a target variable," women, "within a particular collectivity," the field of architectural engineering (Thomas, 2003, p. 41). A specific advantage of a survey is that it can be administered to a large sample in a relatively short period of time. Because little research involving women that had left the engineering profession had been conducted, this survey was intended to estimate current retention rates and identify similarity and differences in responses between the women who remained in the architectural engineering workforce and those who had left. This method provided standardization and anonymity in the data collection process and created an initial contact with the sample from which a second group of participants for the individual telephone interview could be identified. The following sections describe the construction, testing, and procedure of the self-administered survey.

Construction

A new survey instrument was created to address the issues identified in the research questions. The survey consisted of five sections that all participants were asked to complete: General, Family, Benefits, Human Resources, and Final as well as one section the participant completed based on her employment (engineering or non-engineering). The survey was presented in an 8 ½" x 11" booklet format consisting of 9 pages plus a consent form and the front and back cover. The survey was printed on 11" x 17" paper and folded to create the booklet. Questions were configured on the page in a two-column format to increase the number of questions that fit on a page and to minimize the number of words being missed by the reader (Dillman, 2007). There were 80 questions for those still employed in the engineering workforce and 63 questions for those who had left engineering as a career.

The question format included closed-ended questions using Likert-like scales, partially closed-ended questions, and open-ended questions. Closed-ended questions using Likert-like scales were used primarily when asking participants about job satisfaction. In these questions a statement of agreement was typically asked for with a range of five responses from 'very dissatisfied' to 'very satisfied.' The partially closed-ended questions were used frequently in

multiple choice questions for which there was a concern that the correct response would not be listed. In these questions 'Other' was provided as the last option. Some open-ended questions were included to try to gain a clearer picture of the engineering work culture and to obtain the participant's opinions on specific topics that the existing literature has not explored. The difficulty of open ended-questions is the inability to get thorough answers in a self-administered survey since there is no opportunity for the respondent to ask for clarification (Dillman, 2007). The concern with a possible lack of clarity in the data collected was addressed by administering follow-up telephone interviews that allowed greater depth and clarity.

A survey instrument that is newly developed for research is especially vulnerable to issues of reliability and validity since it has limited pretesting of the presentation format and the questions asked (Fowler, 1995). Therefore, questions and format from the survey used in the CREW Project by Mills et al. (2008) were closely referenced. Many of the questions in the CREW survey pertained to satisfaction with and family influence on a woman's career in engineering. The fact that the participants were also women in the engineering workforce was especially helpful in gauging the appropriate level of sophistication of questions for this study's survey development. However, the survey used in the CREW Project was not used in its entirety as some of the questions pertained to job description and performance criteria (all engineering disciplines were included in the survey), and other questions were specific to Engineers Australia, the sponsor of the study. Additional questions were added for this study because the CREW Project survey did not include questions specific to retention and reasons for departure from the engineering workforce, nor was it specific to architectural engineering. Nevertheless, the similarity in format and questions used in the two surveys enable triangulation of the results using the survey instrument developed for this study and contribute to the reliability of the data collected.

Pilot Testing

A pilot test was administered to examine the clarity of the wording and procedures in administering the survey. The draft survey was administered to four female graduates of the Midwest state university's architectural engineering program who were not included in the sample. Three women were selected from the 2006 graduating class, the year immediately following the sample range and one from the 1989 graduating class, the year immediately prior

to the start of the sample range. These women were selected because they most closely represent the sample without sacrificing the data from any of the participants of the selected sample.

The pilot survey was mailed in the same manner as proposed for the survey for the study. This included a hand-written envelope containing the cover letter, the survey, a return envelope, and a duplicate consent form. Each participant was contacted by e-mail or phone prior to the mailing of the survey to ensure that they were willing to participate and to explain the purpose of the pilot test. As they completed the survey, they were asked to make notes directly on the survey form of items that caused confusion. This request was made to encourage the participants to document their initial reaction to the format and wording that may otherwise be forgotten or not mentioned. Upon receipt of the survey, the researcher contacted each respondent again to discuss difficulties they had with understanding the questions and answering them. Also discussed was the approximate amount of time needed to complete the survey as well as any ideas or suggestions for improvement. From this feedback, the survey was revised to correct for erroneous numbering of some of the questions that led to confusion as the participants completed the survey.

Survey Data

The following sections identify in detail the participants and the procedures followed in the administering the survey.

Procedure – Administration and Data Collection

The format for the administering of this survey was the Tailored Design Method as defined by Dillman (2007). This method consists of five components: respondent friendly questionnaire, five contacts with respondent, return envelope, personalization of correspondence, and incentive. Each of these items has been demonstrated to increase response rates. A high response rate was important to increasing the confidence of the final results of the data collected and was therefore a priority for this study. A response rate of 60 percent was the goal. Each of the five suggested components is addressed in greater detail to follow.

The first component of the Tailored Design Method, the respondent-friendly questionnaire, was addressed earlier in the sub-section Survey Construction and therefore will not be expanded upon here. As for the second component, Dillman (2007) recommended that five contacts with the respondents be made in the following ways: “1. prenotice letter, 2.

questionnaire and cover letter, 3. thank you postcard, 4. replacement questionnaire to non-respondents, 5. final special contact" (p. 151). Rather than mailing a prenotice letter and to try to add a more direct and personal approach, each participant was contacted by telephone or e-mail. This contact allowed for a personal introduction to myself and my research as well as provided the opportunity to confirm addresses prior to mailing the survey. Significant time was dedicated to looking up each of the participants on-line to obtain their current phone number or e-mail address. This contact was helpful in saving postage expense and delay incurred in mailing to an incorrect address. This contact was also valuable in creating a personal connection with each of the participants, potentially contributing to a higher response rate.

Four days following the initial telephone or e-mail contact, the surveys were mailed to the sample participants. The surveys were mailed in 6" x 9" kraft paper envelopes with the Midwest state university's College of Engineering logo and Architectural Engineering Department printed return address. These envelopes were advantageous for multiple reasons. First, the preprinted logo and department return addresses provided authority as well as credibility. Next, the addresses of all participants were hand written in engineering font as an additional method of personalization and to eliminate the potential of the participant identifying the letter as a fund raising request. The fact that the envelopes were kraft paper rather than white and were an atypical shape helped ensure that they stood out compared to other items received in the mail. In addition to the survey within the envelope, there were also a cover letter, a pre-addressed and stamped return envelope, and a copy of the IRB consent form with a watermark stating "Participant Copy" (Appendix D). The envelopes were stuffed so as to ensure all items were removed from the envelope simultaneously to minimize the likelihood that an item was overlooked or missed.

The design and content of the cover letter (Appendix E) was intended to make a connection with the participant, explain the purpose of the study and the survey, identify the importance of her participation, provide directions, and ensure confidentiality. The letter was printed on Department of Architectural Engineering stationary and was hand-signed to contribute to the personalization of the communication. The return envelope was pre-addressed and stamped to try to minimize the burden on the participant. The objective was to have as many surveys returned as possible by simplifying the response process.

The correspondence with the participants did not end with the distribution of the survey. One week following the mailing of the survey, a thank you postcard (Appendix F) was mailed to each participant. This thank you note was aimed at reminding the participant that she received a survey and that her participation was valuable and important to the study. Three weeks following the initial mailing of the survey, a second phone call or e-mail contact was made with those who had not responded. This contact reinforced that for representative results, a high response rate was imperative and that their input was crucial in this process. An offer of sending another survey was extended in case the first had been misplaced.

Responses were tracked as the completed surveys were returned using the consent form contained within the survey. A final fifth contact in the form of follow up correspondence was only conducted with those who had not previously responded.

Telephone Interview

The survey was effective in collecting data in an efficient manner from a large sample, but its primary disadvantage was the lack of depth it was able to attain. For this reason, it was valuable to provide a second instrument capable of asking questions that might provide more depth. Interview protocols are commonly considered as such an instrument because the "direct interaction is usually more effective in eliciting the respondents' sincere participation than a written questionnaire" (Thomas, 2003, p. 66). Participants were scattered throughout the United States making individual telephone interviews the most practical interview technique because both a focus group interview and a one-on-one interview would be difficult to coordinate logistically and cost prohibitive.

As with any data collection instrument, there are limitations. In a telephone interview, the researcher cannot see the informal communication provided through body language or facial expressions. Another drawback to a telephone interview was that the participants needed to be comfortable and willing to speak and share their ideas in order to collect the most honest data, and the telephone format presents difficultly in building rapport (Creswell, 2007; Gay et al., 2006). In addition, the potential difficulties in putting the interviewee at ease and the researcher's responses to the interviewee's answer might bias responses to future questions. Therefore attention to protocol and involvement in the interview was important (Gay et al., 2006). The other significant constraint was time. The number of questions asked was limited to

keep the interview to no more than one hour. Although the number of questions was limited, many of the less important or demographic questions were asked in the survey allowing the questions in the interview to focus on the critical issues related to female engineers leaving the engineering workforce.

Construction

A telephone interview protocol (Appendix G) was developed for two reasons. The first reason was to maintain a focused direction while allowing individual perspectives to emerge (Patton, 2002). Secondly, the protocol was important to maintain consistency among multiple interviews. The protocol acted as the procedural outline for the interview as well as provided a list of interview questions and probing follow-up questions. The questions chosen were those that were difficult to include as part of the survey because of their exploratory nature and the anticipated need for clarification or follow up.

Next, the protocol was pilot tested. This pilot test was administered to one of the survey respondents who had left engineering but was not part of the purposeful sample because she had less than 5 years of engineering experience. The intent of the pilot test was to ensure that questions were effectively worded, the sequence of the questions was appropriate, and the number of questions was appropriate for a one-hour interview. As a result, modifications to the question sequence were made to the original protocol. This change allowed the interview to proceed in a more conversational tone.

Participants

A subset of the survey sample was used for the telephone interviews. Respondents to the survey were asked fill out a section on the last page of the survey if they were interested in participating in a focus group interview. The participants indicated the location they could attend and were also asked for their contact information. The focus group interviews were limited to women who had left the engineering workforce as identified in question number 11, page 1 of the survey and to those willing to participate in one of three locations. The locations (Dallas, Houston, or Kansas City) had been chosen based on the high density of women engineers in these specific metropolitan areas. Once the surveys were collected, data was compiled to identify the two locations most common to the women who were no longer employed in engineering. Unfortunately, a concentration of women in one location did not exist,

making focus group interviews logistically prohibitive. Telephone interviews were then substituted for the focus groups.

A subset of the original sample was created that included only the women no longer employed in an engineering capacity. This purposeful sample was further narrowed to those women no longer employed in engineering who had five or more years of industry experience. Five or more years of engineering industry experience was used as a cut off because these women would have a significant understanding of the engineering work environment. A second reason was that the participants would have had the opportunity to sit for the professional engineering licensing exam. The procurement of the professional engineering license was identified in the survey results as representing a significant difference between those remaining in engineering and those who had left. Thus, women who had worked in architectural engineering for five or more years and who had left employment in this field were contacted requesting they participate in a telephone interview in lieu of the focus interview previously introduced in the survey. Each woman who responded as willing to participate in the interview was asked her availability and preference as to time of day and day of the week for the telephone interview to ensure that the interview worked with her schedule.

Procedure – Administration and Data Collection

The purposeful sample contained 16 participants who were contacted by letter (Appendix H) or e-mail and asked to participate in a one hour telephone interview. This contact included a copy of the IRB Informed Consent Form and a list of the questions that would be asked. Allowing the participants to see these questions in advance not only minimized reservations they might have but also allowed the interview to be conducted with greater efficiency. Interview times were scheduled based on the participant's preference. An informal note serving as a reminder as well as the consent form (Appendix B) were mailed to each of the participants prior to the interview. The participants were invited to mail back the consent form in the preaddressed and postage paid envelope provided.

The researcher acted as the facilitator of the interview as outlined in the Telephone Protocol in Appendix G. Questions were asked in the order provided in the protocol, and probe questions were also asked as needed to create more in depth responses. The goal of the facilitator was to keep the conversation on topic while allowing it to deviate from the specific

questions when appropriate. The interview was limited to one hour to respect the time of the participant.

The researcher also took notes during the interview to ensure that data collection was thorough and precise. In addition to taking notes to document the conversations, the researcher audio recorded the interviews. Following the interview, the audio recording was transcribed using verbatim style transcription. This method of transcription recorded each spoken word of the interview but elected to remove the pauses and other expressions such as laughter, ums and uhs where they did not contribute to the final analysis. The transcript of the interview was then sent to each participant for her review and comment. The purpose of providing an opportunity for the participant to review the interview transcript was to ensure the accuracy of ideas presented and allow for correction or additional clarification by the participant.

Analysis

The advantage of using both a self administered survey and telephone interview was that it allowed questions to be asked to address the research questions in different ways. This was important in the process of analysis as it allowed the data to have greater validity and reliability. Table 1- Research/Instrument Question Matrix aligns the survey questions and the telephone interview questions with the research questions. The table comprises three columns. The first column contains the research questions. The second column identifies specific questions from the survey. Here, the survey page number is the first number followed by the question number found on that page separated with an underscore. For example, question five on page one is noted as [1_5]. The final column specifies which telephone interview questions addressed which individual research questions. The question numbers from the protocol are bracketed, and the letter ‘a’ following a number signifies that as a probing question. In addition to the research questions, there were also questions within the survey that specifically related to the demographics of the participants. Although these questions were not directly related to the research questions, they were important in creating a picture of the population that participated in the study.

Table 1. Research / Instrument Matrix**.**

Research Question	Survey	Telephone Interview Protocol
Why do women architectural engineers leave the industry?	[5_4]&[9_2]	(3) What was the primary reason you left your engineering career?
1. What are the actual retention rates of females in architectural engineering?	[1_8], [1_10], [1_11], [9_1], & [9_2]	
2. Do the women who have left intend to return to a career in engineering?	[5_21], [5_22], & [9_3]	(5) When do you intend to reenter the engineering workforce?
3. What are the women's perceptions of the architectural engineering workplace culture?	[1_6], [2_9-12], [3_16-23], [5_9], & [7_4-7]	
4. How has mentoring affected women's architectural engineering careers?	[1_9]	
5. How have issues of family/work balance affected women's architectural engg. careers?	[8_4], [8_7], [8_9-11], & [9_14-17]	(1) What about your career progression is different than what you anticipated?
6. What degree of satisfaction did/do females receive from their career in architectural engg.?	[2_13-14], [4_29-38], [5_10-11], & [6_ 12-20]	(4) How would you describe your feelings or emotion about leaving your engg. career?
7. What family friendly benefits are offered by the employers of architectural engg. women?	[3_24-28] & [7_1-2]	
8. What needs to change to retain or encourage re-entry of more women in architectural engineering?	[8-12], & [9_ 4-7]	(5a) What do you see as the primary obstacle to reentering the engg. workforce? (7) What could change in the engg. work environment to better accommodate women?
9. Are there things that can be done to better prepare women for careers in engineering?		(8) What should be done to more adequately prepared young women for their engineering career?
Demographics	[1_1-5], [1_8], [2_1-2], [2_6-8], [5_1-3], [5_6-8], [8_1-3], & [8_5-8]	

The data was collected utilizing a mixed method study producing both quantitative and qualitative results. Qualitative and quantitative data required different analysis methods be applied since the qualitative data focused on describing kinds of characteristics while quantitative data focused on amounts of characteristics or numerical values. The methods of analysis employed in this study are described in the sections that follow.

Quantitative

The quantitative data was collected in the self-administered survey. The survey's partially closed-ended and closed-ended questions were primarily included in this analysis. These questions included categorical data as a result of multiple choice questions such as the selection of the participants' current employment situation and ordered categories as a response to questions of opinion using the Likert-like scale. Open ended questions were also analyzed as quantitative data when numerical information was the response, such as the number of hours

typically worked in week or the frequency of travel. In either case, data collected using open or closed-ended questions were summarized using descriptive statistics. The primary type of descriptive statistics employed was measures of central tendency. This allowed the data to be presented in a concise manner that can be easily referenced for interpretation. In many cases, the data was clustered for presentation in Chapter 4 in an attempt to condense the information into a more manageable format. Response frequency and, where appropriate, means, modes, and medians were presented on a per question basis in Appendix I – Survey Results Summary. The data was analyzed and presented to coincide with the research sub-questions one through nine. This method of presentation was selected as it correlates directly to the issues of concern identified in the study.

Qualitative

The qualitative data collected from the survey and the telephone interview was more difficult and time-consuming to organize and interpret; the reason is that there is an additional step in the process. The data must be reviewed and coded prior to further analysis.

The qualitative data compiled from the survey was the result of the open ended questions with worded responses that were short in format. These responses were read through to identify common answers or codes. These codes were used to condense the responses into categories (Gay et al., 2006). These categories were then analyzed in reference to the established research questions, and descriptive statistics were examined where applicable. Open-ended questions were important to the collection of information as anticipated responses needed to create multiple choice questions were unknown in some situations (Dillman, 2007). These questions were more exploratory in nature, and the answers could be used to establish multiple choice questions in a future version of the survey.

The data collected through the telephone interviews was analyzed using multiple techniques. These techniques included the audio recording of the conversation, field notes taken during the interview and added to at the completion of the interview, and transcription of the interview recordings. The interview transcripts were reviewed and coded following the review by the participants to ensure that the data being analyzed was accurate. None of the participants made any changes to the interview transcripts. The transcripts of each interview were examined using constant comparison to establish themes or patterns (Creswell, 2007). In this case,

commonalities were of greater interest than differences as the study's intent was to identify the most common influences on the female engineering population rather than individual experiences. Initially, the data was organized by the structured questions and additional probing questions asked in each interview. This technique worked, but more important to the study were the repeating topics that surfaced, which did not specifically align with the interview questions but more with the issues identified in the literature review. These surfacing topics were the themes used to present the interview data. In addition to the themes that emerged from the interview data, it was helpful to look at the demographics of the individuals in the interview and their career progression. This was most effectively achieved through flow charts because they allowed for a more succinct interpretation of the events that impacted the participant's career and her choice to leave engineering.

Validity and Reliability

Validity indicates that a measure does, in fact, measure what is intended and is therefore trustworthy (Creswell, 2007). Two primary techniques, documentation and triangulation, were implemented in an attempt to increase the study's validity (Patton, 1990). Documentation is especially important in establishing the trustworthiness of the qualitative data collected. This was achieved through detailed documentation of contact with participants, the interview procedures, creation of field notes, transcription of the interview recordings, and the review of transcripts by the participants. Two triangulation techniques were implemented in review of the data collected to establish validity of the findings. First, the data gathered using the survey and interviews were compared. This was primarily a comparison of the qualitative data collected between the two techniques – open-ended survey questions and interview questions. Consistency in the data presented by the two sources adds validity to the research, and areas needing further inquiry and research were identified in the case that the data from the two sources contradicted one another. The second technique implemented was a comparison of collected data with results from other studies asking similar questions about women in the engineering workforce or other male dominated workforces.

Reliability reflects the ability of a measure to produce consistent results. Accordingly, the reliability of a survey instrument relates to the likelihood of a participant answering the questions the same way a second time or correctly interpreting what the question is asking. A

good instrument should produce the same results no matter how many times the survey is administered. Reliability of the questions used in this survey was achieved by using a proven and tested instrument. Many of the survey questions used were taken from the CREW Project, which had been updated and revised after its initial use in the 1999 study. The CREW Project surveys were distributed to larger samples (1,819 women in 1999; 3,214 women in 2007) enabling large scale testing of the instrument. Some changes were made to the questions to make the survey more specific to the architectural engineering discipline as well by adding of some questions of interest to this study, especially in regard to retention. The fact that many of the questions incorporated into the survey had been tested a number of times prior to this research greatly enhances the reliability although the CREW Project report itself does not present any reliability data.

Reliability was also built into the study in that the same questions were asked both in the survey and the telephone interview. Although the questions' wording was slightly different between the two data collection methods, the following questions can be compared to predict consistency of response:

What was the participant doing at the time of the study related to work?

- Telephone interview question 2 and survey question [5_1]

What influenced the participant's decision to leave the engineering workforce?

- Telephone interview question 1 and survey question [5_4]

Does the participant intend to return to the engineering workforce?

- Telephone interview question 5 and survey question [5_22] and [9_3]

What does the participant miss about her engineering employment?

- Telephone interview question 4 and survey question [5_5]

What advice would the participant provide to a female entering the field of architectural engineering?

- Telephone interview question 9 and survey question [9_8]

CHAPTER 4 - Results

The purpose of this chapter is to present the data collected as described in Chapter 3 – Methodology. The data was obtained through the administration of two collection instruments – survey and telephone interview. Each of these methods generated data to address each of the research sub-questions.

1. What are the actual retention rates of women in architectural engineering?
2. Do the women who have left intend to return to a career in engineering?
3. What are the women's perceptions of the architectural engineering workplace culture?
4. Does mentoring affect women's architectural engineering careers?
5. How have issues of family/work balance affected women's architectural engineering careers?
6. What degree of satisfaction did/do women receive from their career in architectural engineering?
7. What family friendly benefits do participants report are offered by the employers of architectural engineers?
8. What needs to change to retain or encourage re-entry of more women in architectural engineering?
9. What can be done to better prepare women for careers in engineering?

This chapter is divided into two sections based on the method utilized in the collection of data. The first section describes data collected using the survey instrument beginning with the response rate and demographics of the participants followed by subsections devoted to survey responses that address each of the nine research sub-questions. The second portion of the chapter focuses on the results of the telephone interviews. These results are compiled and organized based on the themes that emerged from the interviews. The chapter concludes with a summary and a discussion of the consistency of the results between the data collected by the two instruments.

A significant amount of data was collected through the administration of the survey and the interview. For this reason, only the compiled data results considered most relevant to the research questions are presented in this chapter. Frequency tables of responses for each question in the survey are included in Appendix I. As data is presented, the corresponding survey

question is referenced either directly within the text or at the end of a sentence. This reference within the text includes the survey page number as the first number followed by the question number found on that page separated with an underscore. For example, question five on page one is noted as [1_5]. As the transcripts from the interviews are lengthy and would require considerable space in the appendix if included in their entirety, only one interview transcript has been included as Appendix J.

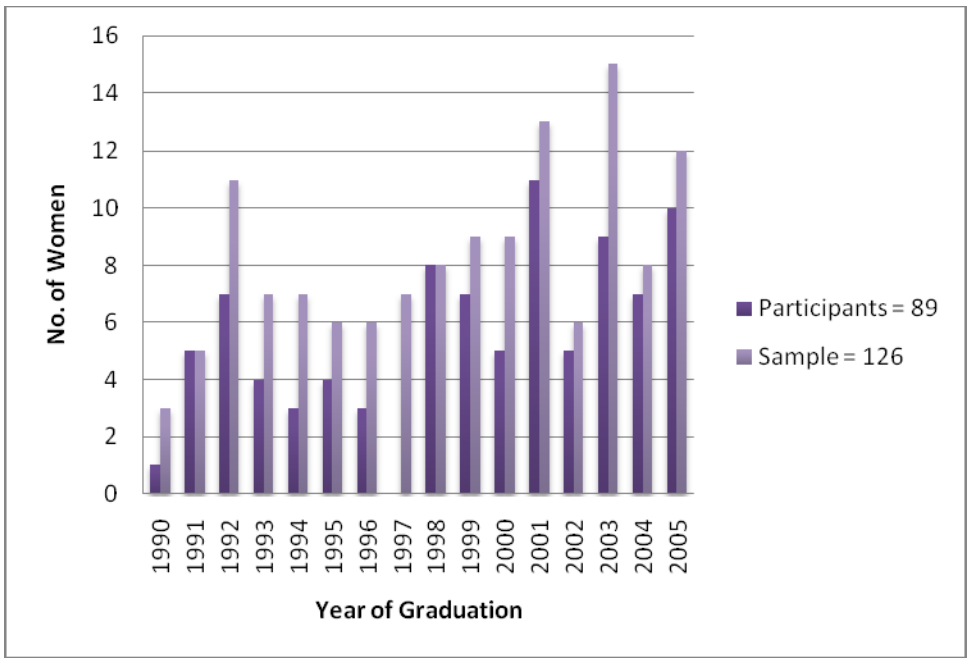
Survey

The survey was the first data collection instrument administered in this study. This was selected as the first instrument as it could generate issues that needed to be addressed in the subsequent interviews and provided a mechanism through which participants no longer employed in architectural engineering could be identified. In addition to aiding in the structure and direction of the research, the data generated allowed for a comparison between those who have remained in the architectural engineering workforce and those who have left.

Response Rate and Demographics

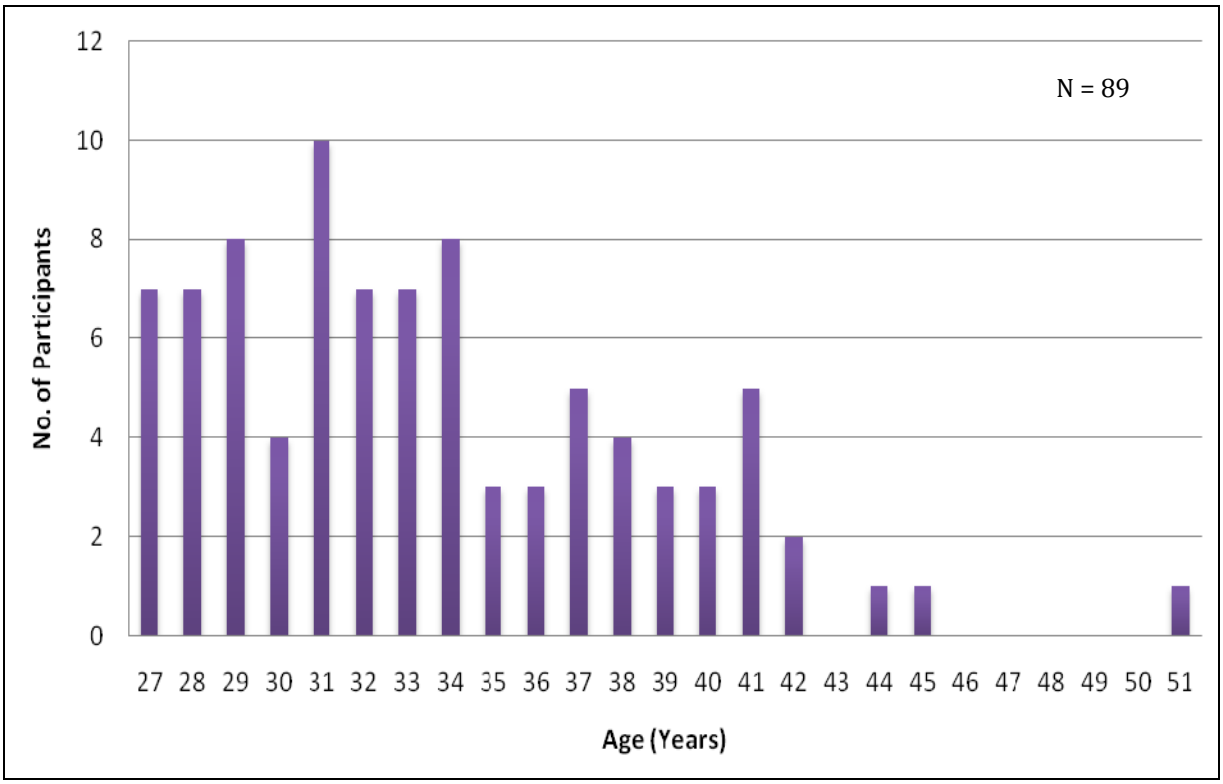
As described in Chapter 3, the sample included all women graduates from the Architectural Engineering Program at a Midwest state university between 1990 and 2005. The names and addresses for these individuals were obtained from the Midwest state university's Foundation. The sample included 126 women of which 89 returned completed surveys, resulting in a 70.6% response rate. Responses included women from all the graduation years except 1997 as depicted in Figure 1.

Figure 1. Sample response based on year of graduation.



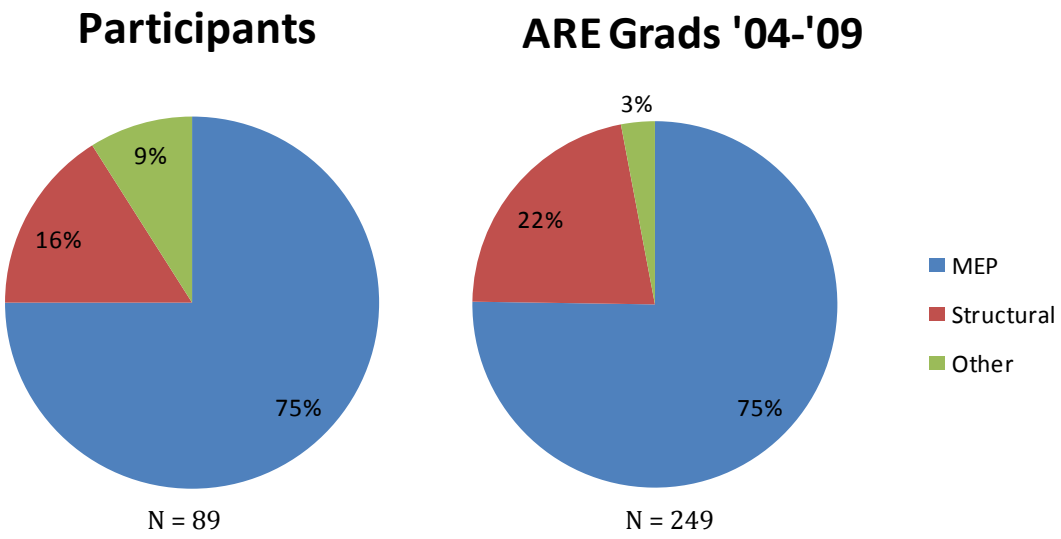
Participant demographic information was collected in an attempt to create a clear picture of those from whom the responses were collected. The demographic information included age, engineering discipline or specialty within architectural engineering, advanced education, and professional licensure. As shown in Figure 2, the participants ranged from 27 to 51 years of age with an average age of 33.6 years [1_5].

Figure 2. Age of survey participants.



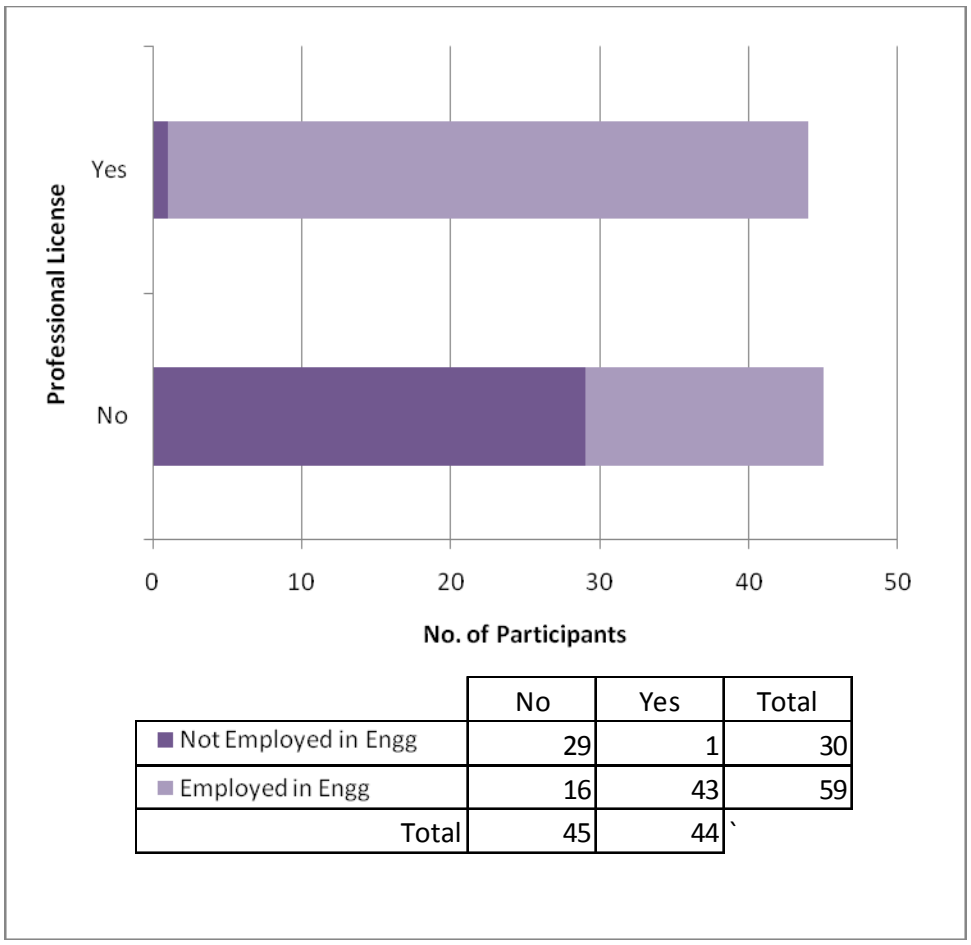
Survey question [1_2] asked participants to identify the specific area of architectural engineering currently practiced or last practiced. The results were distributed among Mechanical (20), Electrical (32), Mechanical/Electrical/Plumbing (MEP) (15), Structural (14) and Other (8). As shown in Figure 3, this distribution is fairly consistent with the distribution of all graduates from the Midwest state university's architectural engineering program over the past five years. Figure 3 has Mechanical, Electrical and Plumbing grouped together as one category, MEP, for comparison because it is difficult to separate or distinguish among the three disciplines at the time students are graduating. Moreover, the area in which a student works can and often does change frequently among the three during one's career as firms typically perform and employ engineers in all three disciplines.

