TRACING CAREER TRAJECTORIES OF IIT WOMEN ALUMNI

Implemented by

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Preface

The Government of India under the aegis of various Departments has over the years aimed to design various initiatives for empowerment of women and enhancing their representation in the field of science and technology (eg. KIRAN & Women Scientist Schemes). An Inter-Academy panel on 'Women in Science' in India shows that while universal enrolment of women in science education has increased from 1950-2001, the enrolment in engineering has been lower compared to science. Thus, there is a need to examine the challenges experienced by women engineers, sources of support and their coping strategies to identify ways of increasing participation of women in engineering. Examining the experiences and barriers faced by women engineers trained at premier technological institutions would give inputs for corrective strategies to increase the representation of women engineers in national development. Also previous researches that have looked at these issues faced by women engineers have identified large scale underemployment and unemployment among women as well as unsatisfactory work opportunities along with family demands. These studies provided recommendations for organizations and policy makers to implement family friendly policies as an important tool for increasing diversity in organizations. However, whether such initiatives and policies become a source of support facilitating growth or challenges remains to be examined to better inform policy making.

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List of Abbreviations

1. TA: Thematic analysis
2. FGD: Focus group discussion
3. STEM: Science Technology Engineering Mathematics
4. Sem: Semester
5. SLSS: Subjective Life Satisfaction Scale
6. MEMS: Micro-Electro-Mechanical Systems
7. CS: Computer Sciences

Executive Summary

The under-representation of women engineering in India is a cause for concern for varied reasons. Firstly, it implies half the population is denied opportunities to contribute towards the development of the nation. Hence, the abilities and talents of half the population are neglected. Secondly, this is a cause for concern for organizations as well, as the competitive success for an organization in today's competitive global marketplace is dependent on diversity in its human resources. Diversity helps enhance creativity, develop products considering needs of different consumers and improves decision making. Also, organizations invest huge amounts on employees by way of recruitment, training and benefits and if women engineers cannot be retained long enough then returns on that investment can be lower and possibly in the negative as well (Maskell-Pretz & Hopkins, 1997). By projecting a more pluralistic image, businesses can increase their pool of potential customers (Powell, Bagilhole & Dainty, 2009). Furthermore, participation of women in engineering is also important for improving the quality of life of women and essential for national development (Parikh, Bindu and Sukhatme, 2003).

The objectives of this study are:

1. To examine the challenges faced by Indian women engineers in pursuing their careers.
2. To explore the sources of support and different coping strategies used by women engineers that were useful in navigating their journeys.
3. To examine factors influencing the satisfaction and well-being of women engineers.

We conducted two qualitative studies and one quantitative study to explore experiences of women engineers and present female engineering students. Participants who had completed engineering had graduated from 1990-2014 from various engineering colleges in India. By doing this we attempt to cover a cross-section of women engineers and see patterns in their experiences. Furthermore, for this project I used a mixed methods approach to overcome limitations of a single method to throw light on support and challenges faced by women engineers and their impact on women's self-efficacy, job satisfaction and well-being.

The thematic analysis of Study 1 shows the presence of stereotypical beliefs about engineering in society as a male-dominated profession. This results in discouragement being given to female students from choosing engineering from different quarters. Also, their journey as engineering students is marred by exclusion and isolation which limits their learning and preparation for life after completing their education. At the same time diversity promoting initiatives like supernumerary seats creates challenges of reverse discrimination as in a highly competitive environment they are perceived as taking a scarce resource despite being undeserving. Negative treatment from various quarters results in self-doubt and lowers feelings of competence amongst female students. Parents, teachers and friends are seen as sources of support by female students.