Figure 3. Comparison of discipline selection between participants and 2004-09 ARE graduates.



As with most professions, enhancing knowledge to stay current in the industry and enhancing credentials is important for advancement. This is typically accomplished through advanced educational degrees and professional licensure. In architectural engineering, a Professional Engineering License (P.E.) is very important due to the liability associated with building design. Building design is different from other product design because all of the testing of the product, the building, is done by the occupant, the end user. For a building to get a permit for construction, a registered professional engineer's stamp and signature is required. This seal and signature signifies that the engineer was responsible for the design and therefore takes on the liability associated with the building. The professional license is therefore extremely important to professional advancement in the architectural engineering industry. Correspondingly, a new version of the professional engineering exam aimed at architectural engineering was offered beginning in spring 2003. Prior to this development, engineers were required to take the version of the exam most closely related to their sub-discipline. Survey question 1_4, revealed that just less than 50% of the respondents had their P.E. license, but the question did not ask in which discipline of engineering they were licensed. What is more interesting is that 72% (43/59) of these participants with their P.E. were currently employed in engineering compared to only 3% (1 of 30) who were no longer working in an engineering capacity (Figure 4).

Figure 4. Participant professional licensure based on employment status.



	No	Yes	Total
Not Employed in Engg	29	1	30
Employed in Engg	16	43	59
Total	45	44	`

As shown in Figure 5, 58.4% of the participants had neither attained nor were working on advanced degrees per the response to survey question [1_3]. These results were further separated to compare those who remained in the engineering workforce and those who had left. This comparison reveals that advanced degrees were attained by more than twice as many participants who remained in engineering. The most common reported advanced degree is a Masters in Architectural Engineering (63%), which likely could be attributed to the fact that the program from which the respondents graduated offers a combined M.S./B.S. degree requiring only 15 additional credit hours on top of the standard five year undergraduate curriculum. The survey did not include a question that would allow for differentiation of when or how the advanced degree was attained.

Figure 5. Participant advanced degree based on employment status.

	Masters in ARE	Other	Inprogress	None	Total
Engg	16	8	1	34	59
Non Engg	7	3	2	18	30

Research Sub-Question 1: Retention Rates

The data collected in survey question [1_11] asking if the participant was currently employed as an engineer or in an engineering-related position revealed that 59 of the 89 participants were still practicing engineering, resulting in a retention rate of 66%. Most (52) of these respondents in engineering employment maintained a traditional full-time position in the building construction industry while two were employed in an engineering position not related to architectural engineering, three were employed in a part-time capacity, and two others worked as consultants [2_1] (Table 2). Of the 30 participants not employed in engineering at the time of the survey, more than half (17) of the respondents were employed in a position not related to engineering. All but three of the remaining 10 were taking a break from employment as identified in survey question [5_1] (Table 2). Eight of the respondents not currently employed in engineering were currently looking for or were planning to look for engineering employment in the future.

Table 2. Participant employment status.

Participant Employment Status			
Engineering Employment	**59**		
Full Time		52	
Part Time		3	
Consultant		2	
Other		2	
Non-Engineering	**30**		
Working Non-Engineering		17	
Taking Career Break		10	
-Plan to return to Engg			*7*
-Plan to return to work Non-Engg			*3*
Out of work		3	
-Looking for Engineering			*1*
-Looking for Non-Engineering			*2*

Employment opportunity for architectural engineering graduates has historically been good. In fact, the survey results of question [1_8] indicated that only one participant was employed in a non-engineering position six months following graduation as a result of lack of job opportunity. Moreover, four participants never actually entered the engineering workforce as they choose another career direction immediately upon attaining their architectural engineering degree. When disregarding these individuals from the analysis, the average years of practice prior to leaving was 6.2 years, while the median value was five years. Figure 6 graphically represents the participants' years of practice prior to leaving the engineering workforce. This question was important to establish whether there is a point in one's career or a critical period within one's career when the decision to leave was made.

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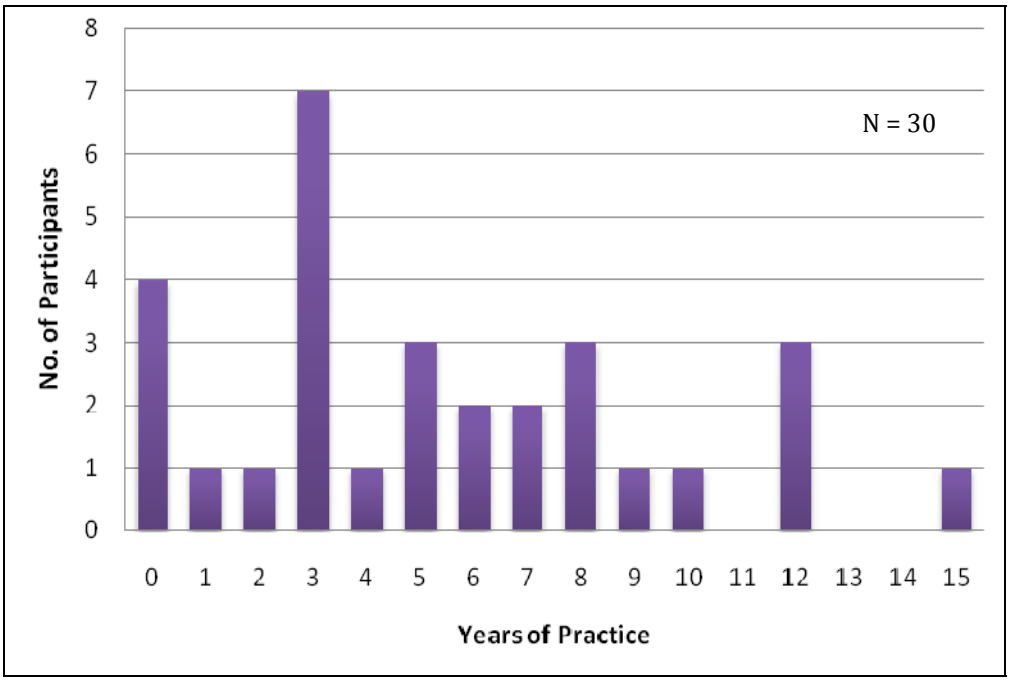
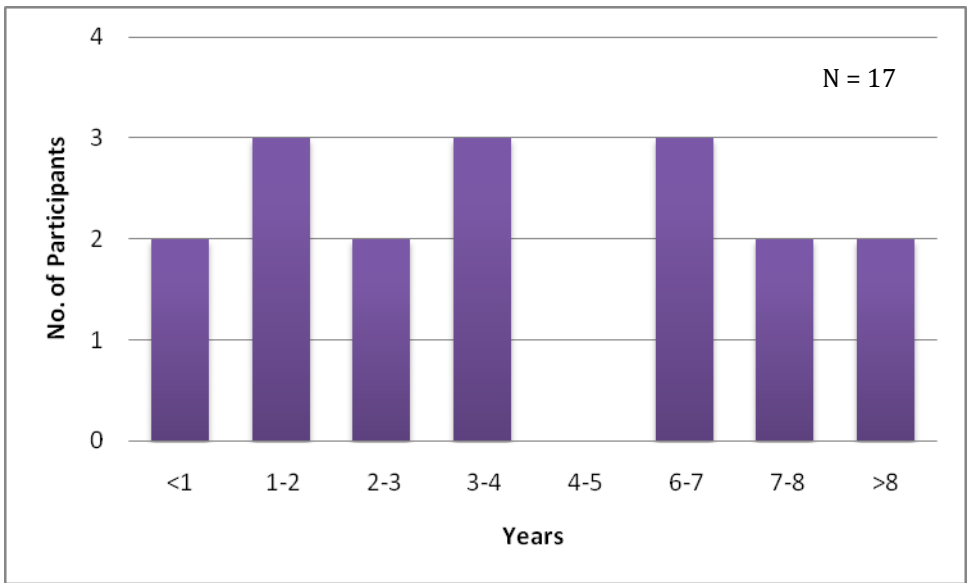
Figure 6. Participant years of practice prior to leaving engineering.



Many different factors influenced a participant's decision to leave an engineering career, as expressed in their response to the open-ended survey question [5_4]. Having children was, by far, the most common response with 16 participants citing this as the reason for leaving. This was followed by eight participants referencing the job and job enviroment being the driving force for their decision to leave. Other factors also cited by more than a single partipant included stress and the desire to contribute to society.

In addition to asking the participants if they were employed outside engineering (results dispayed in Table 2), the survey asked for the extent of time they had been removed from engineering [5_2]. At the time of the survey (July 2009), some of the partipants had recently made the tranistion to employment outside engineering while others had been removed for more than eight years as shown in Figure 7. Particpants were employed outside of engineering on average 4.6 years.

Figure 7. Years employed outside engineering**.**



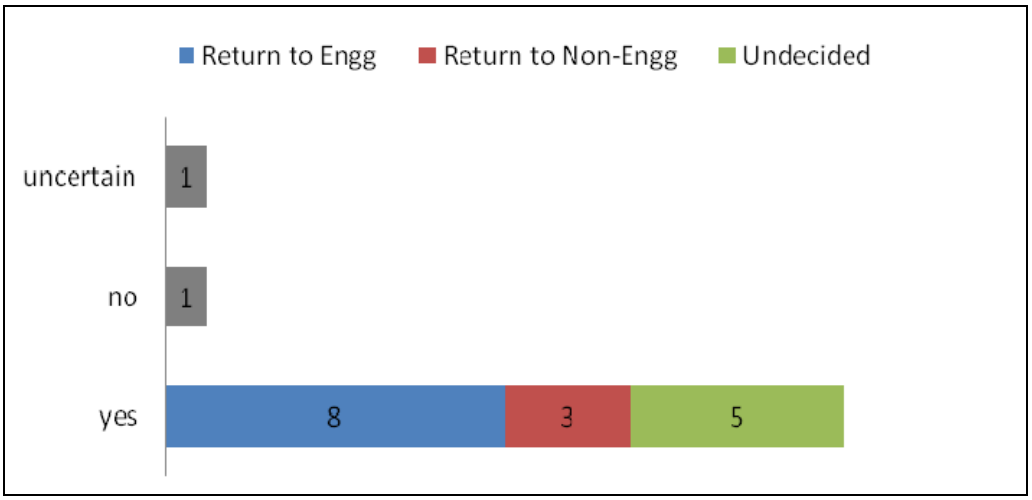
Research Sub-Question 2: Return to Engineering

As presented earlier, some women do leave engineering, each making the decision for her own reasons. Consequently, it was important to investigate if women who leave architectural engineering intend to return to architectural engineering, as it may present a need to address re-entry issues for these women and an opportunity for employers to hire experienced engineers potentially otherwise overlooked or forgotten about.

The survey included questions that addressed both the longer-term plans of those women who had already left engineering as well as the intentions of women who were considering leaving engineering in the next 12 months [5_1, 6_22, 9_1, and 9_3]. As displayed in Table 2, ten participants were taking a career break. Seven (70%) of these participants indicated in their response to survey question [6_22] that they were 'likely' or 'very likely' to return to engineering employment while the other three indicated that they were 'unlikely' to return; no participants expressed they are 'very unlikely' to return to engineering. To determine whether some of the participants employed in engineering may be contemplating leaving the industry, question number [9_1] asked about their career intentions in the next 12 months. Eighteen of the participants employed in engineering at the time of the survey said they are 'likely' or 'very likely' to leave their current employment in the next 12 months with three others indicating that they were undecided (Figure 8). Of these 18 participants, 16 plan to return to work, and half of these participants plan to return to engineering for their employment. Five of the remaining eight

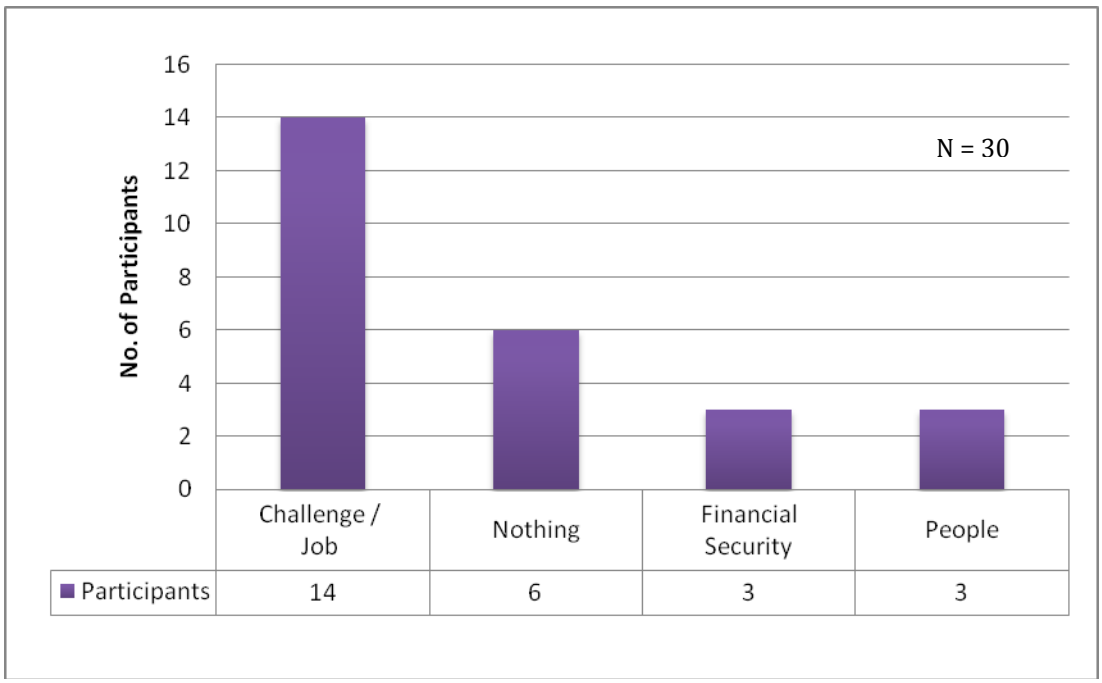
had not decided if their future employment would be in engineering, and three were not returning to engineering [9_3].

Figure 8. Participants' intention to return to employment following leave.



Via an open-ended question format, the 30 participants who were not employed in engineering were asked what they miss about engineering [5_5]. The response identified by nearly half of respondents was the challenge of the job. Other common answers included financial security, people, and nothing as represented in Figure 9. Some participants provided more than one answer to this question, and all responses can be found in Appendix I. Question [5_21] also pertained to this topic as it asked to what extent the women not employed regret not having a full-time career. Only two participants indicated 'a great deal' with most (10) responding in the mid range with responses 'somewhat' and 'occasionally'. The remaining four responded they do not regret not having a full-time professional career.

Figure 9. Most commonly missed items about engineering by participants who left.



Research Sub-Question 3: Perception of Workplace Culture

As indicated in earlier chapters, the workplace culture can influence performance and retention. This section presents a picture of the workplace and its culture as seen by the graduates of architectural engineering who participated in this survey. The survey collected data specific to the demographics of the architectural engineering workplace as well as participants' expectations and experiences within this work environment. All of these items factor into defining the work culture.

The demographics of the workplace were established by analysis of responses to survey questions [2_3, 2_4, and 2_5]. These questions were asked only of the 59 women employed in engineering at the time of the survey. The information included the firm size as well as female representation within the firm. The workplace size ranged from one person as an independent consultant up to 2000 persons. Nearly three quarters of the participants worked in a firm of less than 100 people, with the median firm size being 30 (Figure 10). Eighty percent of the participants were employed at firms in which the female engineering representation was less than 25%, with a mean value of 17.4% and a median value of 14% ratio of females to males within firms (Figure 11). (These values were calculated excluding the four independent consultants) Of these 55 employers, 22 had female representation in upper management.

Figure 10. Participant employer firm size.

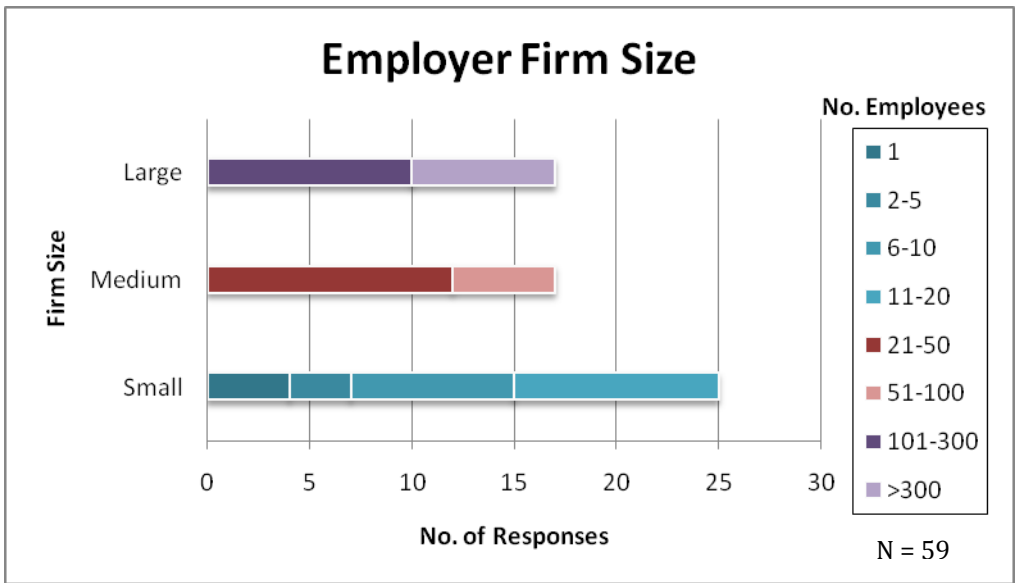
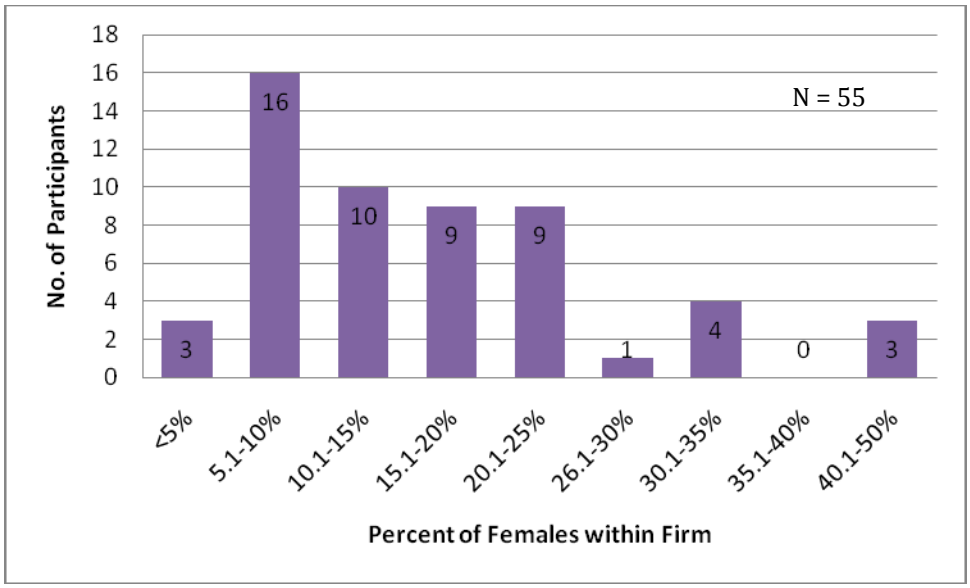


Figure 11. Percent of women at firms employing participants.

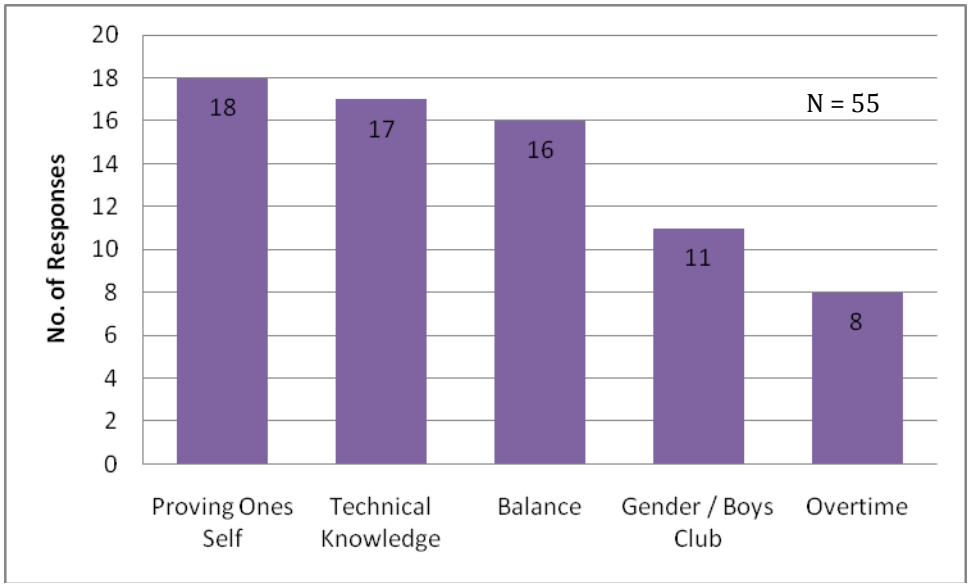


Even with the low representation of females in the architectural engineering workplace, a majority of the participants felt they were given job assignments and pay raises equal to those of their male counterparts and that they had the opportunity to reach the top of their profession [3_18, 3_19, and 3_20]. Five of the 55 respondents indicated they had already reached the top while another 21 either did not want to reach the top or were uncertain if that was their goal [3_20 and 3_21].

The most common challenges identified within the architectural engineering work culture for the participants included proving one's self (18), technical knowledge (17), balance (16),

gender/boys club (11), and the need to work overtime (8). Eliciting these responses took the form of an open-ended format as survey question [2_15] to which some participants provided more than one answer. The most common answers are shown in Figure 12. All responses can be found in Appendix I.

Figure 12. Common challenges encountered by participants.



Two of the common challenges identified above, overtime and balance, can be directly connected to work hours. This is further reinforced by hours/family balance being the most common response to what the women no longer employed in engineering liked about their non-engineering career [5_9]. Less than 20% of the full-time employed participants indicated that they were not required to work overtime in an average work week, likely contributing to the prevalence of this challenge. The responses to survey question [2_10] (hours worked) are presented in Figure 13 and question [2_9] (hours paid) are presented in Figure 14. These figures show that overtime was commonly expected but overtime pay was not typically provided by the employers of the participants. This being said, over 80% of the participants felt that the time schedule imposed was reasonable to accomplish their job responsibilities [2_12].

Figure 13. Number of hours worked per week.

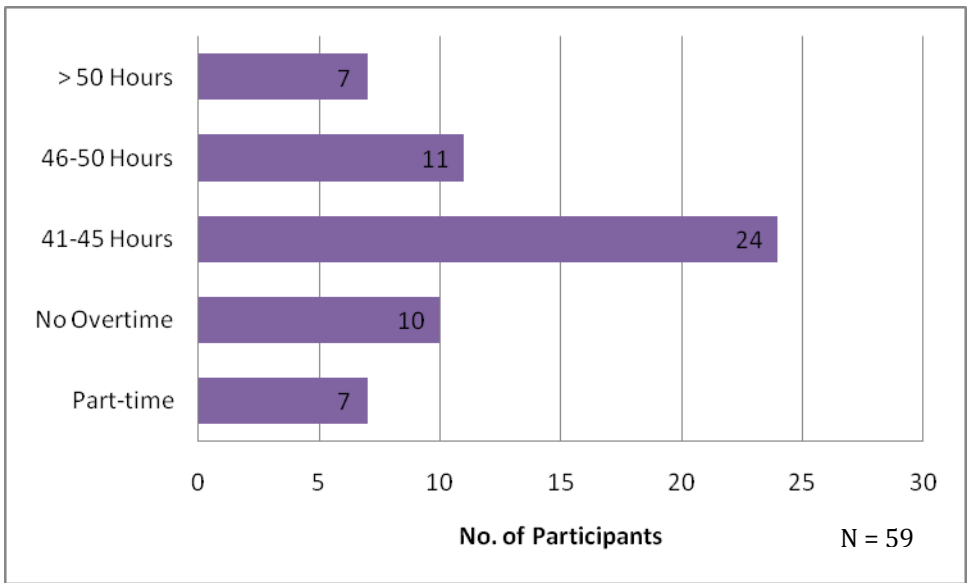
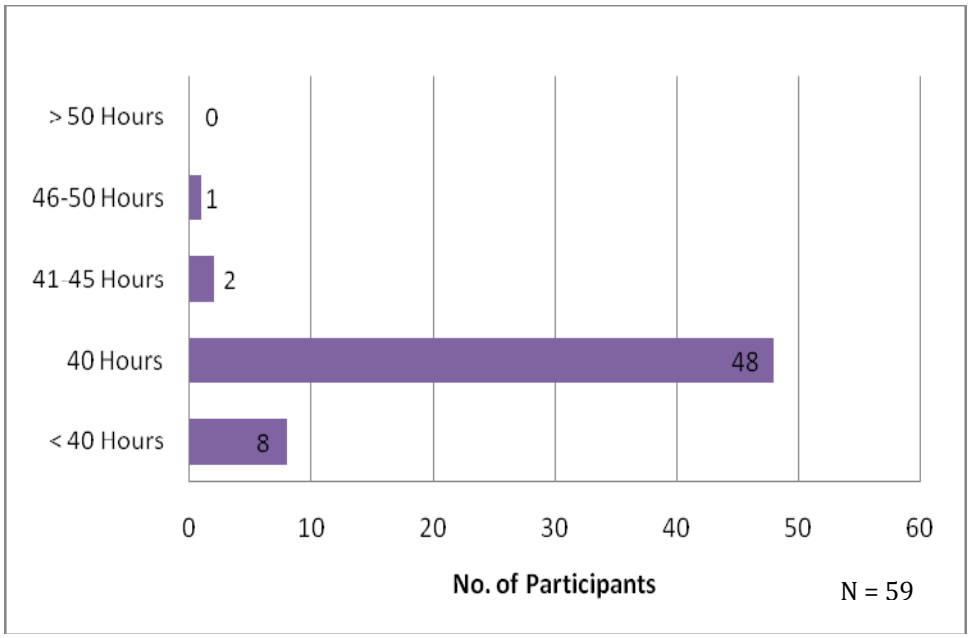


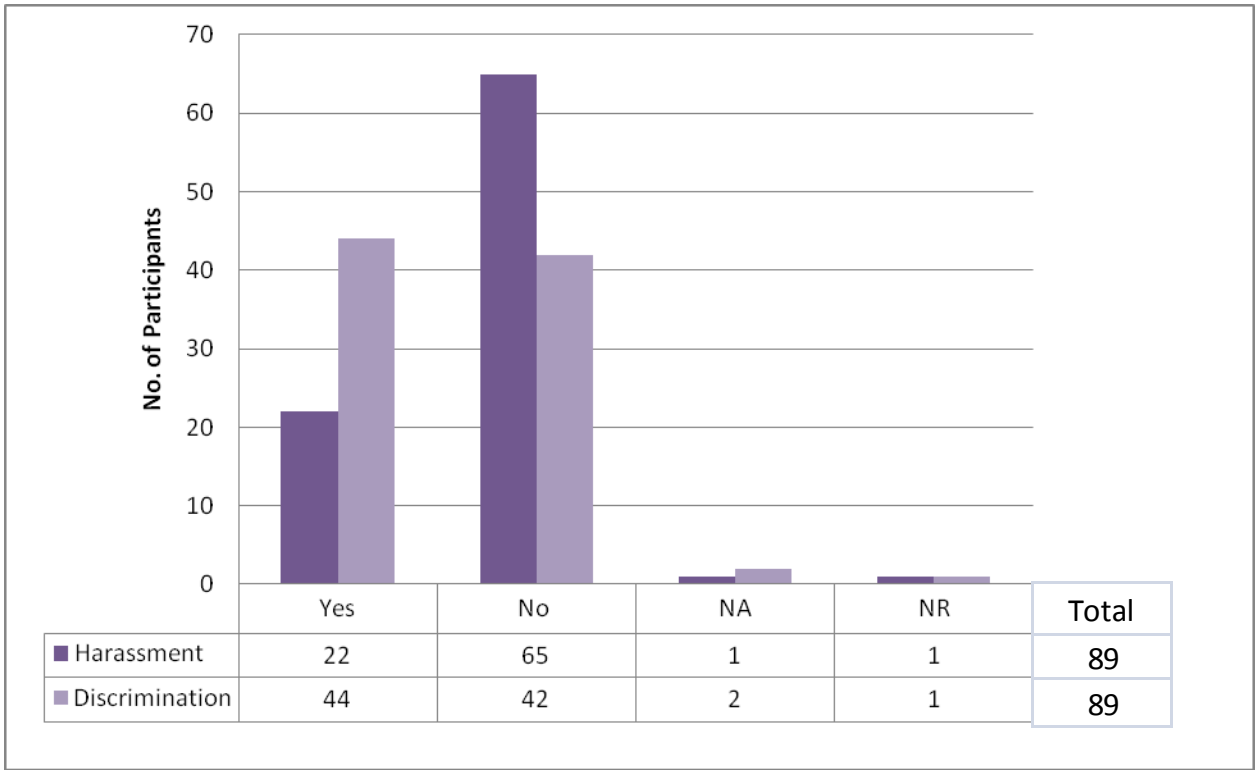
Figure 14. Number of hours paid per week.



Part-time employment did appear to be an option taken advantage of by four of the respondents as they reported being paid for less than 30 hours per week. Another three participants reported that they were paid for a 30-hour work week. Figure 13 merges responses from all participants paid for less than a 40 hour week as part-time for clarity even though part-time employees are technically those who work less than 30 hours and for whom benefits do not need to be provided.

Gender and the existence of the “good ol’ boys club” were other challenges identified. These obstacles are not uncommon in a male dominated work enviornment and can contribute to the prevelence of sexual harassment and discrimination. All participants were asked in survey questions [7_4 and 7_6] about their ecounters with sexual harassment and discrimnination (each term was defined in the survey for clarity). The results indicated that a quarter of the participants reported having encountered sexual harassment. Discrimination was more prevalent with just over half reporting having experienced this within the workplace (Figure 15). These results are somewhat surprising considering that 30% of the participants indicated that their employers provide no information or training on harassment as identified in survey question [7_5]. This being the case, respondents expressed that most (76%) of the employers had what they considered a fair and just procedure for handling issues of harassment and discrimination [7_7].

Figure 15. Participant experience with harassment and discrimination.

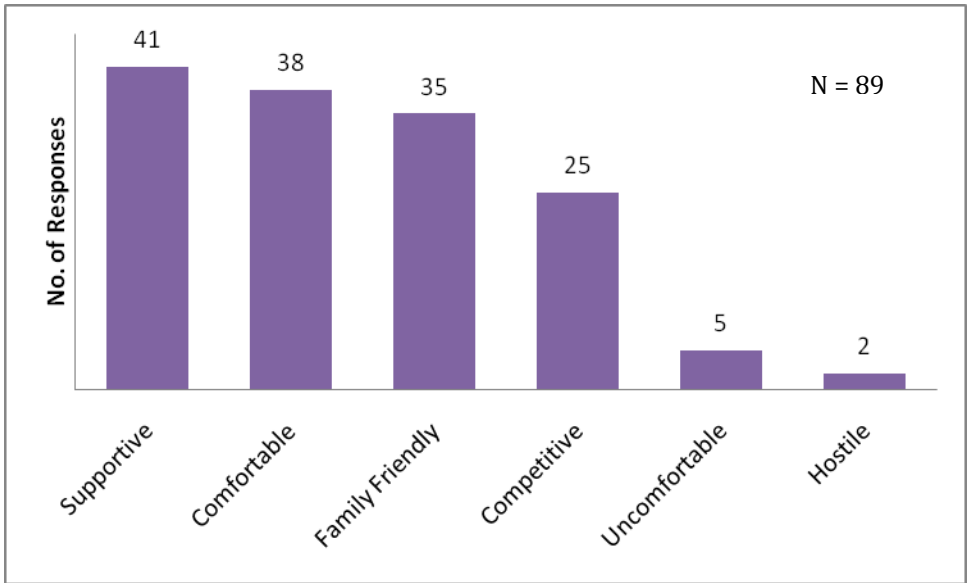


	Yes	No	NA	NR	Total
Harassment	22	65	1	1	89
Discrimination	44	42	2	1	89

Overall, the survey participants had a fairly positive perception of the workplace culture. Survey question [3_16] asked the participants to check the box beside the words best decribing their engineering work culture. Over half of the respondents selected the descriptors supportive, comfortable, and family-friendly, while less than 10% selected uncomfortable and hostile

(Figure 16). Additional descriptors written in by the respondents included an equal mix of positive and negative descriptors: belittling, condensending, disjointed, flexible, open minded, high pressure, low morale, and social.

Figure 16. Responses describing engineering work culture.



This positive perception was further reinforced by the perceived positive feedback received at work. Survey questions [3_22 and 3_23] asked how many times the participant heard positive or negative feedback during a typical month and from whom she was receiving this feedback. The positive feedback occurences ranged from 0-10 times per month from an internal source such as a supervisor or peer, with an average of 3.5 times per month. On the other hand, negative feedback occurances ranged from 0-30 times per month, also from an internal source. The average was only 2.9 times per month.

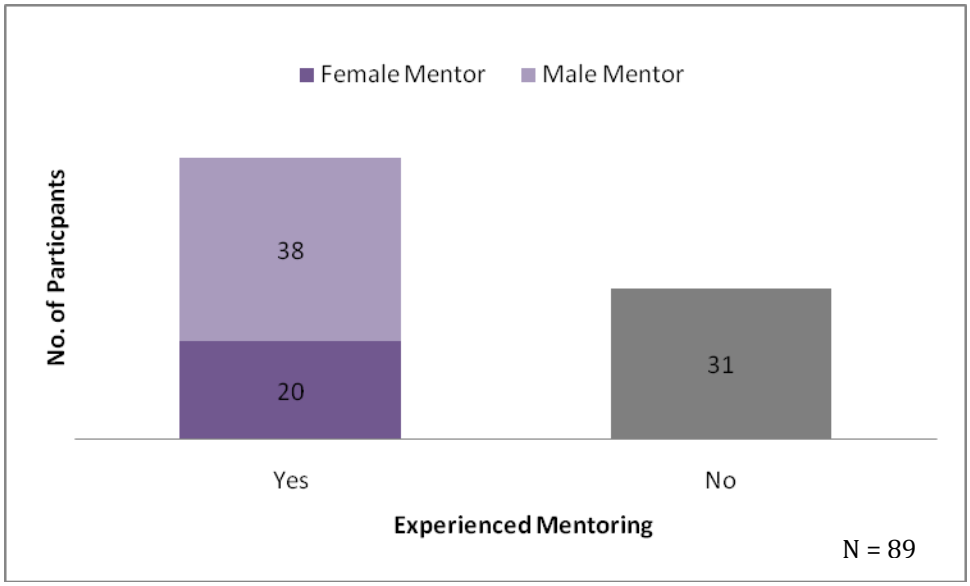
For a good number of the participants, the workplace culture was not a surprise given that 75% of them had an internship prior to full-time employment [1_6]. Of those who completed an internship, nearly 90% felt that the internship experience accurately represented their experiences working in an architectural engineering firm.

Research Sub-Question 4: Effect of Mentoring

Mentoring has been recognized as an important component of career success. Figure 17 presents the responses to survey question [1_9] focused on determining the frequency of mentoring and the gender of their mentor. Sixty-five percent of the participants claimed to have

a mentor for their architectural engineering career. Of the participants who responded they had a mentor, only 20 of the 58 indicated this was a female mentor (34%). This question also asked how the participants felt this interaction influenced their career. The three most common responses to the open-ended question as to how a mentor influenced their career included teach/answer questions (19), support/encouragement (11), and opportunity/promotion (10). Other responses that were common to at least five respondents were example (8) and advice (5).

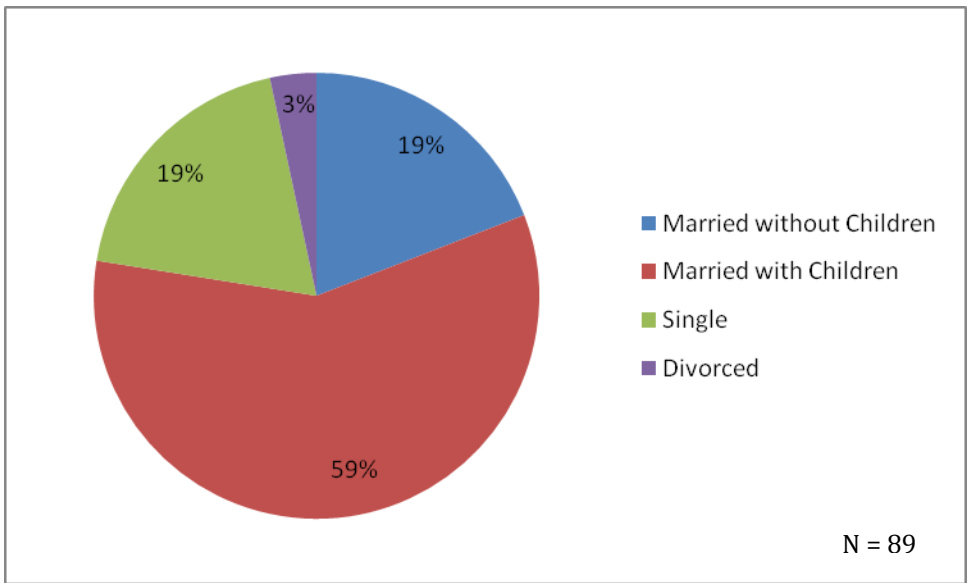
Figure 17. Mentoring experienced by participants divided by gender of mentor.



Research Sub-Question 5: Family/Work Balance

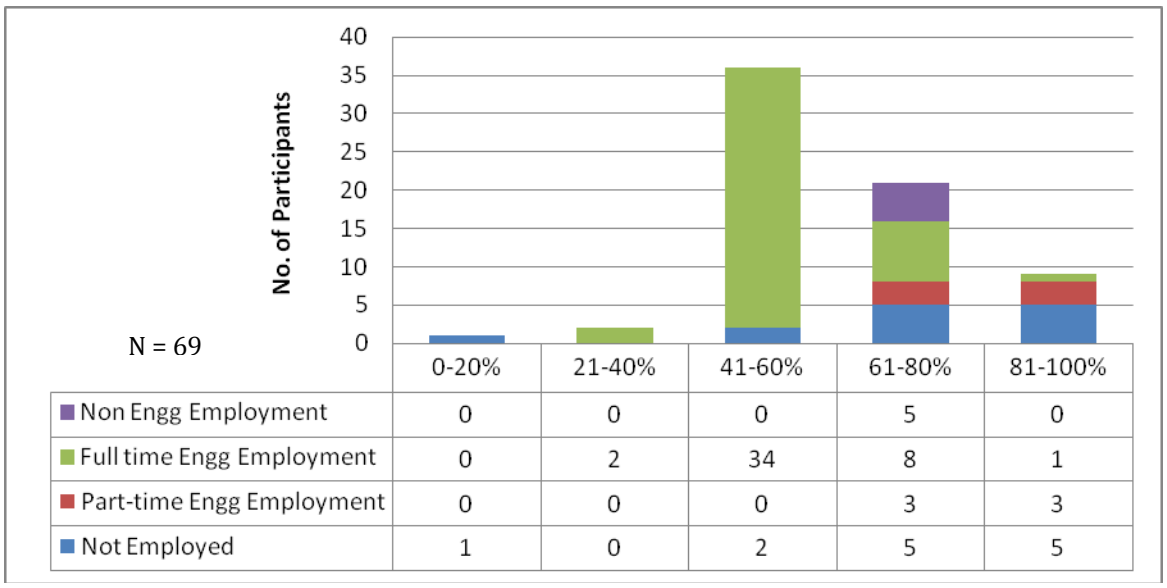
As women become more successful in establishing themselves in the workforce, increased attention to the stresses related to balancing family and career become an important issue. Family balance was an issue of concern for the respondents to this survey, given that over three quarters (77.5%, 69) were married (Figure 18). All of the married participants indicated that their spouse was also employed, and over three quarters had children (52 of 69) [8_1, 8_2, and 8_8].

Figure 18. Participant marital and family status.



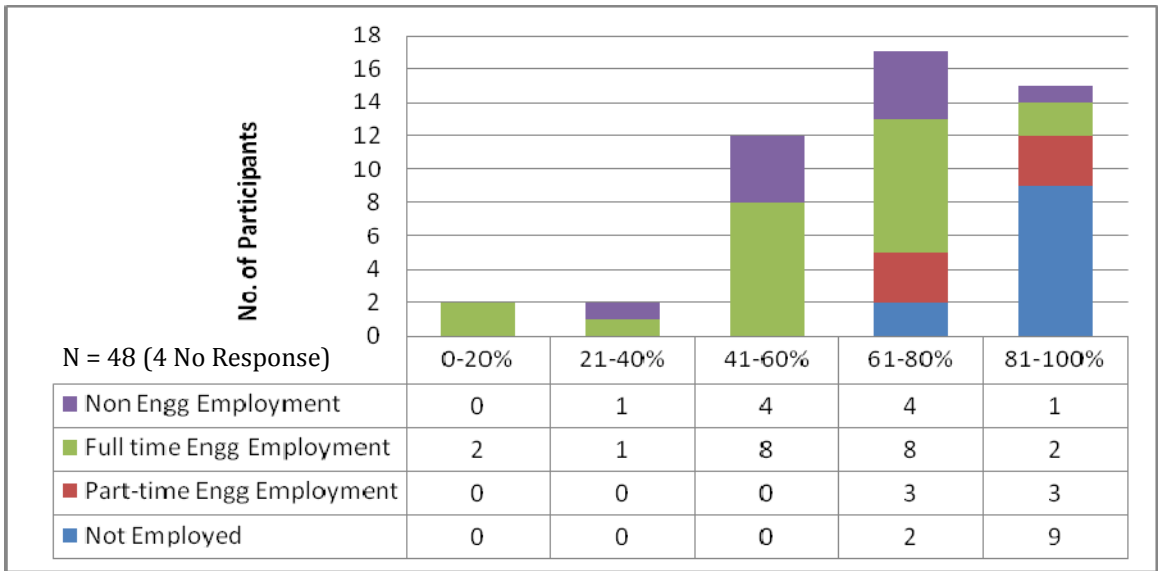
A majority (65%, 45) responded to survey question [8_4] that their career was equal in priority to their spouse's although more than half (58%, 40) did not see their career as a mainstay for their household [8_6]. This likely related to only a quarter of the participants indicating that they were the primary income earner in their household [8_5]. The issue of balance becomes further apparent when considering the division of household responsibilities. Although participants who were working in a full-time capacity felt that their career took equal priority to that of their spouse, they also reported that they took on greater responsibility for the household and childcare as indicated in Figures 19 and 20 [8_7, 8_9, and 8_10]. It is also clear that career choice does influence the distribution of responsibilities as the participants who chose to take a part-time position (less than a 40 hour work week) or were not employed often were more responsible for both the household and the children.

Figure 19. Participants' household responsibilities broken down based on employment.



	0-20%	21-40%	41-60%	61-80%	81-100%
Non Engg Employment	0	0	0	5	0
Full time Engg Employment	0	2	34	8	1
Part-time Engg Employment	0	0	0	3	3
Not Employed	1	0	2	5	5

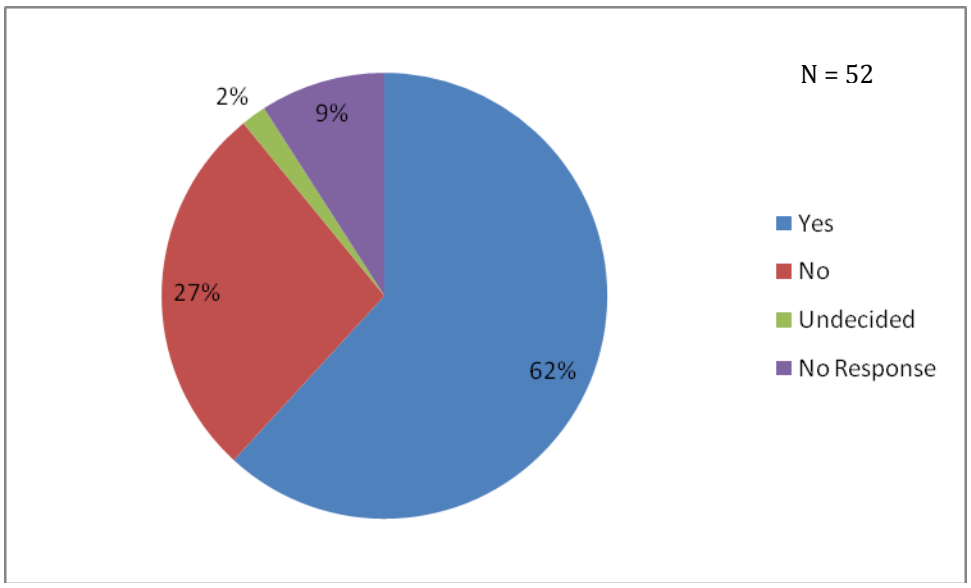
Figure 20. Participants' childcare responsibility broken down based on employment.



	0-20%	21-40%	41-60%	61-80%	81-100%
Non Engg Employment	0	1	4	4	1
Full time Engg Employment	2	1	8	8	2
Part-time Engg Employment	0	0	0	3	3
Not Employed	0	0	0	2	9

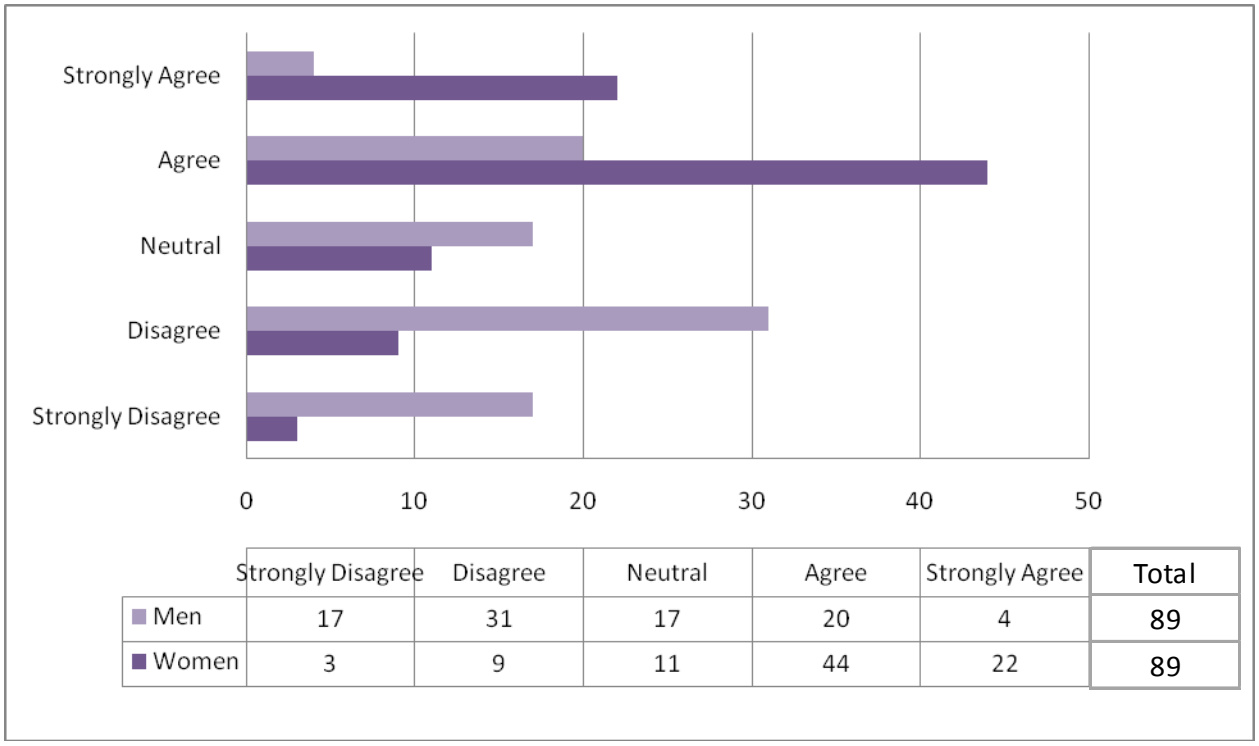
Respondents recognized that family does require time and attention, and gave an overwhelming response (62%) to question [8_11], suggesting that the attempt to balance both a career and a family does affect career progress (Figure 21).

Figure 21. Participants' belief that their career progress was affected by family responsibilities.



This is further reinforced in the participants' response to survey questions [9_15 and 9_16] addressing the sacrifices in relationships/family responsibilities required in one's career and the extent to which men also make substantial sacrifices in relationships/family responsibilities in order to advance in their career. Clearly, the respondents in this study feel that greater sacrifice of family is required by women than by men, as nearly 75% indicated they agree or strongly agree that sacrifice is required for women to reach the top of their profession compared to just over 25% stating the same requirements for men (Figure 22).

Figure 22. Comparison of participants' beliefs that men and women have to make sacrifices in relationships or to have children to reach the top in their career.



	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Men	17	31	17	20	4	89
Women	3	9	11	44	22	89

When asked to provide their opinion as to whether society values motherhood more than a career, 32 (36%) were neutral [9_17] (Figure 23). The responses were fairly evenly split with a total of 25 (28%) either agreeing or strongly agreeing with the statement and 31 (35%) either disagreeing or strongly disagreeing. By contrast, a significant portion (72%) did not believe that there is equal respect in society for a stay at home mother compared to that for a professional [8_13] (Figure 24). Both of these questions relate to the topic of society's value of motherhood, and the results reveal that the participants believe that a professional is more respected than a stay at home mom although motherhood is considered important.

Figure 23. Response to the statement ‘Society values motherhood more than career’.

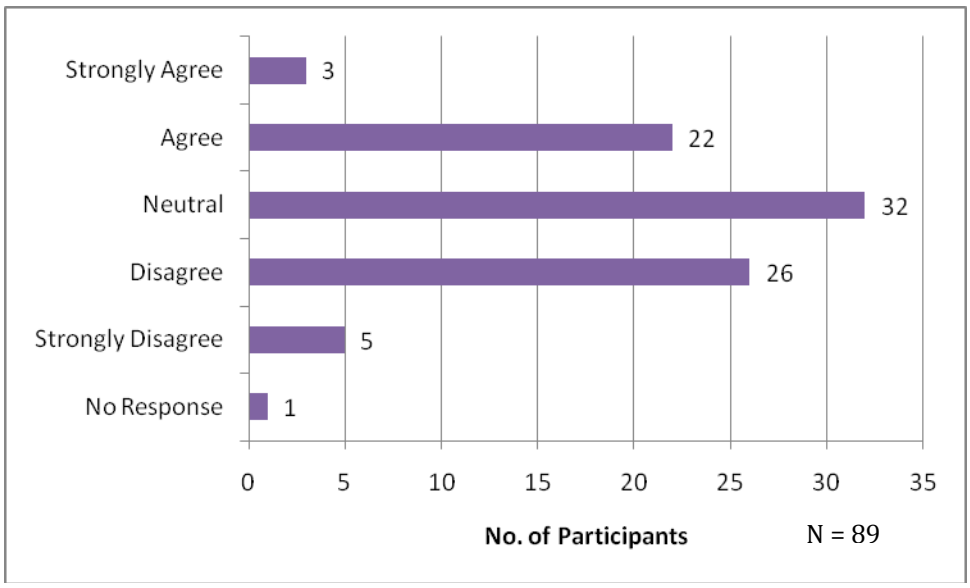
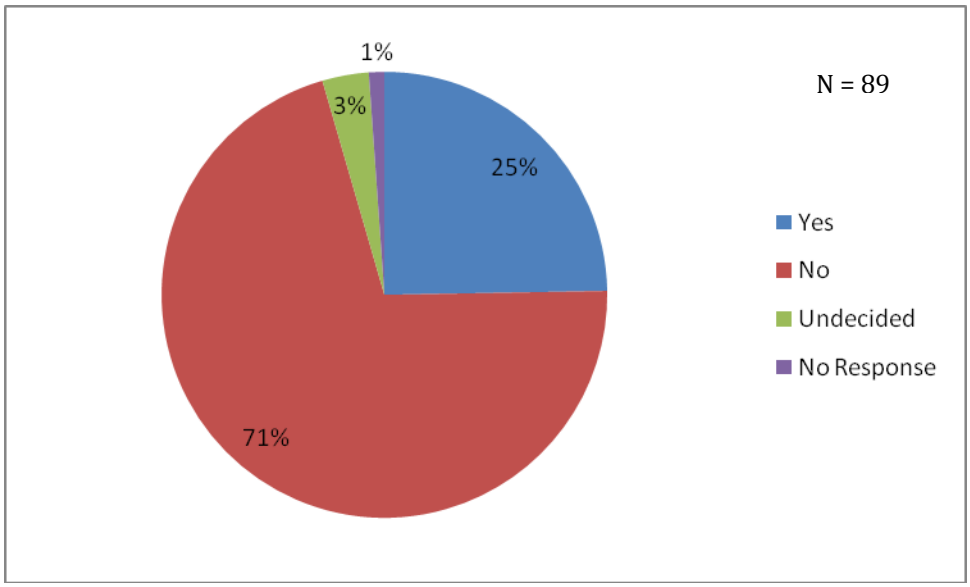


Figure 24. Response to ‘Does society consider stay at home mom and professional equally respectable?’



Research Sub-Question 6: Career Satisfaction

Career satisfaction was evaluated in the survey by all working participants, including both those employed in architectural engineering and those working outside of engineering. The survey asked participants to rank their satisfaction in different areas related to the work environment using Likert-like scales as well as open-ended questions. Overall, the participants, employed in or outside the architectural engineering workforce, appeared to be far more satisfied

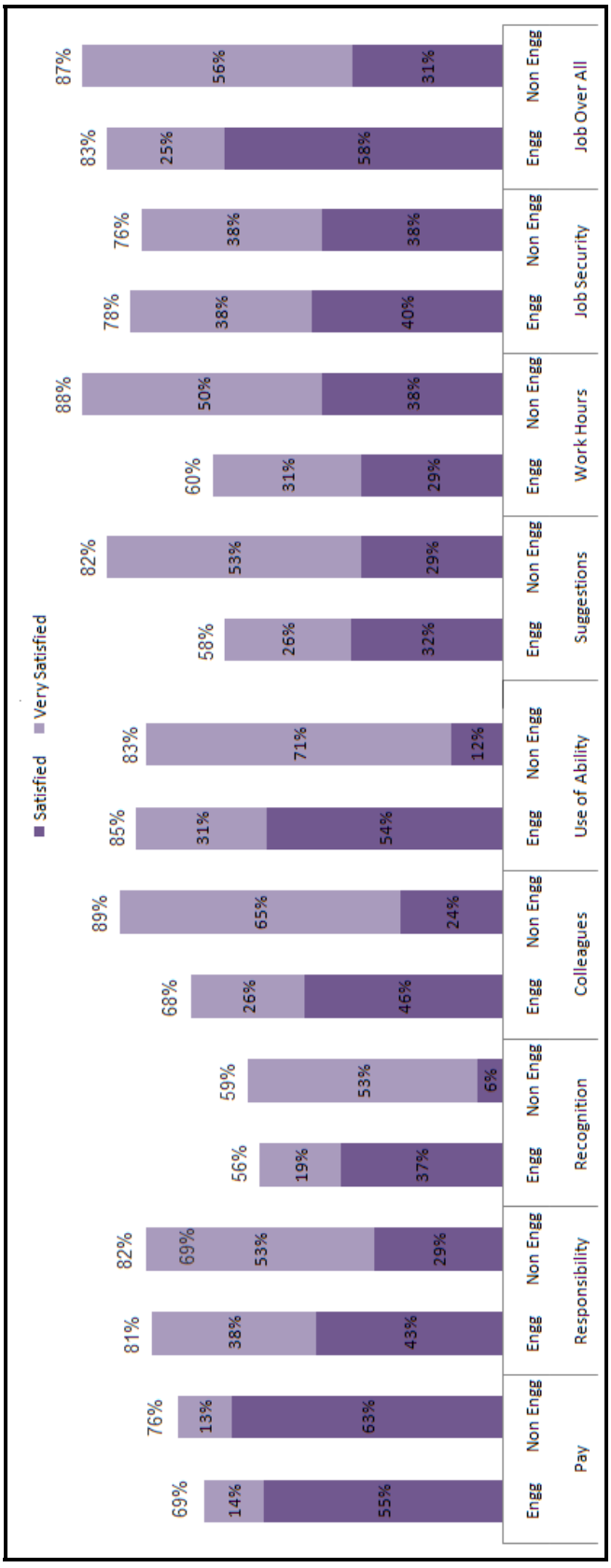
with their careers than dissatisfied. The data is presented in the following two subsections – satisfaction and dissatisfaction.

Satisfaction

Satisfaction responses showed some discrepancy between engineering and non-engineering work environments but more variability in response related to the specific area of satisfaction being inquired about. First, as determined from the responses to open ended questions [2_13] and [5_10], satisfaction was attributed to different factors, depending on whether women were working within or outside engineering. Two items surfaced as common to both groups: the satisfaction of job completion and relationships/interaction with others. The responses to what the 59 participants working in architectural engineering found most satisfying or rewarding about their career listed in order of prevalence included the following: completing a job (26), relationships (19), solving problems (11), designing (9), and satisfying clients (9). Other responses also provided by multiple participants included fieldwork, variety, challenge, learning, and training new engineers. In contrast, the most popular responses from 17 participants working outside engineering were different: helping others (8), completing a project (7), people interaction (5), and career/life balance (4).

Nine specific areas of career satisfaction were focused on in the survey [4_29-38 and 6_12-20]: rate of pay, responsibility, recognition given for work, colleagues, use of abilities, attention paid to suggestions, work hours, level of job security, and overall job. Each of these items was rated using a five-level Likert-like scale (very satisfied, satisfied, indifferent, dissatisfied, and very dissatisfied). Figure 25 breaks down the 'satisfied' and 'very satisfied' responses to each question and compares the responses from those employed in engineering and those working outside of engineering. The data shows fairly consistent results of satisfaction (within 7%) between engineering and non-engineering employment in all areas except colleagues (21% difference), attention paid to suggestions (24% difference), and work hours (28% difference). In those areas where the discrepancy exceeds 7%, those with employment outside of engineering had the greater satisfaction.

Figure 25. Comparison of workplace satisfaction based on employment status.

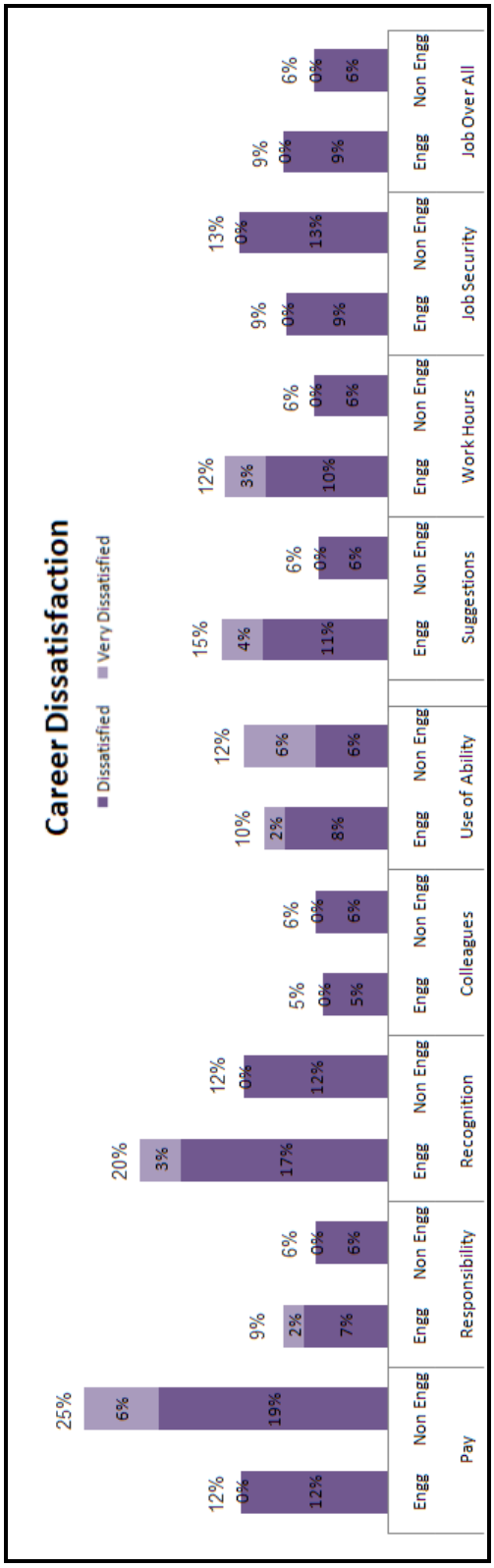


Dissatisfaction

Dissatisfaction versus satisfaction showed some discrepancy dependent on the work environment, engineering versus non-engineering, but more variability in response related to the specific area of satisfaction being inquired about. As determined from the responses to the open-ended questions [2_14] and [5_11)], dissatisfaction is attributed to different factors depending on whether the respondents were working within or outside engineering. Responses to what the participants working in architectural engineering find most dissatisfying or least rewarding about their career listed in order of prevalence included the following: dealing with difficult people (32) (which can be further broken down into the subcategories of difficult people external to the employer (13) and internal to employer (19)), hours/travel (11), and design/technical (11). Other responses also provided by multiple participants included schedule, stress, and others' lower standards. In contrast, the most frequent responses from the participants working outside engineering included lack of responsibility (5) and pay (4).

The same nine areas of satisfaction ranked using the Likert-like scale discussed in the prior section were also analyzed from the perspective of dissatisfaction. Far fewer responses were recorded as 'dissatisfied' or 'very dissatisfied' compared to 'satisfied' and 'very satisfied'. Figure 26 shows the percent of respondents who chose 'dissatisfied' and 'very dissatisfied'. The responses of those employed in architectural engineering and those working outside of engineering have been separated into separate columns for comparison. The data shows fairly consistent low results (less than 13%) of dissatisfaction (within 6%) between architectural engineering and non-engineering employment. Moreover, three areas revealed a larger discrepancy in dissatisfaction between those employed in architectural engineering and those employed outside of engineering: pay (13% difference), recognition (8% difference), and suggestions (9% difference). Ultimately, pay is the area of greatest dissatisfaction for all participants although those employed outside engineering (25%) are more dissatisfied than those in architectural engineering (12%).