The thematic analysis of Study 2 revealed that gender discrimination and biased treatment exists in organizations today towards women engineers. Women are treated to different forms of microaggressions, micro inequalities and denied voice in organizations. All these aspects create a chilling and negative work environment for women engineers. Further, while organizations do provide various forms of accommodations to women to assist in their work-life balance specially for young mothers, these are used only by women and that results in derailing their career growth along with the perception that women are not fully committed to work. These experiences tell us that work family narrative is not the only reason for women's

slow career growth in organization, in fact may not be a reason at all. Secondly, engineering is a profession where different biases exist towards women not because of their lacking technical abilities but because of their communal traits, which are not aligned with agentic traits like competition and assertiveness, goal attainment needed to succeed in engineering. Further, the diversity initiatives result in token service and reverse discrimination towards women. The work family conflicts emerging from traditional division of labour in homes are also an important challenge. An important strategy by which women cope with these challenges is by re-strategizing career growth to balance home and work. Also organizational policies and practices that allow for work-family balance are useful too and in the Indian context help from part-time full-time house helps, grandparents help in taking care of children are useful. Some important coping strategies used by women are learning and upskilling oneself, prioritizing and accepting trade-offs between family and work demands. Finally, they learn to accept these challenges and find ways to work around them and continue their journey.

The multiple regression analyses (in Study 3) was conducted to examine the effects of gender discrimination, family support and perceived supervisory support on self-efficacy, job satisfaction, work engagement and subjective life satisfaction. The results show that perceived supervisory support influences self-efficacy in women engineers, while gender discrimination and family support relate with job satisfaction and subjective life satisfaction. Work engagement is related to family support only.

Another important finding on examining the level of growth women have had in their careers we found in study 2 and 3 the maximum number of participants were middle level managers in organizations. Some comments of our participants had also shared that their growth was slower than their male colleagues.

Recommendations

Bridging the gender gap in engineering will not happen overnight however, based on the above findings I would like to bring out certain recommendations for policy makers and organizations so that engineering is a profession identified with gender equality.

1. In organizations and educational institutions, it is important to increase awareness (through programmes and workshops) about different stereotypical beliefs that influence one's decision making and behaviour and ways one can use to avoid these stereotypes.
2. Organizations and educational institutions should clearly articulate what behaviours are treated as negative aggressive behaviours and zero tolerance towards them.
3. Designing teaching content to make boys more gender sensitive.
4. To make diversity programmes more effective it is important to communicate criteria for using them, reasons for using them and how these do not imply compromise on abilities.
5. Encourage both men and women to use family friendly policies and avoid punishing those who use them.
6. Training women to speak up more, highlight their achievements and reskill them if needed to keep them relevant in the job markets.
7. Train managers/supervisors to learn to deal with different employees in different ways appropriate for each to encourage and support them.
8. Create opportunities for women to grow to leadership positions.

Chapter 1

Introduction

Traditionally the world over engineering has been perceived as a masculine profession and literature emphasizes attitudinal barriers that operate which prevent women gaining entry into and succeeding within engineering or the presence of a leaky pipeline which describes attrition of women at different points of their careers (Fernando et al, 2018; Herman et al., 2013). For a country like India it is important to examine causes of this under-representation as it is a loss for a developing nation like India if half its qualified population is unable to contribute towards development and economic activity. Research examining factors as to why women engineers don't progress in engineering organizations would help policy makers identify points for intervention and would help plug the substantial loss of talent from the workforce. Most previous research in India on women engineers has (Parikh & Sukhatme, 2004; Goel, 2007) found women engineers face career problems like poor growth, lack of opportunities, highly competitive environment and fewer jobs and reluctant employers. These barriers point to the presence of various challenges for women engineers in the field of engineering, many of which have deeper socio-cultural bases. Therefore, there is a need to comprehensively examine challenges faced by Indian women engineers. Also past studies (Parikh and Sukhatme, 2004) have shared various recommendations for organizations to encourage women engineers. Many of these have been implemented by organizations as well, however, equal representation of women has still not been achieved. Thus, another important need for researchers is to examine sources of support of women engineers in their career progression. Many researchers in the western context have examined challenges and determinants of success and well-being of women in STEM professions. Settles (2014) have identified discrimination and negative work environment has various negative consequences on various psychological and workplace

outcomes of women. Further, Richardson (2020) argues cultural patterns around women's achievement in STEM professions are complex and diverse across the globe. Hence, it is important for researchers to examine issues in diverse cultural settings to get insights about unique concerns in those cultures. Thus as part of this research we aim to examine varied experiences of Indian women engineers. The first objective of this study is to examine the challenges faced by Indian women engineers in pursuing their careers. Secondly, this study examines the sources of support and coping strategies of women engineers that were useful in navigating their journeys. Our third objective was to examine factors influencing the satisfaction and psychological well-being of women engineers.