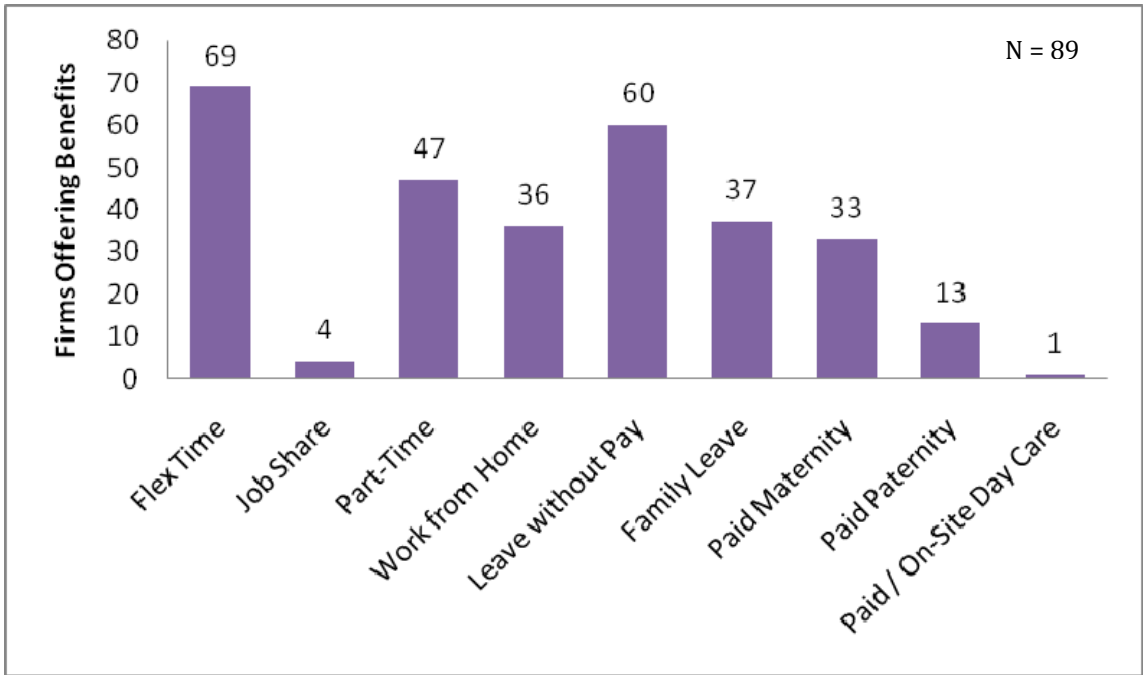
Figure 26. Comparison of workplace dissatisfaction based on employment status.



Research Sub-Question 7: Family-Friendly Benefits

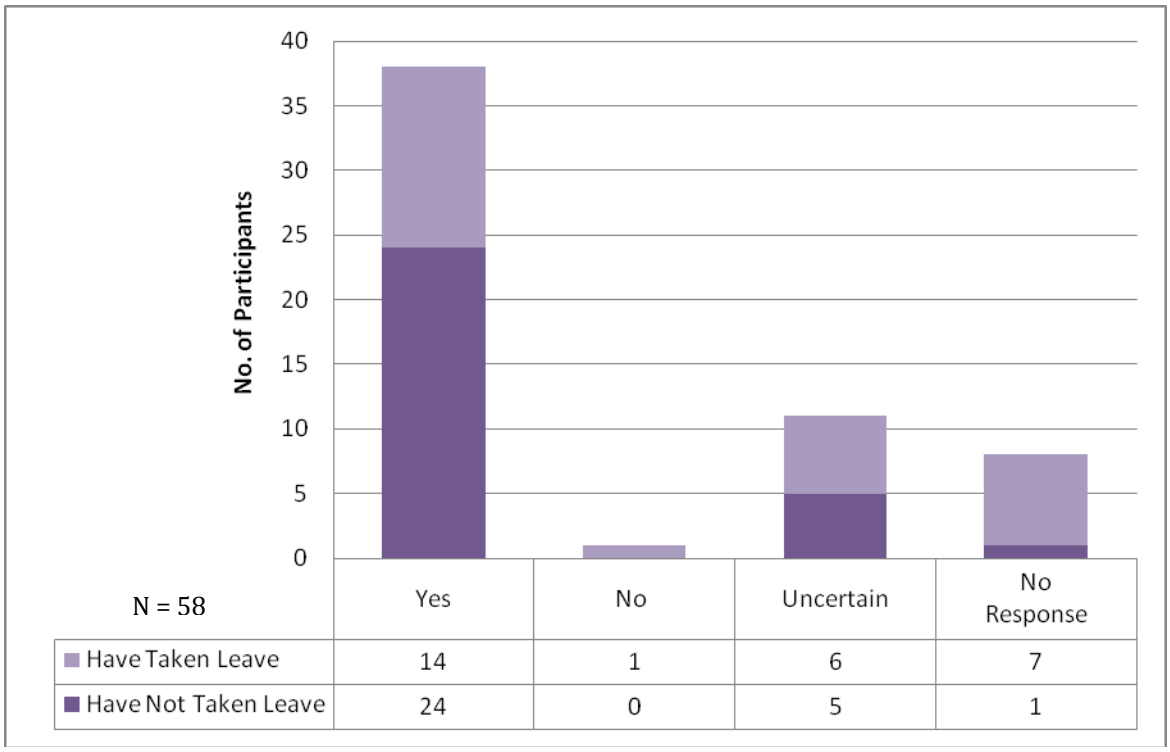
As reported earlier, nearly 60% of the participants have children, and many indicated that family does affect a woman's career progress. Questions were included in the survey to identify the current status of family friendly benefits being offered by architectural engineering firms. All participants were asked to identify which benefits were offered by their current architectural engineering employer or, for those not currently employed in engineering, what benefits had been offered by their most recent architectural engineering employer. Question [7_1] listed many commonly provided family-friendly benefits, and participants were asked to check the box beside those that they were offered. Responses to the benefits offered are presented in Figure 27 listed in the same order as they appeared within the question [7_1]. None of the benefits was provided by all employers according to the respondents although more than half of the respondents reported the firms they worked for provided flex time, part-time, and leave without pay. Other family-friendly benefits that more than a third of the participants indicated their employers provided included work from home, family leave, and paid maternity. Two benefits that were seldom provided include job share and paid/on-site day care. Seventy-seven percent of the participants indicated that they had taken advantage of these family friendly benefits at some point in their career [7_2].

Figure 27. Frequency of benefits provided by engineering employers of participants.



Questions related to taking leave from their career [3_24-28] were also included in the survey and were answered only by those employed in engineering (N=59). Twenty-eight of the 59 participants indicated they had taken leave for maternity with another three indicating they had taken leave for medical reasons. Only one of these participants took more than a year's leave from her career while most (21, 67%) took three months or less. All of the participants reported returning to the same position they had prior to leave, and a majority of these participants stated that the same promotion schedule exists for those who have taken leave as shown in Figure 28.

Figure 28. Participants' belief that the promotion schedule is the same for those who have taken leave as for those who have not.



N = 58	Yes	No	Uncertain	No Response
Have Taken Leave	14	1	6	7
Have Not Taken Leave	24	0	5	1

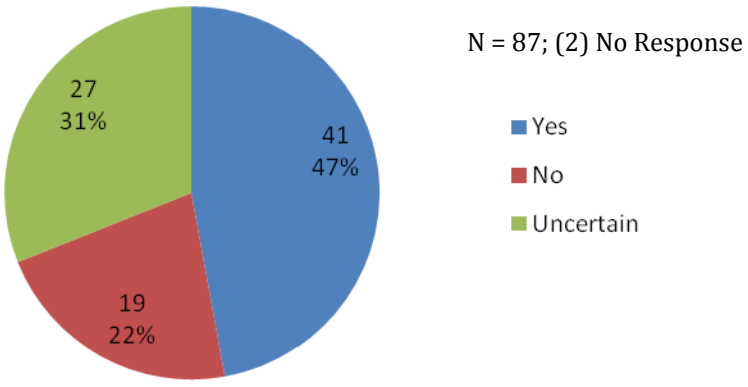
Research Sub-Question 8: Change for Retention or Re-entry

The survey included a set of questions [5_4, 8_12, 9_2, 9_5, 9_6, and 9_7] asked of all participants related to why women leave architectural engineering careers, what the participants perceived as needing to change to retain women in this career, and what could change to encourage re-entry once women have left. The reason most frequently cited by the respondents who had left their career in architectural engineering was children (16) with the next most

frequently cited reason being the job/work environment (8). Other answers provided by multiple respondents were stress, lack of contribution to society/satisfaction, and lay-off. All participants were asked if other careers could better accommodate family balance. Sixty-five percent said yes while another 14% who were not sure or didn't respond. The primary reason for believing other careers are more compatible with family balance was decreased time demands and more manageable schedules. The other most frequently cited responses included lower stress and the opportunity for part-time work or working from home.

The participants were asked in an open-ended format to identify both the obstacles and the advantages associated with being female in a male-dominated work environment [9_4] and [9_5]. Although 12 participants felt there were no advantages to being female, others indicated that being female provided them greater recognition (17) and increased job opportunities (14). On the other hand, only two participants reported no obstacles associated with being female. The most frequently cited obstacles were gaining respect/proving oneself (40), balancing work and family (24), and the existence of the boy's club (8). Recognizing both the advantages and the obstacles, 41 of the participants responded they would pursue the same career path if given the opportunity to do it over again. Only 19 of the participants would have taken a different path while 27 were uncertain what they would do if given a second chance (Figure 29). Of those who would consider a different path, most (15) were not sure what they would have done differently. The most prevalent definitive responses included selecting a career lower in stress or a career that was more family-friendly.

Figure 29. Participants' response to following the same career path if given a second chance.



Research Sub-Question 9: Career Preparation

The final research sub-question was related to what needs to be done to better prepare young women as they enter the architectural engineering workforce. Survey question [1_7] asked the participants what they found to be the most difficult transition between college and professional work. The two most frequently cited responses were the difficulty with balancing time (29) and the lack of technical knowledge (17). Other difficulties encountered in the transition included developing a social network, learning company standards, and adjusting to the cultural change. Seven of the participants responded that they found the transition between college and the architectural engineering workforce easy.

Summary

The data collected from the survey provided a picture of how many women have remained in their architectural engineering careers. In addition to identifying those who have remained, a more defined picture of those who have chosen to leave began to emerge, which permitted a comparison of the data. This comparison included issues of family, career satisfaction, mentoring, workplace culture, and opportunity for re-entry to an architectural engineering career. This data is important in that it had not been collected from women in architectural engineering prior to this study. To create a clearer picture as to the reasons women leave architectural engineering, a second data collection method was used in the form of the telephone interview.

Interview

Telephone interviews were conducted following the survey as a way to gather more data as to why women chose to leave architectural engineering. Following each interview, the audio recordings were transcribed and sent to the participants for their review and approval. These transcripts were then analyzed to identify emerging themes. The themes that emerged include reasons for leaving engineering, intentions to re-enter engineering, engineering workplace experience, and advice for others. These themes are further explored in subsections following the description of the sample used for the telephone interviews.

Sample

The data collected from the survey was used to identify individuals who could be included in the telephone interviews. Among those completing the survey, 30 participants reported that they were not currently employed in engineering. Of those, 26 had been employed full-time before leaving architectural engineering employment and were retained in the sample. The demographics from the survey responses were reviewed and a prominant common factor among the participants no longer employed in the architectural engineering workforce was the lack of professional licensure. In response, a question related to professional licensure was added to the interview protocol, and the sample was limited to participants who had more than five years' experience in architectural engineering before choosing to leave. Five years' experience would be sufficient time to qualify for and take the professional engineering exam. A 16 person sample remained. Each of these 16 participants was contacted via telephone, e-mail, or mail requesting that they participate in a telephone interview (Appendix H). This request for participation was extended twice as a result of which 7 of the 16 participants responded that they were willing to participate in the interview.

The interview participants had between 5 and 12 years architectural engineering work experience with an average of just less than eight years of experience prior to leaving engineering (Figure 30). The number of years that the participants had been removed from the architectural engineering workforce ranged from less than a year up to twelve years with a majority having been away from engineering for less than 5 years (Figure 31).

Figure 30. Years of experience prior to leaving engineering.

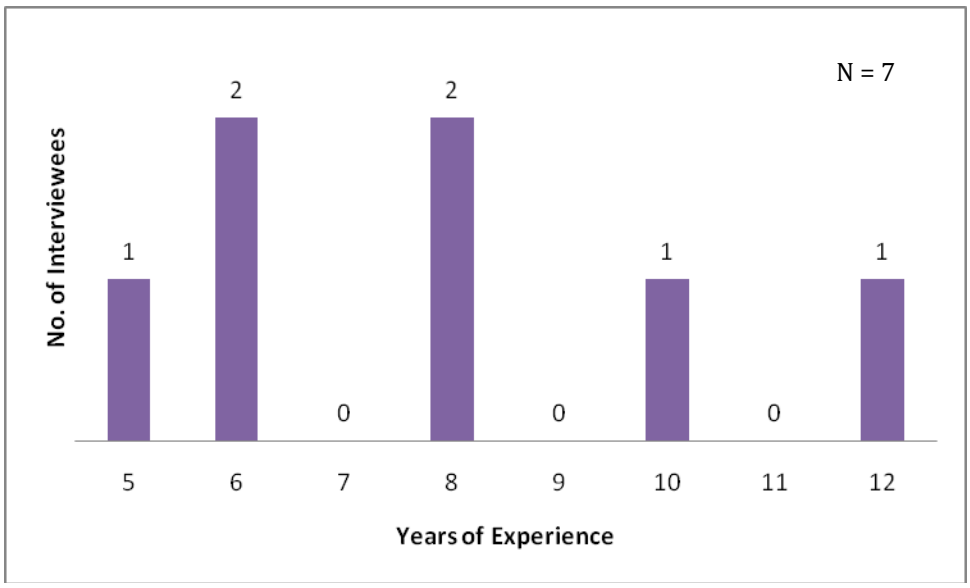
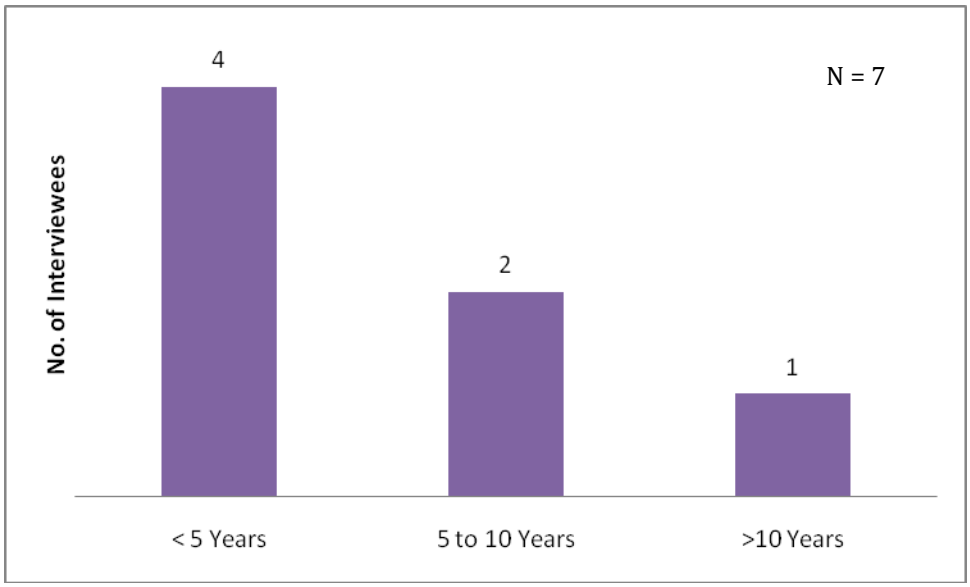


Figure 31. Years removed from engineering.



Employment status of the participants at the time of the survey varied. Three were not in a paid employment position and were stay at home moms. Three had part-time employment in a non-engineering capacity including positions as consultant in parent education, advertising sales, and construction management. Only one of the participants was working in a full-time capacity holding the title of corporate controller. She was also the only interview participant who was single and without children.

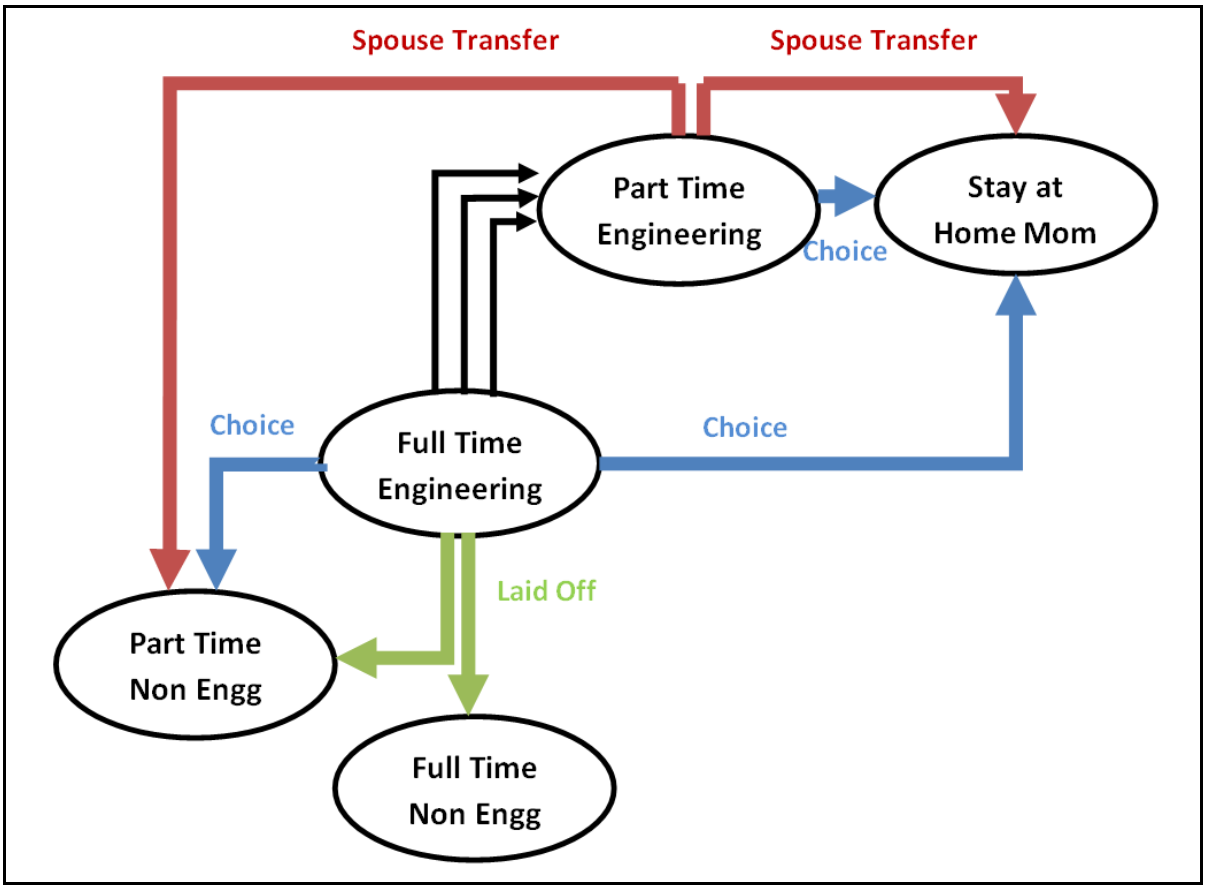
One simialrity among all the interviewees was that none of them had attained their professional engineering license although all were eligible based on work experience. Two of the seven interviewees had never attempted to take the exam while the the other five all took the exam without passing. Four of these five latter interviewees sat for the exam multiple times without success.

The following sections will expand on the experiences of the interviewees, the influences on their decision to leave architectural engineering, and their intent to return to engineering.

Reasons for Leaving Engineering

Each of the seven women interviewed had different reasons for leaving their architectural engineering careers, although commonalities did arise. Figure 32 presents the career path of each of the participants. The center oval represents the full-time status of the seven interviewees at the beginning of their career as engineers. The arrows from this oval indicate a change in career direction and are labeled with the reason for this change when leaving architectural engineering as a career. Three moved to part-time employment in engineering, one chose to move to part-time employment outside of engineering, two were laid off, and one chose to become a stay at home mother. The oval at which the arrow terminates signifies the career status of the each of the participants at the time of the interview. The following section elaborates on this decision to leave engineering as a career.

Figure 32. Interviewees' career progression and decision to leave engineering.



Two situations were unique among the participants. One chose to leave the architectural engineering workforce due to a lack of interest and satisfaction with engineering.

> I think the major thing was I just didn't really like the day to day side of engineering. I got to do a lot of the management side. And when I looked at the end of the day, the part I dreaded the most was doing engineering. So I just looked at it and said "Why don't I just go over to the project management side completely?" (Interviewee 1052, p. 2)

Another participant chose not to pursue a career in architectural engineering after being laid off because she felt that she could do more than just engineering with her career.

> I see that there are a lot of ways that I could use my engineering degree, my background and my education to do something that is still in some way engineering and construction related but yet be a more rounded person and have a lot more to offer to a potential employer. (Interviewee 1114, p. 6)

In each of these cases, the interviewee chose another career direction for their personal development and satisfaction.

The other five interviewees all stated that each enjoyed her architectural engineering careers but balancing family and career became an obstacle. Each of these interviewees found

satisfaction in her architectural engineering career and maintained employment following the arrival of children. In two of the cases, the participants had employers who were very flexible and allowed a part-time schedule to accommodate the balance of career and family but had to terminate that arrangement due to spousal job relocation. The difficulty in both situations was finding an employer in the new location willing to allow similar flexibility as their prior employer had provided. In both cases, a conscious decision was made to allow their spouse's career to take precedence as neither interviewee was willing to minimize her involvement in her children's daily life by returning to a career full-time.

> My husband needed to make a job change about two years ago. We knew we needed to make a job change, so there was some waffling as to whether I would go back to work full-time because at the time I was working part-time, and he would stay home with the kids, or I would stay home, and we would make a move. (It was decided that) I had the career that was probably easier to take a break from and come back to. (Interviewee 1036, p. 4)

> My husband would have been happy to be a stay at home dad. It's still not what I wanted. I wanted to be a mom. (Interviewee 1078, p. 9)

The other three interviewees found they could not find the appropriate balance between work and family and chose to make family the priority for the time being. Two of the interviewees chose to quit while one was laid-off although she indicated that she was contemplating quitting before being laid off and found the lay off to be a relief. One of the interviewees did indicate that if a part-time option had been available with her company, she would likely still be employed in the architectural engineering workforce.

Leaving architectural engineering as a career evoked a variety of feelings from the interviewees. They expressed that they really did not analyze their feelings at the time but could now look back and identify mixed emotions and the internal struggle of making what they considered a difficult decision to leave their architectural engineering career. For most of the interviewees, the decision was difficult in that they did not dislike their career, and they had spent many years in college and the workforce to get to the position they were contemplating leaving.

> What do I do? I can't just throw away this degree. (Interviewee 1052, p. 14)

> I loved it and enjoyed it (engineering career). (Interviewee 1114, p. 6)

> I worked for that degree (architectural engineering) for six years, and I really did enjoy it. (Interviewee 1095, p. 3)

> I love doing the electrical work. (Interviewee 1036, p. 3)

> I just find the whole process of designing a building very enjoyable. I like the collaborative effort that went into the design, the working with other people, and the feeling of accomplishment when the project goes out the door. I enjoyed doing it. (Interviewee 1078, p. 6)

> I really just enjoyed the design work, working with clients, and figuring things out. (Interviewee 1073, p. 3)

The emotions interviewees experienced at the time of leaving their career included guilt at not having done more to prevent the possibility of being laid off, concern about disappointing others, disappointment in one's own career progression, and relief. The relief was from both the elimination of both stress resulting from trying to balance work and family and the agony of trying to make a decision.

> I felt I spent 6 years in college and 10 years working in this field; how can I just walk away from it, but once it all happened that guilt left me, and I was like, you know what, this is where I wish I had been 5 years ago. I wish I could have done it 5 years ago. (Interviewee 1091, p. 6)

> I was a little scared of disappointing my parents because they had paid for my education and they were very proud of the success that I had achieved. I did not know what they would think. I was a little scared and worried that they would be disappointed in me. (Interviewee 1095, p. 3)

> I was really disappointed because I always thought that the company I started with, I would always finish my career in. (Interviewee 1114, p. 4)

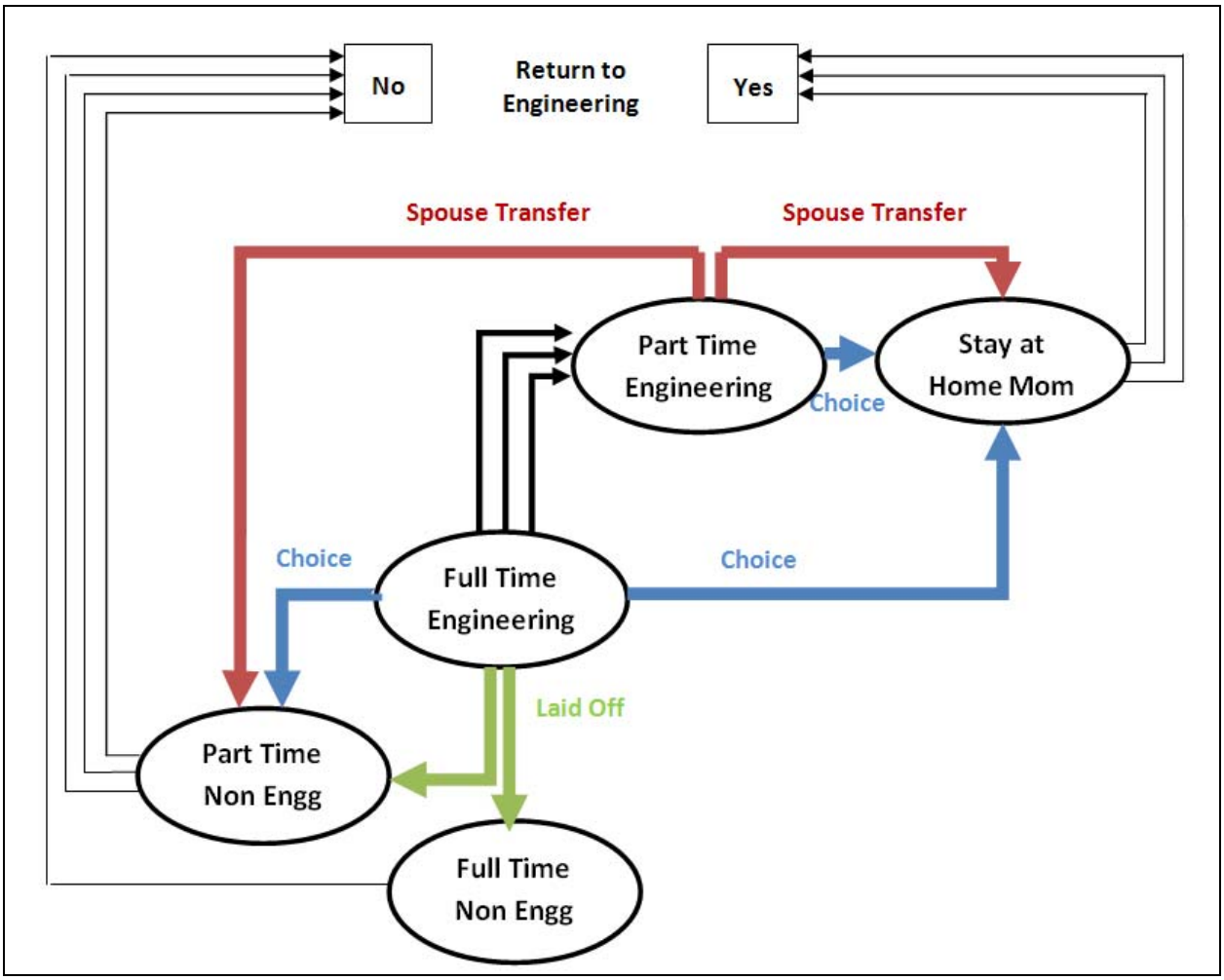
> Some sense of relief knowing that I wouldn't be balancing everything, but I was also a little disappointed. (Interviewee 1078, p. 5)

Even though the decision was difficult for many of the interviewees, not one expressed regret or desire that she had done things differently.

Intentions to Re-Enter Engineering

Just as the interviewees had different reasons for leaving engineering they also have different opinions on the prospect of re-entering the engineering workforce. Figure 33 is the same as Figure 32 but adds graphical representation of the interviewees' plans related to re-entering an architectural engineering career. The interviewees' expressed intention to return to the architectural engineering workforce is depicted by the thin black arrows from where they were in their career at the time of the interview leading to a box at the top of the graphic containing the word yes or no.

Figure 33. Interviewees' career progression and intention to return to engineering.



Not surprisingly, the two interviewees who chose to leave architectural engineering based on the influence of career opportunity and level of satisfaction indicated that they do not intend to return to engineering. The participant who was considering leaving engineering prior to her lay off is now employed with the family business and indicated that she would likely not pursue an architectural engineering career unless the perfect opportunity presented itself. The other four interviewees had very different perspectives of the opportunity for re-employment in engineering and their desire to return to architectural engineering. The participant who had been removed from architectural engineering the longest, 12 years, did not feel she could re-enter the engineering workforce without returning to school. She did indicate that she considers re-entry a greater possibility for those who had not been out for such a long time. She also suggests that re-entering employment is more of a problem in engineering than in other professions.

> I live in a neighborhood where there are a lot of professional women who took a break out of their careers to be moms and to raise their families and a lot of them are able to go back into the careers they were in before they stayed home. That's not an option for me. I'd have to go back to school to really go back into the industry. So I think that was a challenge I did not recognize. You can't jump in and out. You might be able to take a two year break but you can't take a 10 year break. (Interviewee 1078, p. 3)

The other participants, each having taken less than three years off from her career, did not recognize re-entry to the architectural engineering workforce as being an insurmountable task from a technical perspective, although each did comment that she would have some technical catching-up to do.

> My friends who have re-entered the workforce say it takes maybe two or three months of feeling like you're a complete idiot, but after about two or three months you feel caught up. They're like "Your core knowledge is still there. You still know how to build things. It comes back faster than you expect." They said that for the first few months it can be like "What do you want me to do?" As far as the computer, the texting, the blackberry, the instant information - that sort of thing has definitely made an impact that I will have to catch up with. (Interviewee 1036, p. 7)

> Ours is a career that you can go back to. It is not something that is technically changing so rapidly that you can't catch it again. (Interviewee 1036, p. 8)

Each indicated that although she is not currently pursuing architectural engineering employment, she would likely pursue the opportunity in the future in a part-time capacity. These interviewees stated that the time for returning will be when their children are in school. Additionally, these participants anticipate the challenge to re-entry will be in finding employment that will allow flexibility for them to participate in their children's activities.

In addition to the challenges of re-entry, it became clear that the priority of the participants' career and their career goals had changed. Compared to the aspirations to become managers and advance to the top of their career they may have had graduating from college, they found that their desires had changed.

> I do not want to dive back in full-bore and be the boss or be accountable ever. I would be fine being someone's assistant. (Interviewee 1091, p. 4)

> I think before (children) I definitely had in mind the manager track and leadership in the company role, but I do not know if I would want to go along that path as it seems to be more hours and more involvement. I would like to have more flexibility to be able to go to school functions and things like that after school. (Interviewee 1095, p. 4)

Engineering Workplace Experience

A clearer picture of the workplace culture was possible through the discussions with these women. Common topics or themes related to workplace culture surfaced, including expectations within a male culture, the acceptance of women in a male dominated engineering field, flexibility to meet family needs, characteristics of successful women within the engineering workforce, and where they felt they could have been better prepared.

Expectations

Common issues were identified by the interviewees that can be categorized as attributes of a male established work culture. These issues include rules, hours, and isolation. The interviewees identified the architectural engineering field as being a culture defined by men and their rules.

> In architectural engineering, where you're working in the construction industry, the rules were set up by men, and there is very little flexibility or acceptance of traditional female responsibilities. (Interviewee 1078, p. 7)

> If you wanted to work with the boys, you needed to be able to play on their terms, and they were not willing to accommodate a parent-teacher conference. It wasn't in the (company) culture here, so it wasn't a desirable place to work. (Interviewee 1078, p. 3)

These rules were not written down; they were simply implied but critical to being considered for advancement and promotion. One of these 'rules', which impacts female employees, particularly those with families, is the hours expected to be devoted to the workplace.

> The guys in my office would choose to stay until 8:00 or 9:00 at night to work on things. Then when I would come in the next day I was kind of looked down upon because I chose to leave on time even though my work was done. I think women maybe sense that men do not think that they are working as hard as they are because they do not spend an exorbitant number of hours of at work even though they are producing as much, but instead they want to go home. (Interviewee 1091, p. 5)

The number of hours of work expected to be successful was a concern for a number of the participants. It was also more than simply the hours worked, it was also the fact that planning was difficult because of the unpredictable nature of the construction business.

> Some weeks might be a 40 hour work week, but definitely when projects are going out the door you could be working 60 to 80 hours. (Interviewee 1078, p. 3)

> You never know going into a day if you are going to leave at five or if you are going to stay later or if you are going to have to bring work home. (Interviewee 1095, p. 5)

> If you have to be at work at 7 a.m., you aren't even dropping your kids off at school; you're dropping them off with the nanny. It was a choice I made. But I did not fully appreciate what kind of a work commitment was necessary to stay employed. There were not a lot of options available. (Interviewee 1078, p. 3)

> It was very stressful, and part of it was that some days I would go to work before my daughter was up in the morning and would not be home until after she went to bed. (Interviewee 1073, p. 4)

> The last job I had was a little more relaxed. Then again there was still the overtime involved, and that is just the nature of the industry. (Interviewee 1095, p. 2)

The hours that were expected were considered a stressor tied to the male work environment, but there was also the social aspect that affects a woman's success and satisfaction in a male-dominated culture.

> It's (engineering workplace) very male oriented. As a female it is like an outsider looking in. You're there, you're doing the job, but you're not really part of anything… The vendors were great, but they can invite people out to go golfing or to go on trips. I was never invited, and it did not matter, but I think after a long period of time, you begin to see that, when you're out at some of those outings that's when the decision for the company might be made, or design decisions, or discussions, or some of those things that not only build relationships between the vendor and a particular engineering company, but it also gives you a lot more engineering knowledge. If you are not there, then you miss out on a lot. It's not so much an "All Boys Club," it's just that on the business side, it really hinders you. I see that now. That's where a lot of, not only strategic planning happens, but also a lot of the relationships are built. An office setting, it can be confining. It's very transactional, as opposed to relationship building. (Interviewee 1114, p. 11)

The isolation also presents itself in smaller companies or in companies with fewer females.

> I think one of the things that probably happens a lot because there were no other women engineers that were "my peers," I hung out with the admin ladies. We'd eat lunch together. And after awhile, the male engineers begin to see me as support, because that's who I was talking to. I think whether it's conscious or unconscious, they place that "label" on you when it's just out of necessity I guess as opposed to anything else. And there is a stigma that comes with that. (Interviewee 1114, p. 20)

As a response to this isolation and in the pursuit of success, the respondents indicated that they would cope by being one of the guys – playing by the rules established by the guys. This was good until family became part of the picture, and roles and priorities changed.

> Before I had my family, I was one of the guys. I mean you have to be to be successful and happy. (Interviewee 1078, p. 11)

> All of the women who made it to top management who were lead project engineers, none of them had families, and I didn't realize what that meant at the time. They were all single women or married; none of them had children. (Interviewee 1078, p. 10)

Acceptance of Women

The women interviewed, although not directly asked the question, provided their opinion as to how they felt they and other women were accepted within the architectural engineering workforce. It was clear that most of the interviewees felt they are accepted as equals in architectural engineering, but some did identify that this is conditional.

> Women were definitely accepted but only if you could play by the rules that were already established at that company. (Interviewee 1078, p. 10)

Many of the females did not think that gender was an issue or an obstacle to their career advancement. Some of the interviewees worked within firms where they were the only female while others' experience came within firms that had women in the highest management positions.

One interviewee made an observation

> I don't think it's a working woman that's a problem, it's a working mom. (Interviewee 1078, p. 8)

This reinforces the fact that being female is not a problem; rather, the issue is being able to balance an architectural engineering career that is both demanding and inflexible with family. This task is often found to be difficult. The obstacle to trying to compete as a mother is further emphasized in the statement below:

> I think you're viewed as a weaker employee if you chose to make family your first commitment and not the job. And I did not see a lot of acceptance for those decisions. (Interviewee 1078, p. 7)

Flexibility

Some of the companies that the interviewees had worked for provided flexibility to better accommodate family in the form of job sharing, part-time work, work remotely or from home, and flexible hours. In only one case were these options existing when they went to work there. In most cases, the interviewees asked for these arrangements, and the employers obliged.

Thus, the participants' role within their company changed with their need for flexibility. The respondents pointed out that once they could not always be available, their role became more aligned with support staff than with management. The time critical nature of the industry presented some difficulty meshing with the alternate working arrangements.

> Construction happened every day, and there were days that I wasn't at the office and I was available by phone. Certainly they could call me if there was a problem at the site or if they had a question. I was always available to them. But there were just times where they were like

> "We really need you here to look at this," and I was like "Unless you can fit the hard hat on a two year old, I can't be there." (Interviewee 1036, p. 7)

> Construction happens every day and it doesn't really wait for you. (Interviewee 1036, p. 7)

> We had a nanny when we lived in California but my company was still great. If the kids were sick I could work sometimes from home. But I was never the lead project manager because I couldn't have that much responsibility and have two small children. So I was always support staff. Some weeks I would work 50 hours a week and some weeks I'd work 15. It was a fabulous arrangement. (Interviewee 1078, p. 4)

One of the obstacles that existed for two of the participants was when relocation was required for their husband's job. They were not able to find these flexible working arrangements in the new locations. This may be attributed to the fact that their value as an employee was not yet established in a new firm, and they had little negotiating capability with a new employer.

Advice for Others

The interviews of each of the women included questions as to what could change to better equip women for their career in architectural engineering and what advice they would share with other women entering the workforce. The responses varied, likely due to the different experiences of the interviewees. However, a few topics surfaced across multiple conversations – field experience and thinking about the balance between career and family.

Field Experience

Students are prepared for a career in architectural engineering through classroom exercises and textbooks, but hands-on experience is minimal. The interviewees said they felt that they had a secure technical knowledge base. Areas where they were short they could easily learn in the office setting. However, true understanding of the construction process and how components fit together was something they were lacking, and that could only be learned from field experience.

> Men for some reason have more hands-on experience with things. Especially on the construction site, it seems a lot of the men had done a lot of the things and had actually seen a lot more from the practical side. It makes things so much easier in designing projects because they have actually seen how something works, and when they go into a client meeting they are able to explain it better. It does give them a big advantage. (Interviewee 1073, p. 6)

> I would tell them (females pursuing a career in architectural engineering) to spend a summer doing construction work. Don't take that office internship. The most challenging part of engineering is knowing the construction business. (Interviewee 1052, p. 11)

Family Balance

Family balance was an expected discussion item since six of the interviewees were mothers and have struggled with making the right decision for their family and their career. The primary message was that young women should consider or think about the progression of their career and family prior to the emergence of conflict.

> In regard to family balance, "You have to think about if you are going to put it (career) on hold and what that will do later on." (Interviewee 1073, p. 7)

> Consider what their family goals are. Having some idea in the back of their head as far as do I plan to be married, what are the goals for my marriage and my family life, when do we plan to have kids, what are my goals with my kids as far as staying at home or going back to work. (Interviewee 1095, p. 5)

> I didn't consider how this career was going to balance when I wanted to be a mom. I didn't think that through when I was 20 and in college. I wish I would have thought of that; I might have taken a different path. (Interviewee 1078, p. 8)

> Meet as many of your professional goals as you can before having kids. (Interviewee 1095, p. 6)

Result Comparison between Data Collection Techniques

This study obtained a large amount of data pertaining to women's experiences and retention in the profession of architectural engineering. The advantage of conducting both a survey and interviews was it allowed for a greater depth of response. Another advantage of conducting a multimode study was that a comparison between the data in each method can add validity to the findings where consistent results are achieved. Specifically, five questions were duplicated in the survey and the interview although in some cases stated in different ways. As previously outlined in Chapter 3, these five questions include the following:

What was the participant doing at the time of the study related to work?

- Telephone interview question 2 and survey question [5_1]

What influenced the participant's decision to leave the architectural engineering workforce?

- Telephone interview question 1 and survey question [5_4]

Does the participant intend to return to the architectural engineering workforce?

- Telephone interview question 5 and survey question [5_22] and [9_3]

What does the participant miss about her architectural engineering employment?

- Telephone interview question 4 and survey question [5_5]

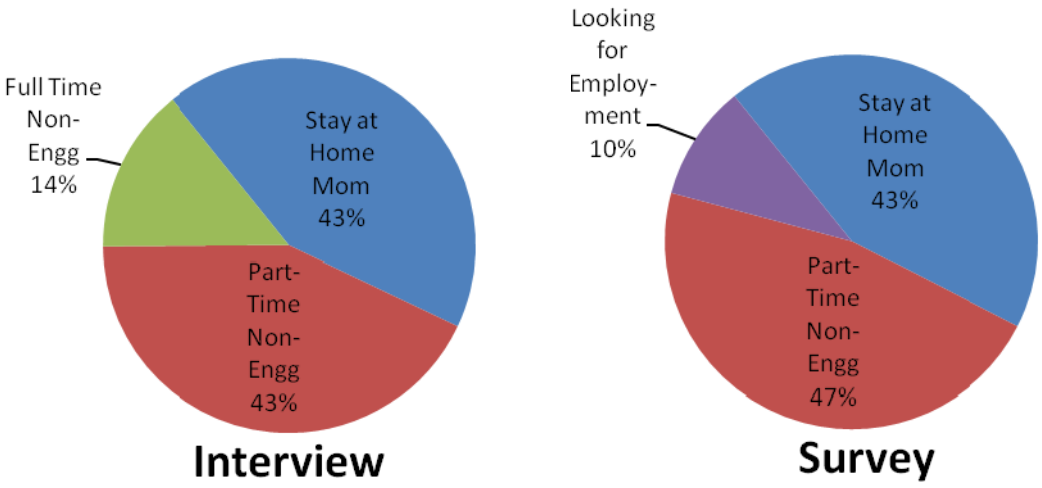
What advice would the participant provide to a female entering the field of architectural engineering?

- Telephone interview question 9 and survey question [9_8]

The data collected in the interview can only be compared to the survey results of the 30 participants no longer employed in the architectural engineering workforce as in both cases the participants are no longer employed in an engineering capacity. This limitation is appropriate considering that the primary focus of the study is to determine why women leave the architectural engineering profession. The similarity in response to the five questions above between the seven interviewees and the 30 survey respondents who were no longer employed in an engineering capacity lends credence to the voice of the small sample used for the interview.

The samples used in the survey and the interviews were very similar. As represented in Figure 34, 43% of each sample were stay at home moms who did not have paid employment outside the home (survey: 14 of 30; interview: 3 of 7), and part-time non-engineering employment was very nearly the same (survey: 13 of 30; interview: 3 of 7) . The other similarity was that in both samples, the time removed from architectural engineering was less than five years. The one minor discrepancy between the sample used in the interview and the 30 survey respondents no longer employed in architectural engineering was the number of years they had worked within engineering. As expected, the number of years employed within the architectural engineering workforce was higher for the interview sample because the interviewees were purposely selected to include only those who had more than five years experience. This being said, the difference between the averages was less than two years (survey average: 6.2 years; interview average: 7.8 years).

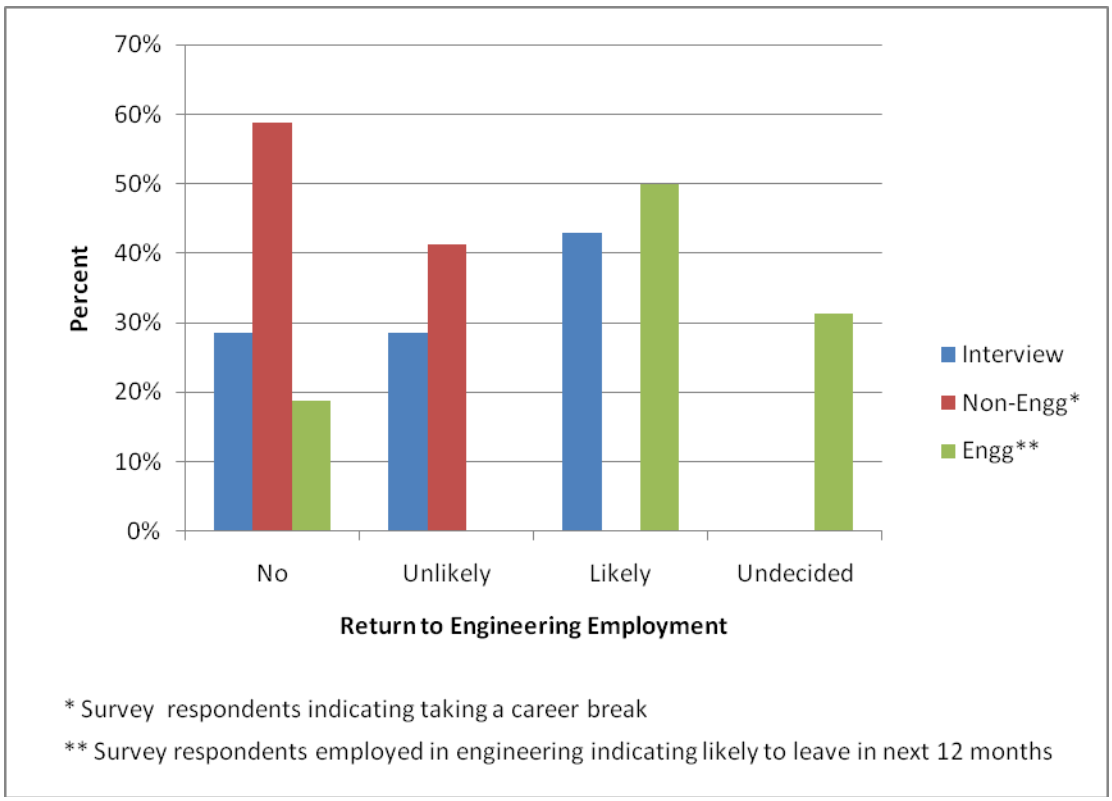
Figure 34. Work status comparison between interviewees and survey participants.



Responses to the reason for leaving the architectural engineering workforce and respondents' intentions to return were found to be especially comparable. The issue identified by more than 50% of the participants in either data collection technique was children or the difficulty in attaining balance between career and family.

An additional issue addressed in this study was whether respondents planned to return to architectural engineering once they left. The results shown in Figure 35 indicate 4 of the 7 interviewees did not plan to return or were unlikely to return to engineering, while the remaining three interviewees expressed that they would likely return in a part-time capacity. The survey results of the 17 participants who indicated that they were taking a career break show a split with 7 of 17 planning to return to work but not in an engineering capacity, while the other 10 participants indicated they intend to return to architectural engineering. These results next were compared to the opinions of the survey participants employed in architectural engineering at the time of the survey but who anticipated leaving the workforce within 12 months. Five of these 16 participants said that they were 'uncertain' if their future employment would be in architectural engineering, while eight indicated they would return to engineering. The opinions of the participants who had not yet left their engineering careers were less definitive, as many reported being uncertain about their return to engineering. The lack of consistency in the results between the different data collection methods relating to participants' likely to return to engineering reveals a need for additional research on this topic.

Figure 35. Intention of participants to return to engineering comparing collection instruments.



Participants' opinion as to what they missed about their architectural engineering career provided consistent results between the survey and interview. In both sets of data, the two most frequently cited items included 'people' and the 'technical and problem-solving' nature in an engineering career. 'Nothing' was another common response on the survey, but this latter response did not surface during the interview. This may be the result of the more conversational and reflective nature of interview compared to that of the survey.

The last common question between the survey and the interview was what the participants would share as advice to women considering a career in architectural engineering. The responses were similar in that nearly all were encouraging and positive, but responses were otherwise difficult to compare because of the large variety of answers. This question was not analyzed in further detail because the responses were too different to compile or compare concisely. In retrospect, the inability to analyze this question does not impact the study results as it not does not directly correlate to any of the previously defined research questions or contribute to identifying reasons women leave the profession of architectural engineering.

Summary

This study obtained a large amount of useful data pertaining to the participants' experiences and retention in architectural engineering. The information from the survey was valuable in that it helped characterize the retention rate of women in architectural engineering as well as provide a clearer picture of their status within architectural engineering careers. The survey also identified the participants who had left the profession. Additionally, the ability to compare opinions and experiences of participants both in and removed from the engineering workforce was important. Finally, identifying of respondents who had left architectural engineering provided a sample whose reasons for leaving architectural engineering could be explored in more depth.

The interview provided the opportunity to explore in greater depth why interviewees had left engineering as well as their intentions to return. The seven women interviewed were similar demographically to the 30 survey participants who indicated they were no longer in engineering. These seven interviewees revealed three topics that would not have otherwise surfaced: acceptance of women in the architectural engineering workforce; the importance of field experience to greater understanding of building design; employment expectations including rules, hours, and isolation. Interviewees' experiences were important in understanding the architectural engineering work environment and why they left the engineering profession.

The final chapter addresses how these results provide a foundation to discuss retention and the experience of women in the architectural engineering work environment. Chapter 5 also compares the data obtained from this study of women in architectural engineering to conclusions drawn in prior research of women employed in engineering in general and women employed in architecture. Finally Chapter 5 establishes the contribution of this study to research on women in the architectural engineering workforce as well as identifies areas needing future research based on the findings of this study.

CHAPTER 5 - Interpretation and Recommendations

As described in Chapter 1, this research study was developed to determine retention rates of women in architectural engineering as well as establish the reasons women leave the profession. This chapter discusses the results presented in Chapter 4, compares those results with prior research introduced in the literature review, and presents implications for practice and recommendations to increase retention. Finally, areas needing further research are identified and limitations related to the research design and sample are presented at the end of the chapter.

Discussion of Results

As reported earlier, a survey of architectural engineering graduates who were working within the architectural engineering workforce, working in a field separate from architectural engineering, or who were completely removed from the paid workforce coupled with telephone interviews with seven women who had left the architectural engineering profession provided the data analyzed in this study. The sub-questions introduced in Chapter 1 provide the most logical outline for discussion as they contain the reasons why the data was collected. The sections that follow restate each sub-question, explore the relevance of the findings, and offer comparisons to prior research.

Three research studies are used for comparisons as they most closely relate in sample or in topic to the data collected in this study. The study that is used most frequently for comparison is the 2007 CREW Project which is based on a survey created in 1999 that was later revised and re-administered in 2007 (Mills et al., 2008). This project was conducted by the National Women in Engineering Committee of Engineers Australia to explore issues of retention and satisfaction in the engineering workforce. One of the major differences between the CREW Project and this study was that the CREW Project was intended to compare male and female responses while this study focused only on female engineers, comparing the responses of women still practicing architectural engineering with those that who left. Because the CREW Project was administered twice, only the most recent results (2007) are used for comparison. The second research study used as a basis for comparison was conducted in 2003 by Gillian Ranson. This is a Canadian study of the gender differences in engineering careers for which the data was collected from a

sample of all graduates from an engineering college during a set range of years, providing a close similarity to the sampling technique utilized in this study. A third research study commissioned by the Royal Institute of British Architects (RIBA) in 2002 was also utilized for comparison (De Graft-Johnson et al., 2007). Although this latter study focused on architects rather than engineers, architecture is a discipline closely related to architectural engineering and is similar in that it has a male-dominated culture, is construction focused, and has comparable company size and function. Similar to the research design of the study reported here, the RIBA study was conducted with a female only sample, and interviews were conducted with women who had left the profession following the survey. Although all these studies are from countries outside the United States, similarities pertain among female engineers and the workforce environment in the USA, Canada, UK, and Australia (Dex & Walters, 1989; Roberts & Ayre, 2002a; Mills et al., 2008).

It is also important to characterize the samples used in these studies before proceeding with comparisons. For instance, the RIBA study sample (170 female architects) (De Graft-Johnson, 2007) was most similar to this study sample (126 female architectural engineers). A significant difference was that the RIBA sample was attained through volunteers who were notified via word of mouth or advertising. The CREW Project included a significantly larger sample of 3,214 women engineers. These women were current members of Engineers Australia, which likely contributed to a lack of participation by women who are no longer practicing as engineers (Mills et al., 2008). Finally, Ranson's (2003) study included a 241 women sample of graduates from a western Canada university between 1980 and 1990, of which 164 participated. Each of these studies' samples is similar in that a majority of the participants were between the ages of 30 and 40.

Research Sub-Question 1: What are the retention rates for women in architectural engineering?

Most prior research has focused on women within engineering, but to date, very few definitive values of retention rates have been established. Researchers assumed that the retention rate for women engineers in the profession is poor since they saw no evidence of an increase in women within the profession even though the number of women obtaining engineering degrees had been on the rise. Initially, the most common methods of establishing retention rates was to

look at the ratio of women in engineering from human resource data of engineering employers or at the membership numbers of women in professional societies. The survey component of this study has provided for a more precise picture of retention of women in engineering.

This was only the second retention study that sought to include all graduates of a program over a specified time period. The retention rate for this study was found to be 66%. Of the 89 participants who returned their survey, only 59 who graduated with an architectural engineering degree were working in architectural engineering. Ranson (2003) conducted the other retention study that used a sample technique similar to that used for this research and found an 81% retention rate (Ranson, 2003). The significant difference between the two studies is that Ranson's research included all disciplines of engineering rather than just architectural engineering.

The 66% retention value could underestimate the retention rates of other studies where the samples are generated using professional organizations, given that some of the survey respondents chose not to enter engineering careers immediately following graduation. If these women never truly entered practice, arguably, it was not the engineering workforce climate that influenced their decision. Workforce retention is therefore used in the following discussion and comparison to other research as their samples are drawn from a population where this would also be true. Workforce retention is different from retention in that the participants who indicated that they were not employed in the engineering workforce after six months following graduation were eliminated from the retention calculation. Accordingly, the workforce retention value increases to 77% (11 participants indicated that they were not employed in an engineering capacity 6 months following gradation – only one of which was due to lack of opportunity). In comparison, the CREW Project established a retention rate of 92.7%. It should be expected that the retention rate of this study would be lower than that of the CREW Project because of the manner in which the sample was generated. The CREW Project used a sample created from the membership of the professional organization: Engineers Australia. It is also important to clarify that the CREW Project sampled all engineering disciplines of which only 32% identified themselves as being in mechanical, electrical, or structural design. These disciplines are the most closely related to architectural engineering, which was not an available discipline for selection on the survey. Meanwhile, the results from the RIBA study reported a retention rate of 78%, which is only 1% higher than the workforce retention rate obtained in this study (De Graft-

Johnson et al., 2007). This value being nearly the same increases confidence that an attrition rate of approximately 20% may be fairly accurate. It is clearly arguable that the field of architectural engineering is similar to engineering in general in that it has a retention issue that warrants attention.

Research Sub-Question 2: Do the women who have left intend to return to a career in engineering?

Retention of women in engineering careers is an issue, but the implication of women leaving temporarily is less of an issue than when they leave never to return. A non-linear work track is not detrimental to engineering as a profession compared to women changing to careers outside engineering. Recommending how to address retention has two components: first, determining the potential influence employers may have on re-entry or retention, and secondly, identifying the need for re-entry programming. Questions were included in both the survey [9_1 and 9_3] and the interview [Question 5] to determine how many respondents that had left architectural engineering plan to return later. Chapter 4 reported that more than half of the participants surveyed (10 out of 17) and interviewed (3 out of 7) who chose to leave architectural engineering intended to return to engineering careers. Inquiry on this topic was expanded through the inclusion of question [9_1] on the survey that asked about the likelihood of the participants leaving the workforce in the next 12 months as well as a second question [9_2] inquiring as to their likelihood to return to engineering. This can be compared to the results of the CREW Project as the same question was included on its survey. Of the participants in the CREW Project who indicated they would likely leave engineering in the next 12 months, 58.2% said they would return to engineering. In this study of women in architectural engineering, that value was lower: 44.4%. As for the respondents who were uncertain of their future in engineering, 34.2 % of the CREW Project participants and 27.7 % of this study's participants indicated that they might return to engineering. The most discouraging component of these results is that in this study, 16.7% indicated that they did not intend to return to engineering as a career, whereas similar CREW results were only 7.6%. Focusing on the positive, most participants who leave the engineering profession intend to come back. With appropriate accommodation and encouragement, more may return than these studies estimate.

The issue of re-entry was further explored in the telephone interview [Question 5] conducted with women who had left the architectural engineering workforce. The results of this study's interview reiterate the concerns identified in the RIBA study that women who have taken a leave from their career feel that they are behind or need a refresher before reentering the profession (De Graft-Johnson et al., 2007). The interviewees felt they had lost touch with technology while removed from the workforce resulting in a loss of confidence. This brings to light the need for change to encourage these women to return to engineering careers. Methods of implementing such programming are discussed further in the recommendations later in this chapter.

Research Sub-Question 3: What are women's perceptions of the engineering workplace culture?

Workplace culture was identified as a significant issue influencing retention of women in engineering. Workforce culture was addressed through a series of questions including participant perception of climate, expectation or exposure through internships, and occurrence of harassment and discrimination [1_6, 3_16 through 3_23, 5_9, and 7_4 through 7_7].

To establish a clearer picture of the workplace climate, the survey contained a question in which the participants were asked to check the box beside the descriptive word(s) that best characterize their work environment. The results of this question were easily comparable to the results of the CREW Project as the same question was used in the 2007 survey. The CREW project and this study had nearly identical responses (within 1%) to the descriptor of the workplace climate as 'hostile/uncomfortable,' a response rate of 10%. It is encouraging that in both surveys this value was low. The descriptor 'comfortable' was the most frequently cited descriptor in both studies, 42% in this study and 64% in the CREW Project. However, a descriptor with a large discrepancy was 'competitive.' In this study, 25% of the participants selected this descriptor while only 8% of the CREW Project participants identified this as a workplace descriptor. This may be attributed to the competitive nature of the construction industry on which this study focused. The consistency of the results may support the claim that the architectural engineering work environment is similar to that of the engineering work environment in general.

Internships are an opportunity for women to experience the engineering workforce and its culture prior to the completion of their degree and full-time employment, yet apparently, internships have only a minor influence on retention. Survey partipcants were asked if they had an intership prior to entry into the workforce following graduation. Sixty-seven of the 89 participants (75%) had completed interships, and most of these woman also indicated that they found the experience representative of actual employment. Of these 67 women, 47 (70%) were employed within the field at the time of the survey, which is very similar to the 66% retention rate established for all participants. In comparison to those who had not had an internship, the retention rate was slightly lower at 59% (13/22). This variation may be explained by the fact that interships typically occur later in a student's accademic career, therefore, those who were leaning away from a career in architectural engineering were less likely to pursue this employment opportunity (four of the 11 of the participants who did not pursue architectural engineering following their grauduation did not have internships). Internships and exposure to the engineering work culture does not appear to impact retention enough to justify change in current practice.

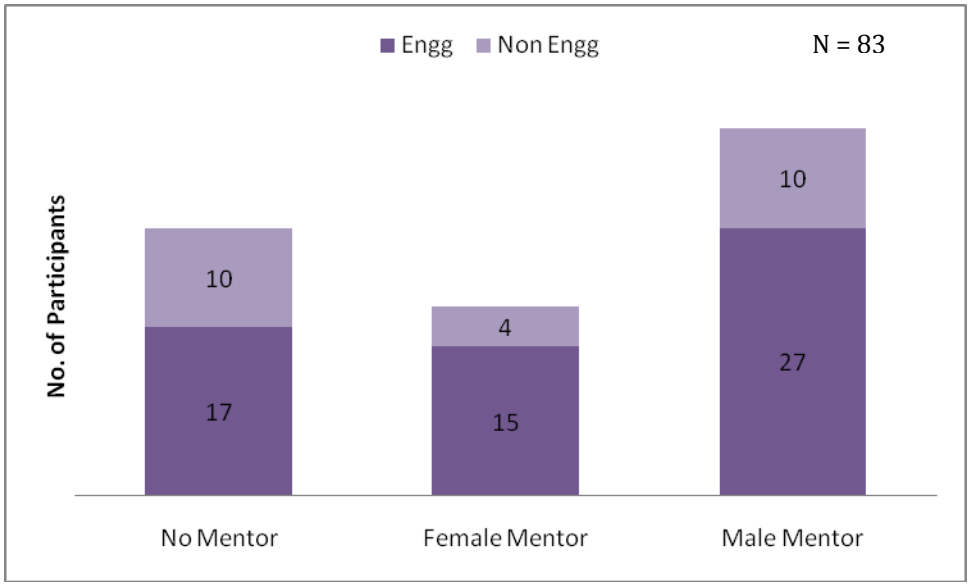
Harassment and discrimination are issues often considered to be indicators of the climate or culture in male dominated professions, and questions related to these topics were included the CREW Project as well as this study. Comparisons between the two studies revealed that the architectural engineering discipline was no different in either of these areas than engineering in general. The frequency of sexual harassment was almost the same (22% in the CREW project and 25.3% in this study) while the frequency of discrimination was slightly higher for this study at 51.2% compared to 42.3% in the CREW Project. Of course, ideally these values would be zero. Clearly, there are still gender issues within the engineering work culture.

Research Sub-Question 4: Does mentoring affect women's architectural engineering careers?

Based on the literature review in Chapter 2, mentoring has been found to play a significant role in the success and retention of women in their engineering careers (Paludi, 1990; Yates, 2001). The results of this study agree with these findings. There was a retention rate of 75% among those who had a mentor compared to 63% for those who had not received mentoring (Figure 36). Prior reaserch has also indicated that same-gender mentoring has a more positive

influence in fields that are male dominated (Paludi, 1990). This, too, is reinforced by the data collected in this study as females mentored by females had a retention rate of 78% compared to 73% for those with male mentors (those who indicated that they had never practiced in the field of engineering were removed from this analysis: N=83). These results agree with prior research results showing that mentoring does have an impact on retention (Mills et al., 2008; Paludi, 1990; Sasser et al., 2004; Yates, 2001).

Figure 36. Effect of mentoring on retention.

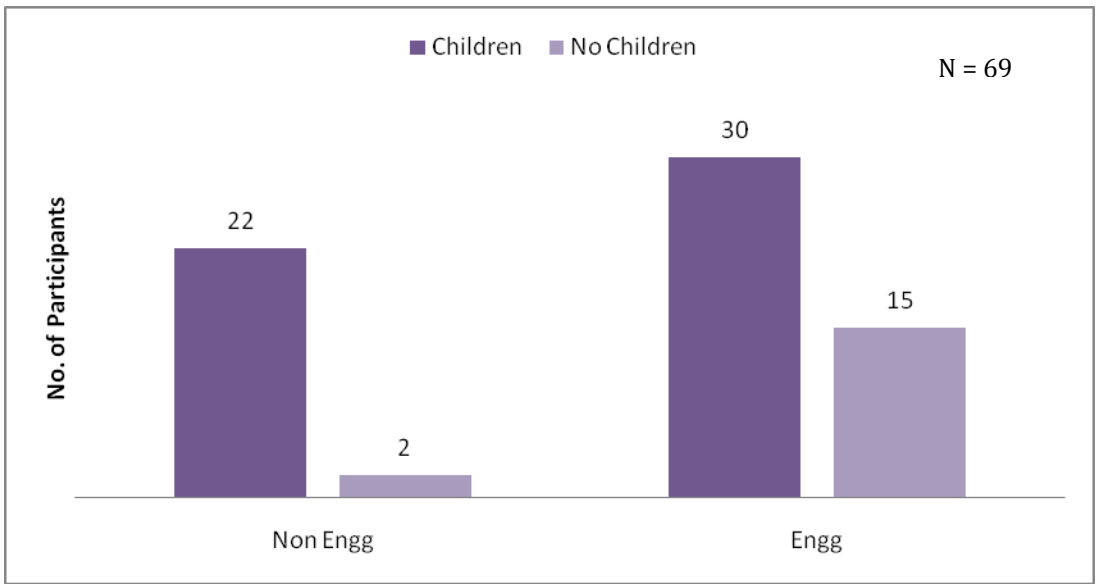


Research Sub-Question 5: How have issues of family/work balance affected women's careers?