We conducted two qualitative studies and one quantitative study to explore experiences of women engineers and present female engineering students. Our participants were women engineers who had graduated from 1990-2014 from various engineering colleges in India. By doing this we attempt to cover a cross-section of women engineers and see patterns in their experiences. Furthermore, for this project I propose to conduct mixed methods research to throw more light on support and challenges faced by women engineers and their impact on women's self-efficacy, job satisfaction and well-being.

1.1 Limitations of the study

Some of the limitations of this study are

1. Our findings are based on the perception of women only, while this is important to understand their viewpoint, understanding the perception of male engineers towards their female colleagues would shed more light on the climate in organizations.
2. We did not have direct contact to reach out to probable participants, we used snowball sampling for all the three studies to ensure wider participation. This can be a limitation as only a certain kind of participants may have responded to the study.

3. For study 3 our sample size was small (only 83 participants) after eight months of repeated requests. A larger sample would allow us to use more robust statistical techniques like factor analysis and Structural equation modelling.
4. At the start of the study my attempt had been to focus on collecting data from graduates of different older IITs. However, since direct communication with the participants was not possible, approaching them through different alumni offices resulted in fewer responses. Also some institutions did not agree to participate in this study and share information with us. Hence, to get a wider representation from different branches of engineering I have had to resort to using snowball sampling and purposive convenience sampling.

Chapter 2

Literature Review

Introduction: This chapter briefly covers the review of literature on the barriers to growth of women engineers in their careers. This chapter also covers different challenges in diverse cultural backgrounds to highlight the socio-cultural factors that create barriers for women are complex and any attempt to provide solutions needs a culture specific approach.

Recent reports on the participation of women in engineering, science and technology in India show a drop in the number of undergraduate women enrolled in the fields of engineering and IT and computer science from 2011 to 2016. Following the trends (Research and Development Statistics Report, 2016-17) we see that from 2001-02 there was a slow but steady growth in the percentage of women enrolled in engineering till 2008-09. This was replaced by a rapid jump in 2010-11 when it reached double digits at 11.4%. But post 2012-13 we find a decline in the percentage of women enrolled in engineering. This drop can be further seen in the percentage, both in the undergraduate and postgraduate, of enrolment of women in engineering. An Inter-Academy panel on 'Women in Science' in India shows that the university-wise enrolment of women in science education has increased from 1950-2001, but the enrolment in engineering has been lower compared to science. While women are 30% of undergraduate students in engineering, the fraction is much lower for the prestigious technical institutes like the IITs. Similar differences can be seen in medical with fewer women in AIIMS despite 45% of total medical students being women. The reason cited by the report is because on average parents do not spend this for a girl child on special coaching and preparation for the difficult competitive entrances to these institutes. The report also highlights variations across states in the proportion of women in higher education due to social and developmental norms and a need for programs to encourage women in these states. Interestingly on examining the fellowship summary for the three national sciences academies for 2015 in engineering and

technology the ratio of men versus women ratio is highly skewed, for the Fellowship of Indian Academy of Sciences it is 145:1, for the Fellowship of Indian National Science Academy it is 108:0, for the Fellowship of the National Academy of Sciences it is 159:3. Further, even in awards and recognitions women engineers are poorly represented. There are only 2 women Shanti Swarup Bhatnagar Awardees in engineering sciences from 1958-2014 versus 66 men. As the fraction of women among practising scientists is small, women are scarce in the top positions in institutions with some outstanding women scientists making important contributions. These findings show that while India has made tremendous strides in education and research in science and technology, women are still underrepresented in the field of engineering and face significant challenges to reach higher levels. There exists a skewed distribution in human resources in the field of engineering favouring men with limited participation of women.