Family/work balance is a frequently discussed factor related to retention as introduced in Chapter 2 - Literature Review. This is further supported in the data collected in this study, where more than half of the respondents (59%) have children. The survey asked only the married individuals to respond to the question as to whether they have children. This could jepordize the accuaracy of the data presented as some of the single and divorced participants in the survey could have children and in all likelihood would be working, since they would likely be a sole source of income. Only three of the respondents were divorced. Based on the data, it does appear that children do influence a woman's decision to leave architectural engineering as 90% of the paricipants who have left architectural engineering have children compared to 67% of those who remain in engineering (Figure 37). This data is also significant in that it indicates that

children are not the only factor that influenced participants to leave as many who have children remain in the architectural engineering profession.

Figure 37. Impact of children on retention.



The balance of family and career is a more difficult issue for females than males as discussed in the prior research persented in Chapter 2. This is further highlighted by the data collected from a series of questions asked in the section of the survey titled family (pages 8 and 9). The data presented in Chapter 4 – Research Sub-Question 5-Family/Work Balance clearly indicates that the respondents in this study struggle in finding a balance. The most significant of the results relates to the perception of required sacrifice to reach the top of one's career as differentiated by gender. The survey asked participants to estimate the necessity of sacrifice of relationship and/or having children for women to rise to the top of their careers. This same question was then asked changing the gender of the individual from women to men. Clearly, the participants in this study feel that greater sacrifice of family is required by women than men for career success. Nearly 75% indicated they agree or strongly agree that sacrifice is required for women to reach the top of their profession compared to just over 25% stating the same sacrifice for men (Figure 22). This is important as it suggests a difference may exist between genders as one considers career progression and goals. These differences may be related to the fact that in every case where a participant was married with children, her spouse was also employed, which

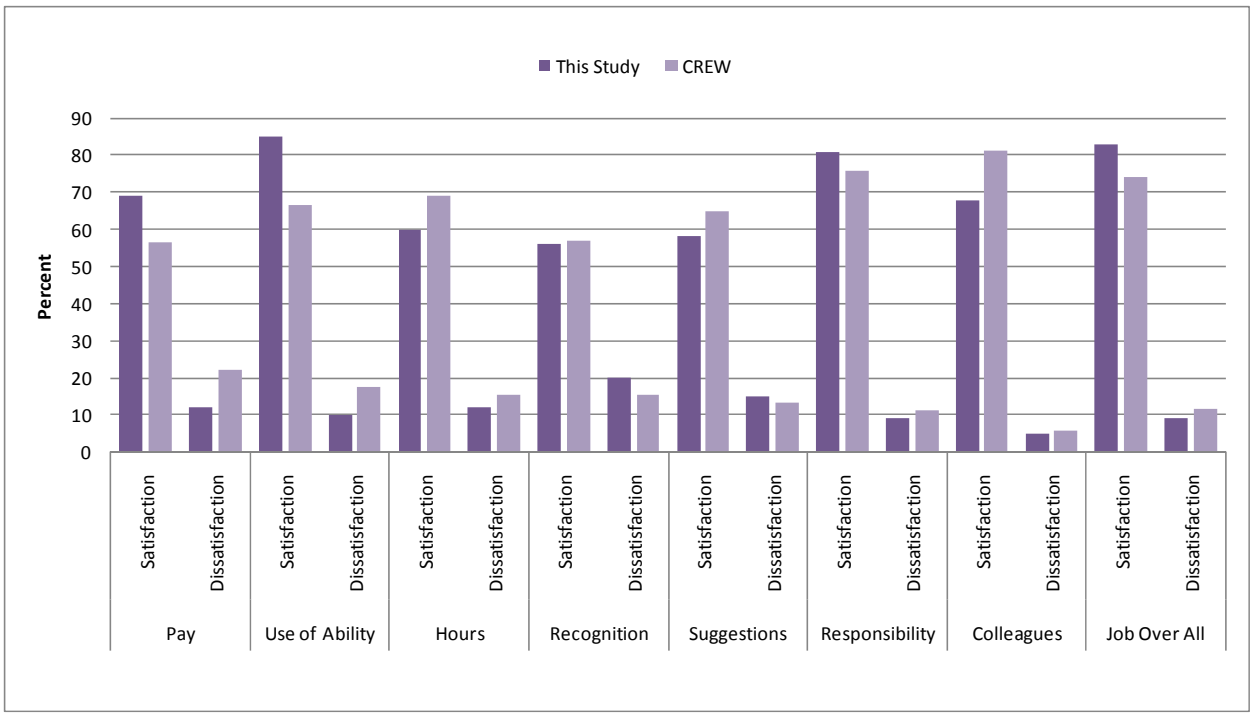
would not likely be the case if male engineers were surveyed since stay at home moms and wives are more prominent in our society than stay at home dads and husbands.

Research Sub-Question 6: What degree of satisfaction do females receive from their career in architectural engineering?

Career satisfaction is an important factor for retention. The purpose of exploring this issue was to determine if women were finding the same degree of career satisfaction whether working in the architectural engineering workforce or in another chosen field of employment. This comparison was presented in Chapter 4, with the results indicating a fairly consistent degree of satisfaction between those working in architectural engineering and those employed in an area outside of engineering. The area of greatest disparity was work hours. This issue of concern for the women working in architectural engineering surfaced in both the survey and interview responses and is connected to the previously discussed issue of family/work balance.

Workplace satisfaction ratings of those employed in architectural engineering could also be compared to women's satisfaction in engineering careers in general. The CREW Project survey contained a similar question asking the participants about their satisfaction in the workplace. As displayed in Figure 38, similar areas of satisfaction were evaluated: pay, use of ability, hours, recognition, suggestions, responsibility, colleagues, and overall job satisfaction. Generally, the participants in this study and in the CREW Project study rated satisfaction and dissatisfaction similarly. This consistency lends credibility to the results as well as further emphasizes that the women employed in the architectural engineering profession have experiences not significantly different from those of women in other disciplines of engineering.

Figure 38. Comparison of workplace conditions with CREW Project.



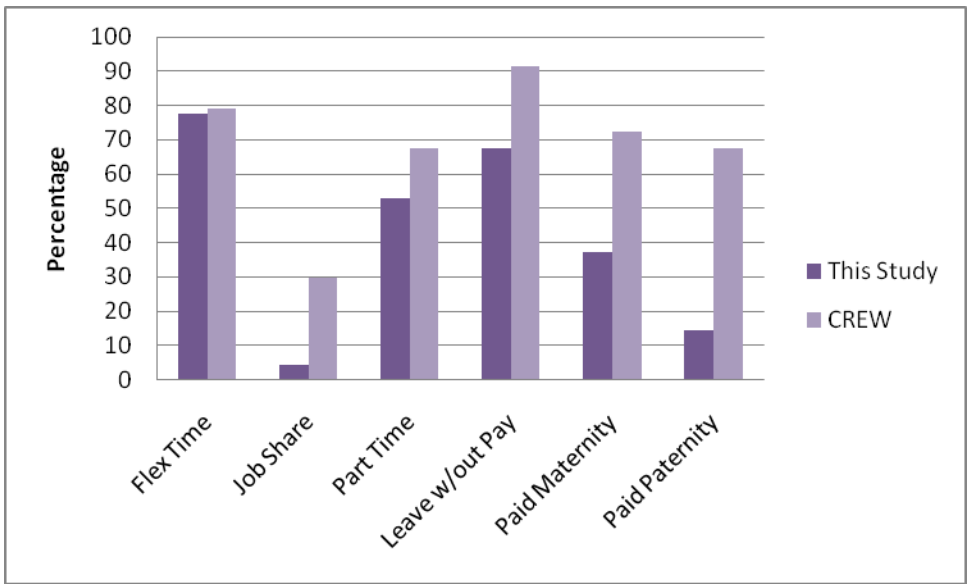
Research Sub-Question 7: What family-friendly benefits do participants report are offered by employers of architectural engineers?

Workplace benefits are an important factor contributing to workplace climate and satisfaction, especially for women in search of family/work balance. Although not all benefits that companies offer are taken advantage of, either because of the stigma associated with their use or not being applicable to the individual, it is interesting to see where the employers of architectural engineering women compare to those in other areas of engineering, as reported by the CREW Project (Mills, et al., 2008). This and the CREW Project both asked the participants to identify which benefits their employers offer. The results are provided in Figure 39. A factor to consider when making this comparison is that these two studies were conducted in different countries where there may be significant differences in benefits required by law.

Consistency between the results of this study and the CREW Project were revealed in two areas: most common benefit and frequency with which benefits are utilized. The single benefit that the participants of both this study and the CREW Project indicated were provided by a majority (75%) of their employers was flex time. Another similarity between the results of the

two studies is that more than 75% indicated that they had used at least one of the offered benefits at some point in their career.

Figure 39. Comparison of employer provided benefits with CREW Project.



The architectural engineering employers fell short in all other categories. This was further supported in the interviews as many of the participants indicated that moving to part-time employment was established at their request rather than as a standard employer benefit. This puts the burden on the employee to request alternate working arrangements, making future planning for family more difficult as they are not sure if their employer will accommodate such requests. It is important to recognize that benefits that better accommodate family are likely to contribute to retention as family/work balance is identified as a major factor in women's decision to leave the profession (Evetts, 1996; Paludi, 1990).

Implications for Practice and Recommendations

The purpose of this research was to identify issues that might increase retention of females in the architectural engineering workforce. The final two research sub-questions specifically address what needs to be done to increase retention (Research sub-question 8: What needs to change to retain or encourage re-entry of women in architectural engineering? and Research sub-question 9: What can be done to better prepare women for careers in engineering?). Retention is important as it contributes to women gaining equality in the workforce and has a positive impact on business success. When women are included in the

design process, an alternate perspective is brought to the design table resulting in increased creative problem-solving and the generation of higher quality ideas (Bantel & Jackson, 1989; McLeod & Lobel, 1992). Based on the results of this study, the primary areas that need to be addressed to retain women in the architectural engineering workforce include work environment, family/work balance, mentoring, and re-entry.

Ultimately, a change in the structure of the architectural engineering and construction industry is needed. Many of the issues influencing retention such as long, unpredictable hours are a result of an industry that centers on and caters to the demands of a client. This is not the case in the medicine, banking, and accounting professions as the hours are set, and we as clients of these services accept that hours of availability are limited. This restructuring issue is something that should be addressed by the industry as a whole since a change by an individual firm would likely result in loss of business as the client would likely simply take his or her project to another firm. Given the magnitude of the task to change the industry as a whole, the following recommendations focus on change that can be made at the firm level as it has greater promise of more immediate implementation.

Instigating change in a firm's work environment is difficult, especially with such small numbers of women in the workforce. Therefore, the recommendations that follow focus on areas that can realistically be influenced in the short term and will contribute to improving work environment. Short term solutions are appropriate because as more women are retained in the architectural engineering workforce, the environment is likely to change. The recommendations address two areas of implementation: the employer and higher education institutions / professional societies.

Employers

Employers of women in architectural engineering have the greatest vested interest in implementing change, as the loss of an employee has the potential to affect their profitability. The following recommendations impact the way things have been traditionally done but do not require a large fiscal investment. The three areas that surfaced that deserve attention include mentoring, employment structure, and re-entry. Each of these recommendations can also be seen as added benefits for male employees. It is very important to the success of these recommendations that all employees be encouraged to take advantage of these options to

minimize the potential for a gender specific stigma, decreasing the likelihood of use and ultimately success.

Mentoring is an area that appears to be under implemented as nearly a third of the participants in this research indicated that they did not have a mentor; however, positive effects of mentoring have been asserted in prior research (Paludi, 1990; Sasser et al., 2004; Yates, 2001) and have been reinforced in this study. Companies may feel that it is the responsibility of a new hire to find his/her own mentor, but this does not always happen. It may be the result of intimidation of asking someone to act as a mentor, or it may be the new employee's lack of a professional network. Nevertheless, employers can make a difference by simply encouraging or assigning mentors to new employees. In the case of female employees, it is most beneficial to find a female mentor because some issues related to gender and culture can be best addressed and understood by another female. Finding a senior level female mentor can be difficult since there are few females in architectural engineering, but any mentor, regardless of gender, is important to retention.

RIBA investigated the reason women leave the profession of architecture and established results similar to this study; there was no single factor for leaving, but there were some common factors to women leaving. Family and the inability of the work environment to accommodate family due to the long hours, inflexibility of the work schedule, and stressful working conditions were cited as key factors for departure (De Graft-Johnson et al., 2007). Recognizing these issues, employers could modify the existing workplace structure and likely increase retention rates.

Often considered a benefit, the employment structure beyond that of traditional full-time employment, such as part-time, job share, or work from home is very important to the retention of female employees. Women often make the choice to be more involved in their children's everyday activities and care, which a traditional full-time position does not allow. The research reveals that a portion of the women who choose to leave the workforce would still be employed if provided an option beyond that of traditional full-time employment. It was also apparent that most firms do not advertise options beyond the traditional full-time positions, but when approached by an employee, most employers were accommodating as found in the interview. It would be to an employer's advantage to approach the employee with alternate working arrangements rather making the employee make the first approach, as it would remove employee

stress and uncertainty. As determined from the responses to survey question [9_1 and 9_3], many participants were uncertain of their plans beyond the fact they anticipate they would likely leave engineering. These participants may be influenced to stay if presented the option of alternate working arrangements or a temporary leave. Respondents suggested that they enjoyed their architectural engineering careers and left not because of the job itself but because of the inability to find a balance between work and family and/or the inflexibility of their employer. A part-time and already trained employee has value in the fact that no expensive job search is required, and employee performance and capability is known. There is the obstacle of the irregularity of the construction business both in the fluctuations in hours and the need for timely response as issues surface. With today's technology, however, many of these barriers can be overcome. Such arrangements can be structured flexibility and would likely be based on the size of the company, the position held by the employee, the anticipated duration of the alternate work arrangements, and the availability of another employee in the case of time share.

Even if an employer provides the option of alternate working arrangements, some women will still choose to take a temporary leave from employment. These women in many cases have not fully contemplated the complications related to re-entry. The most common obstacles for re-entry are feeling out of touch with technology and a lack of confidence at the time re-entry. As employers are considering how to hire and attract a diverse workforce, these females should not be forgotten. They have not lost their architectural engineering capability or knowledge and have likely gained skills in multitasking and communication during their leave that would be difficult to develop as completely in the workforce.

It is in the employer's best interest to maintain contact with these women once they leave as a manner of gauging whether they may be willing to return full-time or even on a part-time basis. This contact is important to the women as it makes them feel wanted, decreasing the effects of lack of confidence, which could play a significant role in influencing their return. It could also be beneficial to create ways to help these women access professional development opportunities while absent from the workforce in a number of ways. One way could be an agreement by the employer to invest in their continued professional development, i.e. conferences, seminars, and professional society involvement, with the understanding that these women will be returning to the company at a predetermined time. If they do not return, the women would be responsible for compensating the company for the expenses incurred. Another

option is that the women could be responsible to present what they learned as a form of training to the current employees, making the expense more justifiable in regards to the company's overhead budget. If this expenditure of funds is not possible, these women could be invited to in-office training to maintain contact, increase their visibility, and keep them current with industry trends. Many women who take leave from the workforce do not maintain their professional development due to the expense and time, not because of a lack of interest. The employer benefits in the long run by maintaining an employee who they may have otherwise lost.

Higher Education and Professional Societies

Higher education and professional societies can help retain females in the architectural engineering workforce. Higher education is better situated to help with preparation although it could play a role with, or in addition to, professional societies in providing continuing education. One item revealed in the interviews conducted in this study is women are not encouraged nor given the opportunity to discuss issues that are specific to being female in a male-dominated environment prior to graduation. Given that many females are in offices as the only or one of a few females, they experience isolation and lack of a community to provide guidance or feedback when female specific issues arise. Programs can be developed in higher education to better prepare women for issues related to gender in the workforce. This could be as simple as a half-day seminar that covered topics such as the following: isolation due to gender, resources available; how to find family/work balance; how to plan for children with a career; what are reasonable requests to make of an employer; how a career can survive taking leave; what success is; mentoring – what it is, why get it, how to find a mentor; reality of the work environment, etc. A seminar like this would alert women to issues experienced by many females employed in a male dominated work environment.

Also professional societies could play an important role by maintaining open discussion and providing resources related to these topics and networking specific to women who have taken a break or are considering taking a break in their career. It would also be advantageous for professional societies to have a membership less expensive option for such women to encourage their involvement rather than lose their membership completely.

There is definitely an opportunity for either the university or professional societies to develop and administer on-line or on-site seminars to help prepare women for re-entry to the workforce. These seminars could address the two primary obstacles to re-entry: confidence and bringing the women technologically up to speed.

Recommended Future Research

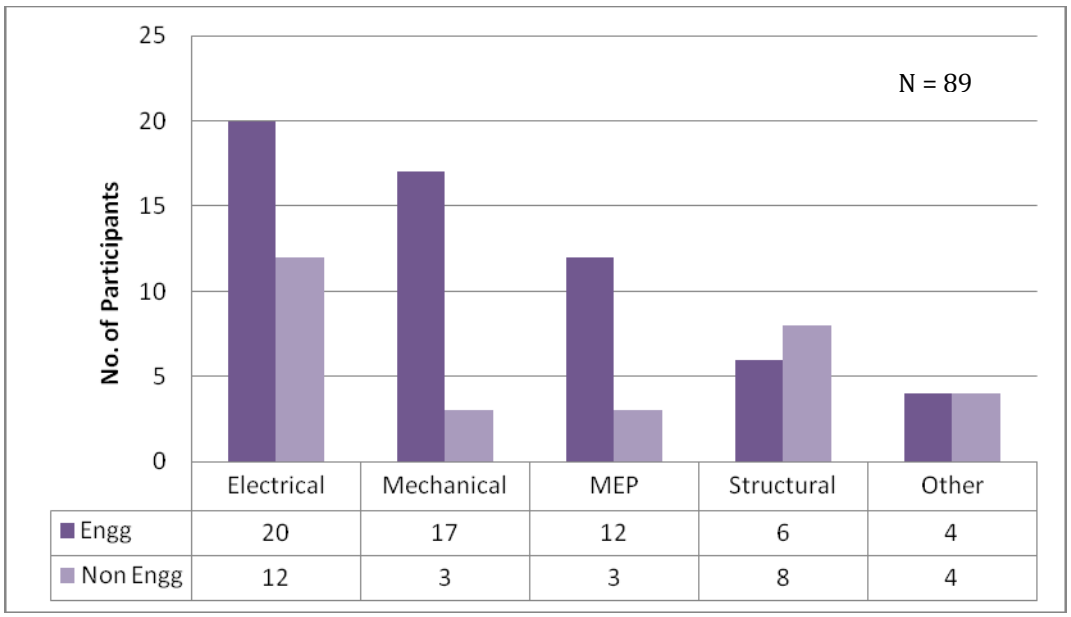
The techniques and methods utilized for this research have been successful but warrant further investigation. With only a sample of women graduates of the architectural engineering program at the Midwest state university, it would be valuable to conduct similar research including men. This would allow a more substantial comparison as retention values could be compared potentially isolating retention as a gender issue if the retention of women is less than that of men. In addition to comparing retention, job satisfaction could also be compared between genders. Another manner in which the sample could be expanded for future research is to include graduates from other architectural engineering programs. This would allow the research to explore issues of preparation.

Professional licensure is another area that could be explored in future research especially because of the importance it has for the advancement of architectural engineers. The pass rate of the exam could be analyzed with gender as a variable to establish if women are equally successful. In addition to the pass rate, future research could be done to determine the influence passing the P.E. has on a woman's career decisions. The result of the survey revealed that only one of the respondents who was no longer practicing engineering had passed the P.E. examination (Figure 4). When asked in the telephone interviews about having sat for the professional engineering exam, two the seven interviewees said they never attempted the exam while the other five all took the exam without passing. Four of these five interviewees sat for the exam multiple times without success. Without additional research, it is hard to say whether the lack of success in passing the exam encouraged the decision to leave engineering. It would be important for comparison to ask those still practicing architectural engineering if they had taken the exam and not passed as well as determine the number of women who choose not to take the exam.

Another item that warrants additional research is retention in the sub disciplines. Architectural engineering is broken into multiple disciplines: electrical, mechanical, MEP

(mechanical, electrical, and plumbing), and structural. For the purpose of the survey, a fourth option was offered for those participants who have taken their career in a direction other than these traditional paths. All but 25% of the participants identified themselves as practicing or having practiced in engineering as mechanical, electrical, and MEP (Figure 40). Only one participant did not declare a discipline. This data could be important because of the manner in which the consulting engineering field is configured. MEP and structural design are typically housed within one firm only when it is a full service firm and typically large. Otherwise, MEP is typically located within a company separate from the structural design firm. As noted in Figure 40, it is clear that far more participants pursued careers in electrical, mechanical, or MEP than in structural, but this is consistent with the proportions graduating from the architectural engineering program independent of gender. What is significant about these results is that structural was the only area that had a greater rate of participants leaving than staying. More research may determine the reason for this trend. Attention should be given to determine if the work climate and environment in structural firms are less accommodating than in MEP firms and what factors contribute to women leaving at an amplified rate.

Figure 40. Retention based on sub-discipline.



	Electrical	Mechanical	MEP	Structural	Other
Engg	20	17	12	6	4
Non Engg	12	3	3	8	4

The last item that should be further explored is what women intend to do following a leave from the engineering workforce. This study examined the issue of re-entry, but the results were inconsistent between those who had left engineering and those who expressed they had

intention to leave within 12 months of the study. There was also inconsistency between the instruments used to collect the data: interview and survey. This discrepancy was examined in Figure 35 found in Chapter 4.

Based on the potential for future research, this is clearly only the first of many studies that could investigate the issue of women's retention in architectural engineering. It is also important to realize that no research study is perfect and if conducted a second time, this method could be improved. The following section discusses the limitations of this study.

Limitations

As with any research there are limitations. Such limitations can influence the generalizability of the results, create questions related to reliability and validity of the findings, and more generally generate ways to improve the study if conducted again. The primary limitation of this study concerns its generalizability. Given that the sample consists of women from a single land grant university who are graduates from a single program during a 15 year segment in time, the results from this study might not generalize to the population of all women architectural engineers. Despite this, there were also advantages to restricting the sample in this way. The first advantage is that the architectural engineering discipline has not been studied in prior research and has a proportionately larger number of graduates than many other engineering disciplines. Another advantage is that the members of the sample had a similar preparatory background for their career. In retrospect, these sample decisions were in the best interest of this study for a couple reasons. First, there was a very good response rate likely because the researcher possessed the same qualification as the sample establishing a greater connection with the participants. Second, the architectural engineering discipline can be compared to other disciplines of engineering as a way to determine if significant differences among disciplines. Moreover, many of these limitations create an opportunity for future research that would include a larger and more inclusive sample.

The validity and reliability of the data is the product of the instrument design and implementation. However, in this study, lack of validity is not a major concern because of the established consistency of the results between the data collected in the survey and the interview as discussed at the end of Chapter 4. Lack of reliability is also not a significant concern since

many of the questions had been previously tested in other research, and the results were similar in this research and in this research.

Recognizing that some of the questions were newly developed and the format was constructed specifically for this research, modifications would be recommended to the survey if implemented again. The survey contained a number of open-ended questions because they were more exploratory in nature as common answers could not be anticipated. If a similar survey were to be used in future, these open-ended questions should be converted to multiple-choice format using the most common responses gathered in this study. This would enable data to be more easily compiled and analyzed. Also, an option of 'other' should be considered as not all responses fit into the common categories identified, and other important items may surface with another sample.

Changing which participants are asked to respond to particular questions and adding more specific questions would have provided data that was more thorough and easily compared. This is true of a group of employment-related questions. Adding a question asking specifically if the participants are working in an alternate working arrangement besides full-time and inquiring as to how this arrangement was established (employer or employee's idea) would have supplied useful information. Furthermore, limiting question [7_3], which asks if participants would prefer a part-time working arrangement, to only those working full-time and not given the opportunity by their employer would have provided a clearer indication as to the value of alternate working arrangements. Beyond the part-time working arrangement, a more specific question as to which benefits listed in question [7_1] participants have taken advantage of would provide information as to the frequency of benefit use and the importance of providing certain benefits compared to others. Other areas beyond employment that could be modified include allowing all participants to answer question [8_8] related to children rather than limiting it to only those who are married. Questions [9_1, 9_2, 9_3] asking about intentions to leave engineering in the next 12 months could be limited to those working in engineering or an option to select 'currently not employed in engineering' could be provided to minimize confusion and achieve more accurate results. The final question of both the survey and the interview asking participants for advice they would provide to other women considering architectural engineering should be changed or removed. This question was too general, resulting in an extensive range of responses that could not be effectively narrowed to create a definitive or clear answer.

It was clear as data was being analyzed that some of the questions included in the survey and the interview did not produce information that was pertinent to this study or did not present a common opinion, and therefore such responses were not discussed in prior chapters. Also, the survey contained some open-ended questions that resulted in responses that were too varied to be organized in a fashion that contributed to the study. These questions include [2_6], [5_5], [5_7], and [5_8], which ask about employment position and job responsibilities as well as question [9_8] pertaining to advice one would provide to others considering architectural engineering as a career. The question concerning advice was also included as the last interview question, and again the information collected was difficult to summarize succinctly although it did reveal issues that did not otherwise surface. Moreover, one question from the survey did not produce data that was valuable to this research: [8_3] partner's occupation. Although this data is interesting, it does not contribute to the research question of why women leave architectural engineering. The final question that was not pertinent to the results was [7_3] pertaining to participants' preference for part-time work. Because all participants of the survey were asked to respond without the ability to distinguish who was already working part-time, the data could not be presented in clear manner. These difficulties may be a result of a novice researcher aiming too broadly in her first attempt to gain information. All of the collected data is available as a summary in Appendix I. An even more effective survey could be developed in the future by eliminating or modifying some of these questions as this would allow the survey to be shorter encouraging a better response rate.

A limitation that may have influenced results was the economic downturn during which the surveys were administered. The cyclical nature of the economy affects the attention given to the recruitment and retention of employees. When the economy is strong, there is often a shortage in the workforce, and companies focus on ways to attract and retain their employees. During these times, it is not uncommon for employers to expand their benefit packages to include more female-friendly offerings such as daycare and job sharing. During times of recession with increased unemployment and fiscal strain, many of these benefits or programs are eliminated (Evetts, 1996, p. 17). In addition to the climate of the workforce changing during fiscally challenging times, it is also important to recognize that the issue of women's careers becomes a lower priority on social and political agendas, therefore reinforcing the timeliness of this research (Evetts, 1996, p. 4).

The final limitation is recall bias, which may surface since this study utilized the opinions of women who have removed themselves from the architectural engineering workforce. Sang, Dainty, & Ison (2007) identify recall bias as a distorted perspective that is reported because the individual has been removed from a situation (as cited in Blane, 1996). More commonly discussed in medical research than social science research, the possibility of recall bias arises any time a study relies on retrospective data. The fact that opinions of women both still employed in engineering and those who have left are evaluated and compared aids in minimizing this bias. Although there is the potential for recall bias, it may also be that women do not have a clear idea as to the reason(s) they are leaving engineering until they have had some time to reflect and process the situation.

Conclusion

Retention of women in the architectural engineering workforce is important to the diversity and future success of the profession. With this in mind, this research study was developed to identify the retention rate of women in architectural engineering. The retention rate of women that attain architectural engineering degrees is 66%. When women who have elected to follow another career path immediately following graduation rather than ever entering practice are removed from this data set, the workforce retention rate increases to 77%. This value is in line with that in other studies of workforce retention.

Even more important to the future of the discipline of architectural engineering than establishing retention rates was determining why women leave the profession. This study did not identify one single factor as being the reason women leave but rather many factors that seem to contribute to or influence this decision. The primary factors that surfaced included work environment, family/work balance, and mentoring, which are consistent with findings in prior work conducted on women in engineering and architecture (Auster & Ekstein, 2004; Hersh (2000); De Graft-Johnson, 2007). Recognizing that the architectural engineering work environment is a difficult area in which to instigate change, especially with such small numbers of women in the workforce, recommendations focused on areas that can more realistically be influenced in the short term. The other reason to address short-term solutions is the architectural engineering workforce environment is likely to change slowly with influence of more women. The two recommendations made to employers are to incorporate alternate working arrangements

into their business practice to better accommodate family responsibilities and to develop mentoring programs to support employees in their career progression. A recommendation was also made to universities to develop programs to discuss issues that are specific to women in a male dominated workforce to help women be equipped better for obstacles they may encounter during their career progression. Lastly, a recommendation was made to employers, professional societies, and universities to take action to promote and assist women in re-entry to the workforce. Given that some women will make the choice to take a break from their career, issues of re-entry need to be addressed as increasing the number of women in the workforce should be the focus rather than keeping them without interruption.

This study was limited to the field of architectural engineering, but many of the recommendations would likely be advantageous to all areas of engineering or male-dominated fields of practice, as the issues that surfaced do not appear to be architectural engineering specific when compared to issues in similar studies.

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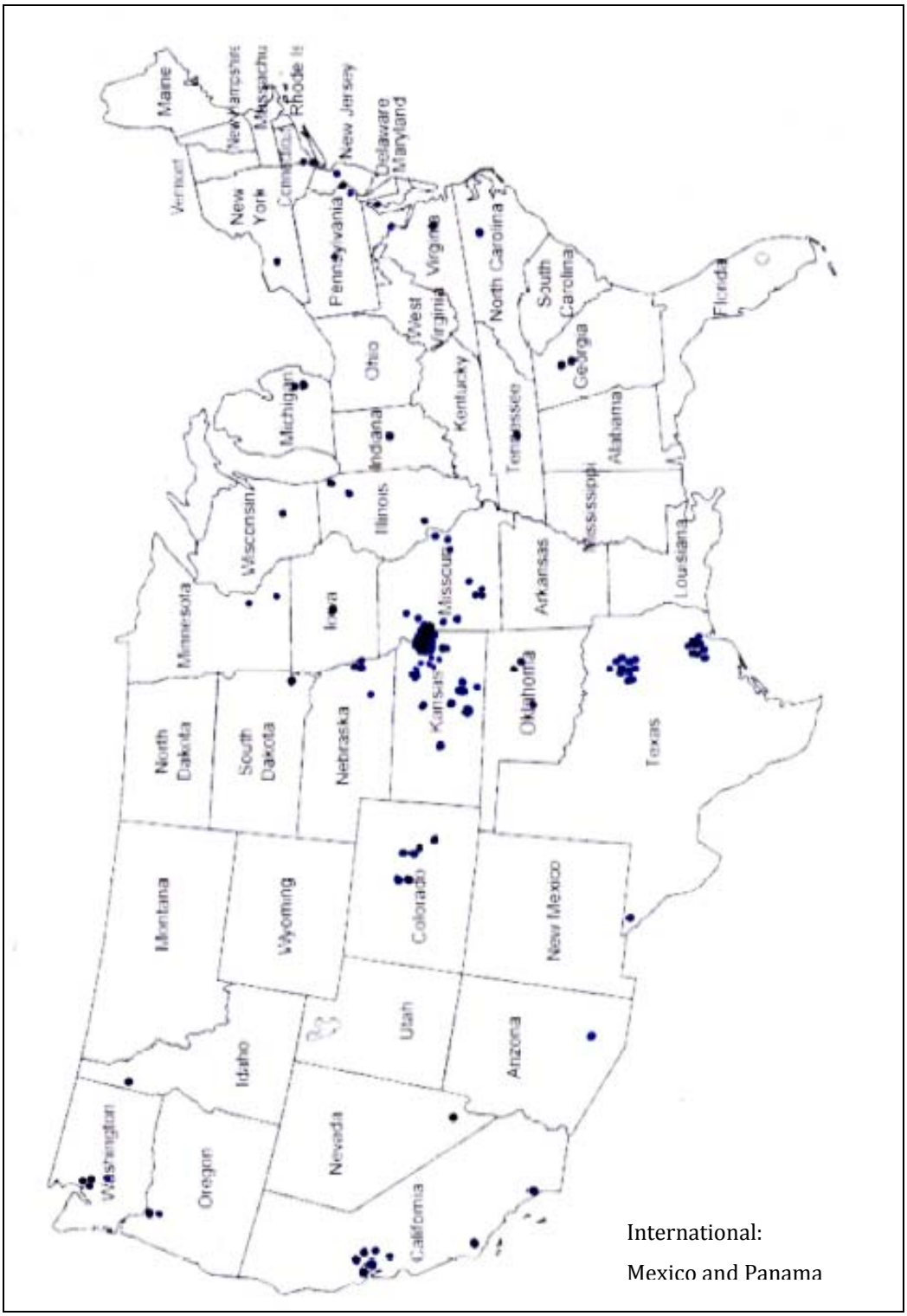
Appendix A - Sample Distribution Map



Appendix B - IRB Consent Forms

[redacted] UNIVERSITY
INFORMED CONSENT FORM

PROJECT TITLE: RETENTION OF WOMEN ARCHITECTURAL ENGINEERS IN INDUSTRY

APPROVAL DATE OF PROJECT: July 15, 2009 **EXPIRATION DATE OF PROJECT:** July 14, 2010

PRINCIPAL INVESTIGATOR: Jacqueline Spears

CO-INVESTIGATOR(S): Julia Keen

CONTACT NAME AND PHONE FOR ANY PROBLEMS/QUESTIONS: Julia Keen (785) 532-3575

IRB CHAIR CONTACT/PHONE INFORMATION:

- [redacted]
-

SPONSOR OF PROJECT: NA

PURPOSE OF THE RESEARCH: This is a doctoral research project being conducted as part of the requirement for a degree in Secondary Education. The research intent is to identify why women leave the field of engineering and to create a picture of the engineering work environment from the female perspective.

PROCEDURES OR METHODS TO BE USED: Participants in this study will be asked to complete a self administered survey.

LENGTH OF STUDY: Complete 80 question survey (approximately 20 minutes time)

RISKS OR DISCOMFORTS ANTICIPATED: There are no known risks to the participants of this study.

BENEFITS ANTICIPATED: The data collected can be used to implement change in the engineering workforce to better accommodate women.

EXTENT OF CONFIDENTIALITY: Confidentiality will be maintained by assigning each participant a tracking number. The key for these tracking numbers will not be accessible to any one other than the researcher and will be kept separate from the data collected. No data at any time will be directly linked to the participant's identity.

TERMS OF PARTICIPATION: I understand this project is research, and that my participation is completely voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation, penalty, or loss of benefits, or academic standing to which I may otherwise be entitled.

I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.

(Remember that it is a requirement for the P.I. to maintain a signed and dated copy of the same consent form signed and kept by the participant

Participant Name: _____

Participant Signature: _____ **Date:** _____

Witness to Signature: (project staff) _____ **Date:** _____

[redacted] **UNIVERSITY**
INFORMED CONSENT FORM

PROJECT TITLE: RETENTION OF WOMEN ARCHITECTURAL ENGINEERS IN INDUSTRY

APPROVAL DATE OF PROJECT: July 15, 2009 **EXPIRATION DATE OF PROJECT: July 14, 2010**

PRINCIPAL INVESTIGATOR: Jacqueline Spears

CO-INVESTIGATOR(S): Julia Keen

CONTACT NAME AND PHONE FOR ANY PROBLEMS/QUESTIONS: Julia Keen (785) 532-3575

IRB CHAIR CONTACT/PHONE INFORMATION*:*

- [redacted]
- [redacted]

SPONSOR OF PROJECT: NA

PURPOSE OF THE RESEARCH: This is a doctoral research project being conduct as part of the requirement for a degree in Secondary Education. The research intent is to identify why women leave the field of engineering and to create a picture of the engineering work environment from the female perspective.

PROCEDURES OR METHODS TO BE USED: Participants in this study will be asked to contribute to discussion and answer questions regarding their past career in engineering during a phone interview. The interview session will be audio recorded and transcribed as a manner of analyzing data. A summary of the interview will be provided to participants within three weeks. Participants are asked to review this document for accuracy and to contact the researcher with any corrections.

LENGTH OF STUDY: The phone interview is anticipated to last no more than 1-hour.

RISKS OR DISCOMFORTS ANTICIPATED: There are no known risks to the participants of this study.

BENEFITS ANTICIPATED: The data collected can be used to implement change in the engineering workforce to better accommodate women.

EXTENT OF CONFIDENTIALITY: Confidentiality will be maintained by assigning each participant a tracking number. The key for these tracking numbers will not be accessible to any one other than the researcher and will be kept separate from the data collected. No data at any time will be directly linked to the participant's identity.

TERMS OF PARTICIPATION: I understand this project is research, and that my participation is completely voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation, penalty, or loss of benefits, or academic standing to which I may otherwise be entitled.

I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.

(Remember that it is a requirement for the P.I. to maintain a signed and dated copy of the same consent form signed and kept by the participant

Participant Name: _____

Participant Signature: _____ **Date:** _____

Witness to Signature: (project staff) _____ **Date:** _____

Appendix C - Survey

SURVEY OF ARCHITECTURAL ENGINEERING WOMEN

[redacted]

DEPARTMENT OF ARCHITECTURAL ENGINEERING

2009

Please return your completed survey in the enclosed envelope to:

Julia Keen

[redacted]

Department of Architectural Engineering

[redacted]

[redacted] UNIVERSITY
INFORMED CONSENT FORM

PROJECT TITLE: RETENTION OF WOMEN ARCHITECTURAL ENGINEERS IN INDUSTRY

APPROVAL DATE OF PROJECT: July 15, 2009 **EXPIRATION DATE OF PROJECT:** July 14, 2010

PRINCIPAL INVESTIGATOR: Jacqueline Spears

CO-INVESTIGATOR(S): Julia Keen

CONTACT NAME AND PHONE FOR ANY PROBLEMS/QUESTIONS: Julia Keen (785) 532-3575

IRB CHAIR CONTACT/PHONE INFORMATION:

- [redacted]
- [redacted]

SPONSOR OF PROJECT: NA

PURPOSE OF THE RESEARCH: This is a doctoral research project being conducted as part of the requirement for a degree in Secondary Education. The research intent is to identify why women leave the field of engineering and to create a picture of the engineering work environment from the female perspective.

PROCEDURES OR METHODS TO BE USED: Participants in this study will be asked to complete a self administered survey.

LENGTH OF STUDY: Complete 80 question survey (approximately 20 minutes time)

RISKS OR DISCOMFORTS ANTICIPATED: There are no known risks to the participants of this study.

BENEFITS ANTICIPATED: The data collected can be used to implement change in the engineering workforce to better accommodate women.

EXTENT OF CONFIDENTIALITY: Confidentiality will be maintained by assigning each participant a tracking number. The key for these tracking numbers will not be accessible to any one other than the researcher and will be kept separate from the data collected. No data at any time will be directly linked to the participant's identity.

TERMS OF PARTICIPATION: I understand this project is research, and that my participation is completely voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation, penalty, or loss of benefits, or academic standing to which I may otherwise be entitled.

I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.

(Remember that it is a requirement for the P.I. to maintain a signed and dated copy of the same consent form signed and kept by the participant)

Participant Name: _____

Participant Signature: _____ **Date:** _____

Witness to Signature: (project staff) _____ **Date:** _____

Last revised on May 20, 2004

GENERAL

1. **What year did you graduate from [redacted] University with an undergraduate degree in Architectural Engineering?**
   Year:_____

   Circle one: Spring Fall

2. **What area of architectural engineering did/do you practice?**

   □ Structural
   □ Mechanical
   □ Electrical
   □ Plumbing
   □ MEP
   □ Other: _____

3. **Have you attained additional or advanced degrees beyond a BS in ARE?**

   □ Yes □ No

   If so, what are they?

   _____
   _____

4. **Do you have your professional engineering license?**

   □ Yes □ No

5. **What is your age?**

   _____ years old

6. **Did you have an internship (employment within an architectural engineering firm) while in college?**

   □ Yes □ No

   If yes, did your internship portray the architectural engineering career accurately?

   □ Yes □ No

7. **What was the most difficult transition between college and the professional workforce?**

   _____
   _____
   _____

8. **How would you best describe your employment situation 6 months after graduation?**

   □ Working in an ARE related position
   □ Working in position related to engineering
   □ Working in position unrelated to engineering by choice
   □ Working in position unrelated to engineering due to lack of opportunity
   □ Traveling
   □ Other: Specify_____

9. **Do you or have you had a mentor for your career?**

   □ Yes □ No → GO TO #10

   If yes, is /was this person female?

   □ Yes □ No

   How has this person influenced your career?

   _____
   _____
   _____
   _____

10. **Do you currently have paid employment?**

    □ Yes □ No

    If not, is this a result of:

    □ Personal Choice
    □ Economic downturn
    □ Other: Specify_____

11. **Are you currently employed as an engineer or in an engineering related position?**

    □ Yes → GO TO ENGINEERING EMPLOYMENT - PAGE [2]

    □ No → GO TO NON-ENGINEERING EMPLOYMENT SECTION - PAGE [5]

[1]

ENGINEERING EMPLOYMENT

Only answered by those that are CURRENTLY practicing engineering

1. **Which of the following best describes your current position?**

   □ Working in a full time engineering capacity
   □ Working in a part-time engineering capacity
   □ Working intermittently in an engineering capacity (as needed consulting basis – no set schedule)
   □ Other: Specify_____

2. **Is this position related to the building design or construction industry?**

   □ Yes □ No

3. **How many engineers are employed with your firm, including part-time?**
   _____ people

4. **How many women engineers are employed with your firm?**
   _____ women

5. **Are any of the highest management or ownership positions held by women?**

   □ Yes □ No

6. **What position do you hold within your company?**
   Title:_____

7. **Describe your position and responsibilities.**
   _____
   _____
   _____
   _____
   _____

8. **In which salary group is your current gross (before taxes) salary?**

   □ Less than $45,000
   □$46,000 - $60,000
   □ $61,000-$75,000
   □ $76,000-$90,000
   □ $91,000-$105,000
   □ $105,000 +

9. **How many hours, on average, are you paid each week?**
   _____ hours

   Do you work overtime?

   □ Yes □ No

10. **How many hours, on average, do you work each week?**
    _____ hours

11. **How many nights have you had to spend away from home for business in the past 12 months?**
    _____ nights

12. **Is the time schedule imposed by your occupation reasonable to accomplish the job responsibilities?**

    □ Yes □ No

13. **Name two parts of your job that you find most satisfying or rewarding.**

    1. _____
    2. _____

14. **Name two parts of your job that you find least satisfying or rewarding.**

    1. _____
    2. _____

15. **Identify 3 major challenges encountered in your engineering career – *list in order of difficulty to resolve or overcome.***
    1. _____
    _____
    2. _____
    _____
    3. _____
    _____

PROCEED TO PAGE [3]

ENGINEERING EMPLOYMENT

Only answered by those that are CURRENTLY practicing engineering

16. How would you describe the engineering work culture at your current workplace?

Please check all that apply.

□ Supportive
□ Comfortable
□ Family Friendly
□ Competitive
□ Uncomfortable
□ Hostile
□ Other: Specify _____

17. How does the environment/culture of your firm affect your performance?

_____
_____
_____

18. Do women receive equal promotions and salary raises as their male counterparts within your firm?

□ Yes □ No

19. Do females within your firm receive equal job assignments and responsibilities as their male counterparts?

□ Yes □ No

20. Do you believe that you could reach the top of your profession?

□ Yes □ No

In your opinion, have you reached the top of your profession?

□ Yes □ No

21. Do you aspire to attain a top managerial position within your company?

□ Yes □ No

22. In the past month, how frequently did you hear positive feedback related to your job?

_____ occurrences

From whom do you usually receive this feedback?

□ Supervisor
□ Colleagues
□ Other: Specify _____

23. In the past month, how often did you hear constructive criticism related to your job?

_____ occurrences

From whom do you usually receive this feedback?

□ Supervisor
□ Colleagues
□ Other: Specify _____

24. Have you ever taken a leave from work that lasted more than 3 continuous weeks (reason other than vacation)?

□ Yes □ No → GO TO #28

25. What was the reason for taking leave?

_____
_____

26. How long were you on leave?

_____ years _____months

27. Following your return from leave, did you return to the same position or similar position as prior to your leave?

□ Yes □ No

28. Is the same promotion schedule available to those that have taken leave?

□ Yes □ No

PROCEED TO PAGE [4]

ENGINEERING EMPLOYMENT

Only answered by those that are CURRENTLY practicing engineering

For Questions 29-38 choose between the following responses.

1 – Very Dissatisfied
2 – Dissatisfied
3 – Indifferent
4 – Satisfied
5 – Very Satisfied

29. How satisfied are you with your rate of pay?

1 2 3 4 5

30. How satisfied are you with the amount of responsibility you are given?

1 2 3 4 5

31. How satisfied are you with your chance for promotion?

1 2 3 4 5

32. How satisfied are you with the recognition you get for your work?

1 2 3 4 5

33. How satisfied are you with your colleagues?

1 2 3 4 5

34. How satisfied are you with the opportunities to use your abilities?

1 2 3 4 5

35. How satisfied are you with the amount of attention paid to the suggestions you make?

1 2 3 4 5

36. How satisfied are you with your hours of work?

1 2 3 4 5

37. How satisfied are you with your level of job security?

1 2 3 4 5

38. Taking everything into consideration, how satisfied are you with your job as a whole?

1 2 3 4 5

PROCEED TO PAGE [7]

NON-ENGINEERING EMPLOYMENT

Only answer if no longer employed in engineering

1. **Which of the following best describes your current position?**
   - □ Have left the engineering profession altogether and am working in another role.
   - □ Taking a career break and intend to return to engineering eventually
   - □ Taking a career break and intend to return to work in a position unrelated to engineering eventually
   - □ Out of the workforce and am currently looking for an engineering position
   - □ Out of the workforce and am currently looking for a position outside of engineering
   - □ Have left the workforce and do not intend to return

2. **In what year did you leave your last engineering related position?**
   Year: _____

3. **What was your last engineering related job title?**
   Title: _____

4. **What factors influenced your decision to leave engineering?**
   _____
   _____
   _____
   _____
   _____

5. **What do you miss most about your engineering career?**
   _____
   _____
   _____
   _____
   _____

IF YOU ARE NOT CURRENTLY EMPLOYED, PLEASE SKIP TO QUESTION #21 – PAGE [6]

6. **How long have you been employed outside the field of engineering?**
   _____ years _____months

7. **What is your current occupation?**
   Title: _____

8. **Do you utilize engineering trained skills in this employment?**
   □ Yes □ No
   If yes, which ones?
   _____
   _____
   _____
   _____

9. **What do you prefer about your career outside of engineering?**
   _____
   _____
   _____
   _____
   _____

10. **Name two parts of your job that you find most satisfying or rewarding.**
    1. _____
    2. _____

11. **Name two parts of your job that you find least satisfying or rewarding.**
    1. _____
    2. _____

PROCEED TO PAGE [6]

NON-ENGINEERING EMPLOYMENT

Only answer if no longer employed in engineering

For Questions 12-20 choose between the following responses.

1 – Very Dissatisfied
2 – Dissatisfied
3 – Indifferent
4 – Satisfied
5 – Very Satisfied

---

12. How satisfied are you with your rate of pay?

1 2 3 4 5

13. How satisfied are you with the amount of responsibility you are given?

1 2 3 4 5

14. How satisfied are you with the amount of recognition you get for your work?

1 2 3 4 5

15. How satisfied are you with your colleagues?

1 2 3 4 5

16. How satisfied are you with the opportunities presented to use your abilities?

1 2 3 4 5

17. How satisfied are you with the amount of attention paid to your suggestions?

1 2 3 4 5

18. How satisfied are you with your work hours?

1 2 3 4 5

19. How satisfied are you with the level of job security?

1 2 3 4 5

20. Taking everything into consideration, how satisfied are you with your job as a whole?

1 2 3 4 5

---

21. If not employed, to what extent do you regret not having a full-time professional career?

□Great deal
□Somewhat
□Occasionally
□Not at all

22. If not employed, what is the likelihood you will return to engineering as a career?

□Very Likely
□Likely
□Unlikely
□Very Unlikely

PROCEED TO PAGE [7]

HUMAN RESOURCES

Answer the following questions for your current/most recent engineering employer

1. **Does/did your employer offer any of the following either formally or informally?** *(Check all that apply)*

   □ Flexible work hours
   □ Job sharing
   □ Part-time work
   □ Work from home
   □ Leave without pay
   □ Family leave
   □ Paid maternity leave
   □ Paid Paternity leave
   □ Paid or on-site daycare

2. **Have you taken advantage of any of the benefits list above?**

   □ Yes □ No

3. **If given the same opportunities and possibilities for advancement would you prefer to work part time?**

   □ Yes □ No

Utilize the following definitions when answering questions 4 -7:

Discrimination - Treated differently, ignored, undermined, unfairly criticized, taken advantage of, not receiving equal access to opportunity, based on characteristics such as gender, race, age, disability, marital status or pregnancy

Sexual harassment - any unwanted sexual advances or unwelcome conduct of a sexual nature.

4. **Have/did you experiences discrimination while working as an engineer?**

   □ Yes □ No

5. **What information or literature have/did you received from your employer related to harassment?**

   _____
   _____
   _____
   _____

   Does/did every new employee receive the same information?

   □ Yes □ No

6. **Have you ever been sexually harassed while working as an engineer?**

   □ Yes □ No

7. **Are/were there procedures established within your firm to handle harassment and discrimination issues?**

   □ Yes □ No

   Do you view these established procedures as fair and just?

   □ Yes □ No

CONTINUE TO PAGE [8]

FAMILY

1. **What is your current marital status?**

   □ Married / Partner →GO TO #2
   □ Single → GO TO #12
   □ Divorced → GO TO #12
   □ Widowed → GO TO #12

If married or have a partner with whom you live, please answer questions 2-11.

2. **Is your spouse or partner also employed?**

   □ Yes □ No

3. **What is your spouse/partner's occupation?**

   _____

4. **If in a dual career partnership, which person's career interests take priority?**

   □ Yours
   □ Theirs
   □ Approximately equal
   □ Not Applicable

5. **Who is the principal income earner in your household?**

   □ You
   □ Spouse/Partner
   □ Approximately equal
   □ Not Applicable

6. **Is your income or benefits mainstay for your household?**

   □ Yes □ No

7. **What is the division of domestic duties/household responsibilities you are responsible for compared to your married spouse or partner?**

   □ 0-20%
   □ 21- 40%
   □ 41 – 60%
   □ 61 – 80%
   □ 80% - 100%

8. **Do you have children?**

   □ Yes □ No → GO TO #12

9. **Childcare is the primary responsibility of:**

   □ Self
   □ Spouse
   □ Split with spouse
   □ Outside assistance

10. **What portion of childcare are you responsible for compared to your spouse or partner?**

    □ 0-20%
    □ 21- 40%
    □ 41 – 60%
    □ 61 – 80%
    □ 80% - 100%

11. **Has your career progress been affected by family responsibilities?**

    □ Yes □ No

12. **Can the balance between work and family be better accommodated by careers other than engineering?**

    □ Yes □ No

    If yes, what is the difference?

    _____
    _____

13. **Do you believe that society considers being a stay at home mother and being a professional equally respectable?**

    □ Yes □ No

PROCEED TO PAGE [9]

FAMILY

For Questions 14-17, please indicate how strongly do you agree/disagree with the statement. Please choose between the following responses.

1 – Strongly Disagree
2 – Disagree
3 – Neither Agree nor Disagree
4 – Agree
5 – Strongly Agree

14. A woman who leaves the workforce for a few years to raise children will never rise to the top of their profession.

1 2 3 4 5

15. Women often have to make big sacrifices in terms of relationships or having children to rise to the top of their careers.

1 2 3 4 5

16. Men often have to make big sacrifices in terms of relationships or having children in order to rise to the top of their careers.

1 2 3 4 5

17. Society values women for being good mothers more than being successful in their careers.

1 2 3 4 5

FINAL

1. How likely is it that you will be leaving your current job in the next 12 months?

□ Very unlikely → GO TO #4
□ Unlikely → GO TO #4
□ Undecided → GO TO #4
□ Likely → GO TO #2 & 3
□ Very likely → GO TO #2 & 3

2. What is the main reason why you intend to leave?

_____
_____
_____

3. Do you anticipate searching for another job in the future?

□ Yes □ No □ Uncertain

If yes, will it be in engineering?

□ Yes □ No □ Uncertain

4. What advantages exist for females in the male dominated field of engineering?

_____
_____
_____

5. What obstacles/issues exist for female engineers that are different from male engineers?

_____
_____
_____
_____

6. Given the experience you have now, would you have pursued the same college degree and career path if you could do it over again?

□ Yes → GO TO #8
□ No → GO TO #7
□ Uncertain → GO TO #7

7. What would you have done differently?

_____
_____
_____
_____

8. What advice would you give young females considering a career in architectural engineering?

_____
_____
_____

[9]

Focus Group Interview Participation

Focus group interviews are planned as another manner of collecting information on the experiences of females in the engineering workforce. By filling out the information below you are indicating interest in participating in a focus group interview.

Identify which of the locations below you would be most likely to attend:

DALLAS / HOUSTON / KANSAS CITY (please circle preference)

The following information will allow you to be contacted to coordinate the date, time, and location of this interview.

Name: _____

Phone Number: ( ) _____ - _____

e-mail: _____

Thank you for your interest and willingness to participate.

Thank you for taking the time to complete this survey. Feel free to contact me with any questions or concerns.

Appendix D - Participant Copy of IRB Consent Form

[redacted] **UNIVERSITY**
INFORMED CONSENT FORM

PROJECT TITLE: RETENTION OF WOMEN ARCHITECTURAL ENGINEERS IN INDUSTRY

APPROVAL DATE OF PROJECT: July 15, 2009 **EXPIRATION DATE OF PROJECT:** July 14, 2010

PRINCIPAL INVESTIGATOR: Jacqueline Spears

CO-INVESTIGATOR(S): Julia Keen

CONTACT NAME AND PHONE FOR ANY PROBLEMS/QUESTIONS: Julia Keen (785) 532-3575

IRB CHAIR CONTACT/PHONE INFORMATION:

- [redacted]
- [redacted]

SPONSOR OF PROJECT: NA

PURPOSE OF THE RESEARCH: This is a doctoral research project being conducted as part of the requirement for a degree in Secondary Education. The research intent is to identify why women leave the field of engineering and to create a picture of the engineering work environment from the female perspective.

PROCEDURES OR METHODS TO BE USED: Participants in this study will be asked to complete a self administered survey.

LENGTH OF STUDY: Complete 80 question survey (approximately 20 minutes time)

RISKS OR DISCOMFORTS ANTICIPATED: There are no known risks to the participants of this study.

BENEFITS ANTICIPATED: The data collected can be used to implement change in the engineering workforce to better accommodate women.

EXTENT OF CONFIDENTIALITY: Confidentiality will be maintained by assigning each participant a tracking number. The key for these tracking numbers will not be accessible to any one other than the researcher and will be kept separate from the data collected. No data at any time will be directly linked to the participant's identity.

TERMS OF PARTICIPATION: I understand this project is research, and that my participation is completely voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation, penalty, or loss of benefits, or academic standing to which I may otherwise be entitled.

I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.

(Remember that it is a requirement for the P.I. to maintain a signed and dated copy of the same consent form signed and kept by the participant

Participant Name: _____

Participant Signature: _____ **Date:** _____

Witness to Signature: (project staff) _____ **Date:** _____

- PARTICIPANT FILE COPY-
DO NOT RETURN WITH SURVEY

Appendix E - Survey Cover Letter

[redacted]

July 17, 2009

Department of
Architectural Engineering
and Construction Science

[redacted]

Dear Fellow [redacted] Architectural Engineering Graduate:

I need your help! I am a 1998 Alum of th[redacted] Architectural Engineering program. Apparently I couldn't stay away, since I am currently employed as faculty teaching future ARE graduates. I am conducting a survey of all female alumni between the years of 1990 and 2005. The information collected will be used in my research related to retention of women in the engineering profession as the topic of my dissertation as I pursue a PhD in Education. This information will be helpful in influencing change in the workplace to best accommodate the needs of female engineers. I intend to share the results with the engineering community through publications in technical and education journals. Regardless of whether you choose to participate, please let me know if you would like a summary of my findings by e-mailing me at jkeen@ksu.edu.

Please take the time to review and complete the enclosed questionnaire. It should not take more than 20 minutes of your time. Your participation is strictly voluntary and any questions that make you uncomfortable may be skipped. There are no correct or incorrect responses, only your much needed opinion. All responses will be treated confidentially and will in no way be traceable to individual respondents once the survey process has been concluded. Please drop your postage-paid, preaddressed envelop in the mail by August 7.

I will be conducting focus group interviews to attain more in depth answers to specific questions. These focus group interviews will be arranged locally in KANSAS CITY/DALLAS/HOUSTON. The time commitment is no more than 2 hours in a single evening. If you are willing to contribute, please fill out the information sheet on the last page of the survey. I will be in contact with the date, time, and location.

If you have any questions or concerns about completing the questionnaire or about being in this study, you may contact me at [redacted] The Institutional Review Board (IRB) at Kansas State University has approved this study. If you have any concerns about your rights as a participant in this study you may contact Rick Scheidt, Chair, Committee on Research Involving Human Subjects, [redacted]

Thank you for your assistance. Your opinions are important to me and the profession. I value your time and input.

Sincerely,

Julia Keen, P.E.
Assistant Professor

Appendix F - Thank You Post Card

Return Address

Name

Street Address

City, State Zip

DATE

Last week a survey seeking your opinions about females in engineering was mailed to you.

If you have already completed and returned the survey, please accept my sincere thanks. If not, please do so today. I am especially grateful for your help because it is only with your input that necessary changes to better accommodate women in the workforce can be identified.

If you did not receive a survey, or if it was misplaced, please call me at [redacted] and I will get another one in the mail to you today.

Julia Keen, P.E.
Assistant Professor
[redacted]

Appendix G - Telephone Interview Protocol

Telephone Interview Protocol

Welcome Participant and Explanation of Procedure

Thank you for agreeing to participate taking time from your busy schedule. Honest and thorough answers to the following questions will be very important to finding if there are common reasons among females for leaving their engineering career and potentially influencing change if it is needed in the engineering workforce.

As a requirement of the university and to ensure confidentiality I need to have you sign an Informed Consent Form which was mailed to you last week. Included with the consent form was a postage paid envelope in which it can be returned.

The questions are to concentrate on your experiences within the engineering work environment during your time of employment. However, if you have or are working outside engineering and can point out positive work experiences that could be incorporated into engineering that input is also valuable.

I am taping this session so that I can record and study what you have said, but it goes no farther than this interview. Anything you say will be held in strict confidence.

Questions

1) Think back to your career aspirations graduating from college. What about your career progression is different than what you anticipated?
Probe: What were the primary influences for this change in direction (reason you left engineering)?
2) What are you doing now?
Probe: Other employment – full time or part time?
Civic service / volunteer activities?
What are your new career aspirations?
3) Have you sat for the professional engineering exam?
Probe: If no - Why not?
Do you plan to set for the P.E.?
Why do you feel you need or want this licensure?
If yes - How many times?
Have you attained your P.E.?
Do you plan to set for the exam again?
Why do you feel you need or want this licensure?
4) How would you describe your feelings or emotion about leaving your engineering career?
Probe: Was there a feeling of relief or disappointment or enthusiasm or etc?
What do you miss about your engineering career?
Are you able to find other things to compensate or replace those things you miss?
5) Do you intend to reenter the engineering workforce?
Probes: If yes - When?
What do you see as the primary obstacle to reentry?
If no - What has influenced you decision not to return?
Do you anticipate being employed in a full time capacity outside of engg?
6) Why do you think women in engineering are more likely to leave the profession than women in other professions such as lawyers, bankers, physicians?
7) What could change in the engineering work environment to better accommodate women?
Probes: With these changes would you have considered staying in engineering?
8) What should be done to more adequately prepared young women for their engineering career?
9) What advice would you provide a young female when making a career decision if they are contemplating engineering?
10) Is there anything else you would like to discuss, add or comment on related to the issues we have discussed?

Conclusion/Wrap--up

Thank you for participating and contributing to this process.

Appendix H - Telephone Interview Request

[redacted]

September 29, 2009

Department of
Architectural Engineering
and Construction Science

[redacted]

Dear Participant:

Thank you for participating in the survey of female graduates from [redacted] Architectural Engineering. Upon my graduation from the [redacted] ARE program in 1998, I was employed in Iowa for two small consulting engineering firms. In 2003 I returned to [redacted] for a teaching position in the ARE program. About this time in my career, I began recognizing that many of my female friends and colleagues were leaving their engineering jobs for other work or completely leaving the workforce. This was concerning for me and I wanted a more definite answer as to why. I could not find this answer in existing literature. I then decided to find the answer myself through research which turns out is the basis of my PhD dissertation. So before we go any further I must thank you for helping me personally in my research as well hopefully contributing to instigating change in the engineering work environment to help future female engineers.

I had originally hoped to conduct focus group interviews but it turns out that potential participants are scattered around the country not allowing this to be logistically possible. If you are willing, I would instead like to conduct a phone interview that will not take more than hour of your time and can be planned for a time convenient to you. If you are interested and available to participate in an interview before November 1 please e-mail me at [redacted] or call me at [redacted] to arrange an interview day and time.

The purpose of this interview is to try to identify why women leave their engineering careers. This is research that has not been done before because trying to locate females once they leave engineering is very difficult. I am hoping to interview women that are currently not in a position of paid employment as well as those that have chosen to pursue careers outside of engineering.

I realize that your time is valuable and limited. In an attempt to be efficient I have attached a copy of the informed consent form and a list of the questions you can expect to be asked during the interview. The attached items are simply for you to look at before the phone interview in hopes of addressing any concerns you may have.

Questions

1) Think back to your career aspirations graduating from college. What about your career progression is different than what you anticipated?
2) What are you doing now? What are your new career aspirations?
3) Have you sat for the professional engineering exam?
4) How would you describe your feelings or emotion about leaving your engineering career?
5) Do you intend to reenter the engineering workforce?
6) Why do you think women in engineering are more likely to leave the profession than women in other professions such as lawyers, bankers, physicians?
7) What could change in the engineering work environment to better accommodate women?
8) What should be done to more adequately prepared young women for their engineering career?
9) What advice would you provide a young female when making a career decision if they are contemplating engineering?
10) Is there anything else you would like to discuss, add or comment on?

Sincerely,

Julia Keen

Appendix I - Survey Results Summary

1_1 What year did you graduate from [redacted] with an undergraduate degree in architectural engineering?

Year	Number
1990	1
1991	5
1992	7
1993	4
1994	3
1995	4
1996	3
1997	0
1998	8
1999	7
2000	5
2001	11
2002	5
2003	9
2004	7
2005	10
Total	89

1_2 What area of architectural engineering did/do you practice?

Discipline	Number	%
Structural	14	15.7
Mechanical	20	22.5
Electrical	32	36.0
Plumbing	0	0.0
MEP	15	16.8
Other	8	9.0
Total	89	100.0

1_3 Have you attained additional or advanced degrees beyond a BS in ARE?

Response	Number	%
Masters ARE	23	25.8
Other	11	12.4
In Progress	3	3.4
None	52	58.4
Total	89	100

1_4 Do you have your professional engineering license?

Response	Number	%
Yes	44	49.4
No	45	50.6
Total	89	100

1_5 What is your age?

Age	Number
27	7
28	7
29	8
30	4
31	10
32	7
33	7
34	8
35	3
36	3
37	5
38	4
39	3
40	3
41	5
42	2
43	0
44	1
45	1
46	0
47	0
48	0
49	0
50	0
51	1
Total	89

Mean: 33.6 years, Median: 33 years

1_6a Did you have an internship (employment with an architectural engineering firm) while in college?

Response	Number	%
Yes	67	75.3
No	22	24.7
Total	89	100

1_6b If 'Yes' response to 1_6a, did your internship portray the architectural engineering career accurately?

Response	Number	%
Yes	59	90.8
No	6	9.2
No Response	2	-
Total	67	100

1_7 What was the most difficult transition between college and the professional workforce?

Response	Number
Time Balance	29
Technical	17
Social	8
Company Standards	7
Easy	7
Cultural Transition	6
Disappointment w/ Challenge	4
Responsibility	4
Professional Respect	3
No Response	6
Other	6

(Multiple responses recorded)

1_8 How would you best describe your employment situation 6 months after graduation?

Response	Number	%
Working in an ARE related position	78	87.6
Working in a position related to engineering	3	3.4
Working in a position unrelated to engineering by choice	2	2.3
Working in a position due to lack of opportunity	1	1.1
Traveling	0	0
Other	5	5.6
Total	89	100

1_9a Do you or have you had a mentor for your career?

Response	Number	%
Yes	58	65.2
No	31	34.8
Total	89	100

1_9b If yes, was this person female?

Response	Number	%
Yes	19	32.8
No	38	65.5
Both	1	1.7
Total	58	100

1_9c How has this person influenced your career?

Response	Number
Teaching	15
Support/Encouragement	11
Promotion/Opportunity	10
Example	8
Advice	5
Answer Questions	4

1_10a Do you currently have paid employment?

Response	Number	%
Yes	74	83.1
No	15	16.9
Total	89	100

1_10b If not is this a result of..?

Response	Number	%
Personal Choice	14	93.3
Economic Downturn	1	6.7
Other	0	0
Total	15	100

1_11 Are you currently employed as an engineer or in an engineering related position?

Response	Number	%
Yes	59	66.3
No	30	33.7
Total	89	100

2_1 Which of the following best describes your current position?

Response	Number	%
Working in a full time engineering capacity	52	88.1
Working in a part-time engineering capacity	3	5.1
Working intermittently in an engineering capacity (as needed consulting basis - no set schedule)	2	3.4
Other	2	3.4
Total	59	100

2_2 Is this position related to the building design or construction industry?

Response	Number	%
Yes	57	98.3
No	1	1.7
No Response	1	-
Total	59	100

2_3 How many engineers are employed with your firm, including part time?

# of Employees	Number	%
< 25	28	47.4
26 - 50	9	15.3
51 - 100	5	8.5
> 100	17	28.8
Total	59	100

Mean: 126 Employees, Median: 28.5 Employees

2_4 How many women engineers are employed with your firm?

Percentage	Number
<5%	3
5.1 - 10%	16
10.1-15%	10
15.1-20%	9
20.1-25%	8
>25%	9

Mean: 17.4%, Median: 14%
(Does not include (4) independent contractors)

2_5 Are any of the highest management or ownership positions held by women?

Response	Number	%
Yes	22	40.7
No	32	59.3
No Response	1	-
Total	55	100

(Does not include (4) independent contractors)

2_6 What position do you hold within your company?

Response	Number
Assistant Mechanical Dept Manager	1
CEO	2
Associate	8
Instructor	2
Design Engineer	17
Electrical Engineer	5
Engineer in Training	3
Mechanical Engineer	2
Owner/Principal	5
Pre-construction Engineer	1
Project Manager	9
Process Utility Engineer	1
Project Designer	1
Structural Engineer	2
Total	59

2_7 Describe your position and responsibilities.

Response
All, project management, daily business, marketing, design, quality control
Code specialist, training, design, problem solving
Design engineer, project management
Design
Design and business development
Design and inspect falsework and shoring for bridges and preparation of bridge plans
Design and Spec clean utility systems
Design and supervision of other engineers and designers
design of electrical systems, minor project management
Design, project management, coordination
Design, project management, all
Design, specify, coordinate
Electrical engineer and project manager
Electrical system designer
Electrical system designer

Electrical system designer and some project management
Engineer on design build and design assist on MEP systems
Engineering design
Engineering design
Engineering design
Engineering design and project management
Engineering design, project management, marketing, office and staff management
Everything
Everything
field investigate, design and draw construction documents
Instruct students
Lead mechanical engineer, coordination with other disciplines
Lighting design, management, and lighting education
Manage construction projects for client
Manage design teams, schedules, client relations
Manage projects and associated personnel
Manage projects, lead electrical engineer
Marketing
Marketing, project scheduling of staff, project quality, general mentorin gof staff, and project management
No Response
Oversee design
Owner representative, project management
Owner representative, project management
Owner representative, project management, develop standards
owners representative
Perform due diligence, forensic analysis, review others work
Project manager, mentor, designer
Project engineering, project management, document production and quality control of project staffs work
Project management
Project management and design
Project management, business development, write proposals and reports, project design
Project management, client relations, drawing review, training and mentoring
project management, design coordination between disciplines
Project management, electrical system design, train younger engineers
project management, marketing, supervision of employees
Project manager
Project manager, design, detailing
Project manager, maintain client relationships
Project manager, marketing, design
Project manager, mentor, staffing assignments, developing proposals, billing review
Review of projects, client relations, employee management
Run branch office - marketing, design, everything
Run structural department, employee management, marketing, project management
Teaching, research, and service

2_8 In which salary group is your current gross (before taxes) salary?

Salary	Number	%
Less than $45,000	5	8.6
$46,000 - $60,000	12	20.7
$61,000 - $75,000	24	41.4
$76,000 - $90,000	5	8.6
$91,000 - $105,000	7	12.1
$105,000 +	5	8.6
No Response	1	-
Total	59	100

Mean: $71K, Median: $61-75K
(Includes full and part time employment)

2_9a How many hours, on average, are you paid each week?

Hours	Number	%
< 40	8	13.6
40	48	81.3
45	2	3.4
50	1	1.7
Total	59	100

2_9b Do you work overtime?

Response	Number	%
Yes	47	79.7
No	12	20.3
Total	59	100

2_10 How many hours on average do you work each week?

Hours per week	Number	%
40	10	19.6
41-45	24	47.0
46-50	11	21.6
>50	6	11.8
Total	51	100

Mean: 46.9 Hours, Median: 45 Hours
(Excludes participants working less than 40 hours)

2_11 How many nights have you had to spend away from home for business in the past twelve months?

Nights	Number	%
0	22	3.7
< 5	12	20.3
5 - 10	11	18.6
11 - 25	10	16.9
>25	3	5.1
No Response	1	-
Total	59	100

Mean: 8 Nights, Median: <5 Nights

2_12 Is the time schedule imposed by your occupation reasonable to accomplish the job responsibilities?

Response	Number	%
Yes	47	81.0
No	11	19.0
No Response	1	-
Total	59	100

2_13 Name two parts of your job that you find most satisfying and rewarding.

Response	Number
Seeing Job Complete	26
Relationship Management	19
Solving Problems	11
Design	9
Satisfying Clients	9
Challenge/Learning	7
Variety	6
Training New Engineers	5
Field Work	2
Other	20

(Multiple responses recorded)

2_14 Name two parts of your job that you find least satisfying or rewarding.

Response	Number
Dealing with Difficult People (internal)	19
Dealing with Difficult People (external)	13
Hours/Travel	11
Design/Technical Component	11
Schedules	6
Budget/Fees	6
Lack of Variety	5
Others with Lower Standards	5
Stress	3
Other	28

(Multiple responses recorded)

2_15 Identify three major challenges encountered in your engineering career.

Response	Number
Respect/ Proving One's Self/ Voice	18
Technical Knowledge	17
Balance	16
Gender/Good Ol' Boys	11
Overtime/Time for Work	8
No Response	7
Other	53

(Multiple responses recorded)

3_16 How would you describe the engineering work culture at your current workplace?

Response	Number
Supportive	41
Comfortable	38
Family Friendly	35
Competitive	25
Uncomfortable	5
Hostile	2
Other	see below

Belittling, condescending, disjointed, flexible, open minded, high pressure, low morale, and social

(Multiple responses recorded)

3_17 How does the environment/culture of your firm affect your practice?

Response	Number
Motivation	19
Supportive	10
Cooperation/Communication	5
Performance	4
Comfort	4

3_18 Do women receive equal promotions and salary raises as their male counterparts within your firm?

Response	Number	%
Yes	35	64.2
No	5	9.4
Unsure	14	26.4
No Response	2	-
Total	55	100

(Values do not include (4) independent consultants)

3_19 Do females within your firm receive equal job assignments and responsibilities as their male counterparts?

Response	Number	%
Yes	49	90.7
No	5	9.3
Unsure	1	-
Total	55	100

(Values do not include (4) independent consultants)

3_20a Do you believe that you could reach the top of your profession?

Response	Number	%
Yes	43	79.6
No	11	20.4
Unsure	1	-
Total	55	100

(Values do not include (4) independent consultants)

3_20b In your opinion, have you reached the top of your profession?

Response	Number	%
Yes	5	9.1
No	50	90.9
Total	55	100

(Values do not include (4) independent consultants)

3_21 Do you aspire to attain a top managerial position within your company?

Response	Number	%
Yes	29	52.7
No	16	29.1
Unsure	5	9.1
Accomplished	5	9.1
Total	55	100

(Values do not include (4) independent consultants)

3_22 In the past month, how frequently did you hear positive feedback related to your job?

Range: (0-10) occurrences

Mean: 3.55 occurrences

Median: 3 occurrences

Most commonly from internal source

3_23 In the past month, how often did you hear constructive criticism related to your job?

Range: (0-30) occurrences

Mean: 2.9 occurrences

Median: 2 occurrences

Most commonly from internal source

3_24 Have you ever taken a leave from work that lasted more than three continuous weeks (reason other than vacation)?

Response	Number	%
Yes	30	51.7
No	28	48.3
No Response	1	-
Total	59	100

3_25 What was the reason for taking leave?

Response	Number
Maternity	28
Medical	3
Other	1
No Response	1

(Some participants took more than one leave)

3_26 How long were you on leave?

Response	Number	%
< 3 months	11	35.5
3 months	10	32.3
3 - 12 months	9	29.0
> 1 year	1	3.2
No Response	1	-
Total	32	100

3_27 Following your return from leave, did you return to the same position or similar position as prior to your leave?

Response	Number	%
Yes	31	100
No	0	0
No Response	1	-
Total	32	100

3_28 Is the same promotion schedule available for those that have taken leave?

Response	Number	%
Yes	39	76.5
No	1	2
Uncertain	11	21.5
No Response	8	-
Total	59	100

Questions 4_29-4_38 survey participants were asked to respond to the questions in the following manner: (1) Very Dissatisfied, (2) Dissatisfied, (3) Indifferent, (4) Satisfied, (5) Very Satisfied

4_29 How satisfied are you with your rate of pay?

Response	Number	%
1	0	0
2	7	12.1
3	11	19.0
4	32	55.2
5	8	13.7
Not Applicable	1	-
Total	59	100

4_30 How satisfied are you with the amount of responsibility you are given?

Response	Number	%
1	1	1.7
2	4	6.8
3	6	10.2
3.5	1	1.7
4	25	42.4
5	22	37.2
Total	59	100

4_31 How satisfied are you with your chance for promotion?

Response	Number	%
1	0	0
2	10	17.2
2.5	1	1.7
3	11	19.0
4	19	32.8
5	17	29.3
Not Applicable	1	-
Total	59	100

4_32 How satisfied are you with the recognition you get for your work?

Response	Number	%
1	2	3.4
2	10	17.0
3	14	23.7
4	22	37.3
5	11	18.6
Total	59	100

4_33 How satisfied are you with your colleagues?

Response	Number	%
1	0	0
2	3	5.1
3	13	22.0
3.5	1	1.7
4	26	44.1
4.5	1	1.7
5	15	25.4
Total	59	100

4_34 How satisfied are you with the opportunities to use your abilities?

Response	Number	%
1	1	1.7
2	5	8.5
3	3	5.1
4	32	54.2
5	18	30.5
Total	59	100

4_35 How satisfied are you with the amount of attention paid to the suggestions you make?

Response	Number	%
1	2	3.5
2	6	10.3
3	16	27.6
3.5	1	1.7
4	18	31.0
5	15	25.9
Not Applicable	1	-
Total	59	100

4_36 How satisfied are you with your hours of work?

Response	Number	%
1	2	3.5
2	6	10.3
3	15	25.9
4	17	29.3
5	18	31.0
Not Applicable	1	-
Total	59	100

4_37 How satisfied are you with your level of job security?

Response	Number	%
1	0	0
2	5	8.5
3	8	13.6
3.5	1	1.7
4	23	39.0
5	22	37.2

4_38 Taking everything into consideration, how satisfied are you with your job as a whole?

Response	Number	%
1	0	0
2	5	8.5
3	5	8.5
3.5	1	1.7
4	33	55.9
4.5	1	1.7
5	14	23.7
Total	59	100

5_1 Which of the following best describes your current situation?

Response	Number
Have left the engineering profession and am working in another role	13
Taking a career break and intend to return to engineering eventually	9
Taking a career break and intend to return to work in a position unrelated to engineering eventually	5
Out of the workforce and am currently looking for an engineering position	1
Out of the workforce and am currently looking for a position outside of engineering	2
Have left the workforce and do not intend to return	0

5_2 In what year did you leave your last engineering related position?

Year	Number
1997	2
1998	1
1999	0
2000	0
2001	2
2002	4
2003	2
2004	0
2005	4
2006	2
2007	5
2008	6
No Response	2
Total	30

5_3 What was your last engineering related job title?

Response	Number
Associate	1
Design Engineer	2
Engineer in Training	2
Electrical Engineer	5
Engineer	2
Intern	4
Mechanical Engineer	2
Project Designer	1
Project Manager	7
Structural Engineer	2
Not Applicable	1
No Response	1
Total	30

5_4 What factors influenced your decision to leave engineering?

Response	Number
Child	16
Environment/ Job	8
Stress	3
Contribution to Society/Reward/Satisfaction	3
Laid Off	2
Other	1

(Multiple responses recorded)

5_5 What do you miss most about your engineering career?

Response	Number
Engg/Challenge/Job	14
Nothing	6
Financial Security/Money	3
People	3
Everything	1
No Response	1
Other	2

(Multiple responses recorded)

5_6 How long have you been employed outside the field of engineering?

Response	Number	%
< 12 months	2	11.8
12 - 24 months	3	17.6
25 - 36 months	2	11.8
37 - 48 months	3	17.6
49 - 60 months	0	0
61 - 72 months	0	0
73 - 84 months	3	17.6
> 85 months	2	23.6
Total	17	100

5_7 What is your current occupation?

Occupation	Frequency	%
Accountant	1	3.3
Advertising Sales Rep	1	3.3
Architect	1	3.3
Business Analyst	1	3.3
CEO	1	3.3
Corporate Controller	1	3.3
Director/Office Manager	1	3.3
Energy Consultant	2	6.6
Event Production	1	3.3
Merchandiser	1	3.3
Physical Therapist	1	3.3
Project Engineer	1	3.3
Server/Bartender	1	3.3
Student/Teacher	1	3.3
Survey Manager	1	3.3
Volunteer Work	1	3.3
Total	17	100

5_8 Do you utilize engineering trained skills in this employment?

Response	Number
Yes	12
No	5

5_8b If yes, which ones?

Response	Number
Engineering Concepts / Construction	7
Problem Solving / Logic	5
Math	3
Not Applicable	14
No Response	4
Other: Teamwork and Technical Writing	

(Multiple responses recorded)

5_9 What do you prefer about your career outside of engineering?

Response	Number
Family/Hours/Balance	6
People Interaction	5
Helping/Contributing to Others	3
Managing/Project Completion	2

(Multiple responses recorded)

5_10 Name two parts of your job that you find most satisfying or rewarding.

Response	Number
Helping/Contributing	8
Completion of a Job	7
People Interaction	5
Balance	4
Other	10
No Response	2

5_11 Name two parts of your job that you find least satisfying or rewarding.

Response	Number
Lack of Responsibility	5
Money	3
Other	17
No response	9

(Multiple responses recorded)

Questions 6_12 – 6_22 survey takers were asked to respond to the questions in the following manner:

(1) Very Dissatisfied, (2) Dissatisfied, (3) Indifferent, (4) Satisfied, (5) Very Satisfied

6_12 How satisfied are you with your rate of pay?

Response	Number	%
1	1	6.2
2	3	18.8
3	0	0
4	10	62.5
5	2	12.5
Not Applicable	1	-
Total	17	100

6_13 How satisfied are you with the amount of responsibility you are given?

Response	Number	%
1	0	0
2	1	5.9
3	2	11.8
4	5	29.4
5	9	52.9
Total	17	100

6_14 How satisfied are you with the recognition you get for your work?

Response	Number	%
1	0	0
2	2	11.8
3	5	29.4
4	1	5.9
5	9	52.9
Total	17	100

6_15 How satisfied are you with your colleagues?

Response	Number	%
1	0	0
2	1	5.9
3	1	5.9
4	4	23.5
5	11	64.7
Total	17	100

6_16 How satisfied are you with the opportunities presented to use your abilities?

Response	Number	%
1	1	5.9
2	1	5.9
3	1	5.9
4	2	11.8
5	12	70.5
Total	17	100

6_17 How satisfied are you with the amount of attention paid to the suggestions you make?

Response	Number	%
1	0	0.0
2	1	5.9
3	2	11.8
4	5	29.4
5	9	52.9
Total	17	100.0

6_18 How satisfied are you with your hours of work?

Response	Number	%
1	0	0
2	1	6.3
3	1	6.3
4	6	37.5
5	8	50.0
Not Applicable	1	-
Total	17	100

6_19 How satisfied are you with your level of job security?

Response	Number	%
1	0	0
2	2	12.5
3	2	12.5
4	6	37.5
5	6	37.5
Not Applicable	1	-
Total	17	100

6_20 Taking everything into consideration, how satisfied are you with your job as a whole?

Response	Number	%
1	0	0
2	1	6.3
3	1	6.3
4	5	31.2
5	9	56.2
Not Applicable	1	-
Total	17	100

6_21 If not employed, to what extent do you regret not having a full time professional career?

Response	Number	%
Great Deal	1	7.7
Somewhat	2	15.4
Occasionally	6	46.2
Not at All	4	30.7
Total	13	100

6_22 If not employed, what is the likelihood you will return to engineering as a career?

Response	Number	%
Very Likely	3	23
Likely	5	38.5
Unlikely	5	38.5
Very Unlikely	0	0
Total	13	100

Questions 7_1 -7_ 3 are answered about most recent engineering employer.

7_1 Does/ did your employer offer any of the following either formally or informally? (multiple responses allowed)

Choices	Number
Flexible work hours	69
Job Sharing	4
Part-time work	47
Work from home	36
Leave without pay	60
Family leave	37
Paid maternity leave	33
Paid paternity leave	13
Paid or on-site daycare	1

7_2 Have you taken advantage of any of the benefits listed above?

Response	Number	%
Yes	69	83.1
No	14	16.9
No Response	6	-
Total	89	100

7_3 If given the same opportunities and possibilities for advancement would you prefer to work part time?

Response	Number	%
Yes	53	62.4
No	29	34.1
Currently Part-time	3	3.5
No Response	4	-
Total	89	100

7_4 Have you experienced discrimination while working as an engineer?

Response	Number	%
Yes	44	51.2
No	42	48.8
Not Applicable	2	-
No Response	1	-
Total	89	100

7_5 What information/literature have/did you receive from your employer related to harassment?

Response	Number	%
Handbook	33	39.2
Training	20	23.8
Unknown	3	3.5
None	25	30.0
Other	3	3.5
No Applicable	3	-
Not Response	2	-
Total	89	100

7_6 Have you ever been sexually harassed while working as an engineer?

Response	Number	%
Yes	22	25.3
No	65	74.7
Not Applicable	1	-
No Response	1	-
Total	89	100

7_7a Are/were there procedures established within your firm to handle harassment and discrimination issues?

Response	Number	%
Yes	55	65.5
No	22	26.2
Uncertain	7	8.3
No Response	5	-
Total	89	100

7_7b Do you view these established procedures as fair and just?

Response	Number	%
Yes	55	76.4
No	9	12.5
Uncertain	8	11.1
Nor Applicable	12	-
No Response	5	-
Total	89	100

8_1 What is your current marital status?

Response	Number	%
Married/Partner	69	77.5
Single	17	19.1
Divorced	3	3.4
Widowed	0	0
Total	89	100

8_2 Is your spouse or partner also employed?

Response	Number	%
Yes	69	100
No	0	0
Total	69	100

8_3 What is your spouse/partner's occupation?

Response	Number	%
Engineering	30	43.5
Business	11	15.9
Construction	6	8.7
Architecture	5	7.3
Computer	4	5.8
Technology	3	4.3
Other	10	14.5
Total	69	100

8_4 If in a dual career partnership, which person's career interest takes priority?

Response	Number	%
Yours	6	9.5
Theirs	12	19.0
Approximately Equal	45	71.5
Not Applicable	6	-
Total	69	100

8_5 Who is the principle income earner in your household?

Response	Number	%
You	19	27.5
Spouse/Partner	32	46.4
Approximately Equal	18	26.1
Not Applicable	0	-
Total	69	100

8_6 Is your income or benefits mainstay for your household?

Response	Number	%
Yes	27	40.3
No	40	59.7
No Response	2	-
Total	69	100

8_7 What is the division of domestic duties/ household responsibilities you are responsible for compared to your spouse or partner?

Response	Number	%
0-20%	1	1.5
21-40%	2	2.9
41-60%	36	52.2
61-80%	21	30.4
81-100%	9	13.0
Total	69	100

8_8 Do you have children?

Response	Number	%
Yes	52	75.4
No	17	24.6
Total	69	100

8_9 Childcare is the primary responsibility of

Response	Number	%
Self	20	40.0
Spouse	3	6.0
Split with Spouse	12	24.0
Outside Assistance	15	30.0
No Response	2	-
Total	52	100

8_10 What portion of childcare are you responsible for compared to your spouse or partner?

Response	Number	%
0-20%	2	4.2
21-40%	2	4.2
41-60%	12	25.0
61-80%	17	35.4
81-100%	15	31.2
No Response	4	-
Total	52	100

8_11 Has your career progress been affected by family responsibilities?

Response	Number	%
Yes	34	68.0
No	15	30.0
Undecided	1	2.0
No Response	2	-
Total	52	100

8_12 Can the balance between work and family be better accommodated by careers other than engineering?

Response	Number	%
Yes	58	69.0
No	19	22.6
Undecided	7	8.3
No Response	5	-
Total	84	100.0

8_12b If yes, what is the difference?

Response	Number
Time Demands/Schedule/Flexibility	42
Stress	12
Alternate Work Arrangement	9
Understanding Females	3
Undecided	3
Other	4
No Response	13

(Multiple responses recorded)

8_13 Do you believe that society considers being a stay at home mother and being a professional equally respectable?

Response	Number	%
Yes	22	25
No	63	71.6
Undecided	3	3.4
No Response	1	-
Total	89	100

Questions 9_14-9_17 survey takers were asked to respond to the questions in the following manner.

(1) Strongly Disagree, (2) Disagree, (3) Neither Agree nor Disagree, (4) Agree, (5) Strongly Agree

9_14 A woman who leaves the workforce for a few years to raise children will never rise to the top of their profession.

Response	Number	%
1	17	19.1
2	25	28.1
3	24	27.0
4	19	21.3
4.5	1	1.1
5	3	3.4
Total	89	100

9_15 Women often have to make big sacrifices in terms of relationships or having children in order to rise to the top of their careers.

Response	Number	%
1	3	3.4
2	9	10.1
3	11	12.4
4	44	49.4
5	22	24.7
Total	89	100

9_16 Men often have to make big sacrifices in terms of relationships or having children in order to rise to the top of their careers.

Response	Number	%
1	17	19.1
2	31	34.8
3	17	19.1
4	20	22.5
5	4	4.5
Total	89	100

9_17 Society values women for being good mothers more than being successful in their careers.

Response	Number	%
1	5	5.7
2	26	29.5
3	32	36.4
4	22	25.0
5	3	3.4
No Response	1	-
Total	89	100

9_1 How likely is it that you will be leaving your current job in the next 12 months?

Response	Number	%
Very Unlikely	51	58.6
Unlikely	17	19.5
Undecided	3	3.5
Likely	12	13.8
Very Likely	4	4.5
No Response	2	-
Total	89	100

9_2 What is the main reason why you intend to leave?

Response	Number
Negative Work Environment	3
Better Pay	3
Lack of Advancement Potential	3
Children	2
Other: Job Happiness, Better Benefits	

9_3a Do you anticipate searching for another job in the future?

Response	Number	%
Yes	14	87.6
No	1	6.2
Uncertain	1	6.2
Total	16	100

9_3b If yes, will it be in engineering?

Response	Number	%
Yes	8	57.2
No	3	21.4
Uncertain	3	21.4
No Response	2	-
Total	16	100

9_4 What advantages exist for females in the male dominated field of engineering?

Response	Number
Recognition	17
Job Opportunity	14
None	12
Relationship/Communication	10
Gender Interaction	4
Another Perspective	3
Multi- Tasking	3
Uncertain	2
No Response	16
Other	10

(Multiple responses recorded)

9_5 What obstacles/issues exist for female engineers that are different from male engineers?

Response	Number
Respect/Proving One's Self	40
Balancing Work/ Family	24
Not in Boy's Club	8
None	2
No Response	12
Other	10

(Multiple responses recorded)

9_6 Given the experience you have now, would you have pursued the same college degree career path if you could do it over again?

Response	Number	%
Yes	43	48.3
No	19	21.3
Uncertain	27	30.4
Total	89	100

9_7 What would you have done differently?

Response	Number
Family Friendly and Flexible	7
Lower Stress	7
Teaching	4
Better Benefits	2
Undecided	15
Other	13
No Response	7

(Multiple responses recorded)

9_8 What advice would you give young females considering a career in architectural engineering?

Response
Advance your skills well. Make yourself well rounded and it will pay you back eventually.
Always be willing to learn and expand your skills.
Are you genuinely interested in construction and the applied engineering concepts?
Balance life and career. Be prepared for the hours required to succeed.
Be comfortable in all male settings, climb ladders, be comfortable in what you do and do not know and that is okay - guys do not know everything either!
Be persistent, remain steadfast, give back.
Be prepared to work hard but it is a fun career.
Be strong on the things you want out of life and make them happen. Get your PE before you have kids and a husband.
Be tough - do not give up.
Connect with women. Do internships. Be aware of cultural differences between various career paths.
Develop thick skin early.
Develop thick skin. You will hear/see many things in your career that may be upsetting but you will have to roll with it. As much as we hope for equality and as much as our employers strive to create it in the workplace they do not have control over clients, contactors, etc.
Diversify your experiences in life and work somewhere those differences are valued and put to work. If that is not where you are go somewhere else.
Do it because you love engineering, not to prove you can make it in a male dominated industry.
Do not be afraid to ask. After my son was born I tried to go back full time but it was too much for me - I felt like I was missing out on seeing him grow. With my husband's encouragement I asked about working part time and the boss said they had never done it before but they were willing to give it a try - best thing I ever did.

Do not be afraid to put family first - it is better than both family and career suffering.
Do not be intimidated by co-workers putting in long hours, stay on task at work and go home and enjoy life.
Do not get defensive in the face of discrimination.
Do not let anyone talk you out of an engineering degree if that is what you want. Learn to communicate well with males - you will be doing a lot of that.
Do not sweat the small stuff!
Do something you are passionate about, something you love. If that is ARE, wonderful. If it is not, do not be afraid to follow your instincts and go with your heart.
Do what you love and create your own path that fits your desires.
Do you love it enough to make it your life's 1st priority? If not, don't do it.
Don't be discouraged or intimidated.
Don't be intimidated, be confident but respectful, do not be easily offended or scared.
Don't go in hoping something better will come along…
Find a career you enjoy and do not let a job come before family and friends.
Find a mentor. Get and internship. Be prepared to be tough and want to be an engineer.
Follow what you enjoy. You have to really enjoy this work if you plan to stick with it for 30+ yrs. I know many that have dropped out - usually to teach.
Get a job in construction - hand on. Learn to write well. Educate yourself on the details (literally - the detail sheets).
Get an internship in the field to make sure it is what you want, be confident, be flexible.
Get an internship(s). Realize that school is very different than work. Stick to your guns and do not let anyone bring you down.
Get as much field experience as possible before graduating.
Get involved in professional organizations, take the PE early.
Get your PE so you are able to work as a consultant to better accommodate family.
Go for it!
Go in with the right mind set. If you think you will be a victim you will make yourself one.
Go that route if you really want to do the work and can be okay with not being at the top with a strong family at the same time.
Go to KSU. Work hard. Keep your notebooks. Find your passion in your job. Be confident. If it does not get done the sun will still rise tomorrow.
Grow thick skin, try not to take things personally, take in all the information you can and learn as much as possible. Fins someone to be your mentor and provide support.
Have to give 110% of one's time.
If a mentor is not assigned to you find one both in college and once you are in the working world. Think about if you want a family and how to structure your career around that. If you do not enjoy what you are doing - find something that fulfills you
If you want to be successful in the business world think broader than engineering. Take courses in finance, real-estate, and management. All of these things are valuable once you get up from the design desk.
It is a demanding and challenging position/career. At times it can be rewarding but make sure you're ready for it mentally.
It is a good career that you have the ability to go a lot of different directions with.
It is a great job and I really have enjoyed it. It is rewarding and fun. I would definitely encourage females to go this direction although they need to understand the job requirements and time commitment.
It is hard to ignore a good work ethic, positive attitude, and willingness to work on anything and everything.

It is hard work but challenging and rewarding.
It might not be worth the work if you want to stay home with kids. Most of the time people do not realize that they are being sexist. Just speak up and be confident.
It's a great career but do not forget family.
Job shadow and/or intern to make sure it is right for you. Try and find a place to work with other females preferably close to your age.
Keep going! Have confidence in who you are and the gifts/abilities you have.
Keep your eyes open for possibilities; there are a wide range of opportunities with this degree.
Learn how to handle conflicts while keeping emotions in check.
Lots of internships early.
Make sure you do not compromise yourself and realize that you still have to be better than the guys.
Make sure you really understand the responsibilities you will have as you climb the ladder. Even though it might not seem like it as a project designer there is a lot of stress being a project manager and even more as an owner. Money is not always worth the stress. Be prepared to travel!
May have gotten a degree in education.
Our profession is challenging and rewarding, but know that it is not an 8-5 job - those rewards come with a great deal of hard work.
Picked a more family friendly field.
Pursue your passion not your pride's satisfaction, there are sexist jerks out there do not take it personally - just find a different situation/job.
Research the end result to make sure that is where you want to be.
Shadow an ARE early on and take advantage of internship opportunities to get a good sense of what ARE do. Learn how to work well in groups to develop solutions.
Stand up for yourself and do not have too thin of skin.
Stay flexible. Try new things. Take advice and comments without being so sensitive.
Stick to your guns if this is what you want to do. It is a very rewarding career and those around you see that you are knowledgeable and good at your job they will welcome you.
Study; pay attention in class; work several different internships.
Succeed at your job is the best way to overcome discrimination - prove them wrong.
Take advantage of learning from those who have experience.
Talk to people who have results in their life you want and learn how to do what they did to get that life style.
This degree has many limitation therefore they need to be sure they understand the degree.
This is by far the best discipline of engineering.
Try to attain all/most of your professional goals before having children.
Try it! There are several options.
Understand your strengths and play them up. Find a mentor to promote you or suggest you for certain advancements or opportunities. Work hard.
Work hard but learn to balance work and life so work does not become your life.
Work hard, be yourself, stick up for yourself, and do not go in with a stick on your shoulder (thinking you will get unfair treatment before you do).
Work harder than those around you and don't give anyone an excuse to put you down.
Yes, you can have it all - family and a rewarding career. It's all about finding balance that works for you (and your family and your employer). That balance changes too and you can re-adjust.
You can have a good career and family - it takes hard work, lots of time and little sleep.
No Response
No Response