This under-representation of women in India is a cause for concern for a developing nation for varied reasons. Firstly, it implies that half the population does not have adequate opportunities to contribute towards the development of the nation. Hence, the full range of skills and talents of women are neglected. Secondly, this is a cause for concern for organizations as well, as the competitive success for an organization in today's competitive global marketplace is dependent on maximising the potential of all its human resources, especially women engineers. Organizations invest huge amounts on employees by way of recruitment, training and benefits and if women engineers cannot be retained long enough then returns on that investment can be lower and possibly in the negative as well (Maskell-Pretz & Hopkins, 1997). Thirdly, the products and services developed would be shaped only by the male perspective though the end users may be both men and women. This may make the design of these products and services inadequate and unsuitable. By projecting a more pluralistic image, businesses can increase their pool of potential customers (Powell, Bagilhole & Dainty, 2009). Participation of women in

engineering is also important for improving the quality of life of women (Parikh, Bindu and Sukhatme, 2003).

Under-representation in the fields of science and engineering has been a concern the world over, with researchers identifying different challenges responsible for holding women back. The challenges range from lowered self-efficacy of women towards engineering, gendering of professional identities, outright discrimination and paucity in advancement opportunities and homophile in network formation which relegates women to the margins in the social network. These barriers can be understood as barriers at the entry into the career of engineering, next level would involve barriers in career advancement and continuance in the profession. The next section discusses various challenges faced by women in the field of engineering.

2.1 Barriers for women in engineering

2.1.1 Self-Efficacy beliefs

The construct of self-efficacy has been used in the area of career choice and adjustment to explain the under-representation of women in what are believed to be traditional male-dominated professions. Research suggests that women limited their career choices and occupational goals due to the lack of strong self-efficacy beliefs in relation to career-related behaviors. Though social barriers may impose external barriers on women's career development, these societal expectations can become internalized by women and translated into their career choices. Hackett and Betz (1981) point towards different background experiences associated with gender socialization that influence the development of self-efficacy beliefs. Typically, early experiences of boys are more mechanical, scientific and technical in nature than those of girls, this results in boys developing greater self- efficacy than girls towards careers that require those skills. Further, men are more likely than women to have role models to learn vicariously and develop career-related efficacy. In the absence of role

models, women have fewer chances of developing expectations regarding efficacy in non-traditional careers. Also, as part of their development process men form identities that are primarily independent and achievement oriented while for women identity formation is based on attachment and intimacy in relationships.

2.1.2 Issues of Socialization

Differential socialization can be one possible theory explaining the paucity of women in engineering. Young girls are actively discouraged from going into science and engineering but choose more female dominated careers. Further, even those women who entered the field of engineering their representation in the higher ranks has not happened as yet (Haupt, 2005).

2.1.3 Work Environment barriers

Organization work environments affect women engineers by either creating hurdles with various professional barriers or removing barriers and supporting their enhancement. The professional barriers faced by women engineers are paucity of advancement opportunities, mentoring and training opportunities. Challenges to advancement opportunities are related to 'style' and 'experience'. In organizations men are expected to be aggressive and competitive and expect their peers to conform to this style. Women on the other hand tend to be uncomfortable with being aggressive and competitive as it is contradictory to the 'softer style' society expects of them. This 'softer style' limits the advancement of women in corporate scenarios. Women engineers are also discouraged from working on the plant floor by supervisors and male counterparts. This results in their missing out on valuable hands on experience, which may in turn impact their evaluations for advancement (Maskell-Pretz & Hopkins, 1997).

2.1.4 Mentoring opportunities

"Glass ceiling" refers to attitudes that perpetuate stereotypes and preconceptions about women in the workplace and women engineers face an inability to break through this ceiling and a probable cause is the absence of mentoring opportunities. Women engineers are generally out of the mentoring network as many times networks extend into social situations (Maskell-Pretz & Hopkins, 1997). Mentors can assist in issues regarding retention and provide advancement opportunities and moral support.

2.1.5 Training opportunities

While women can perform at the same level as their male counterparts', organizations need to provide training opportunities to women on skills essential for excellent performance like initiative, networking, leadership, self-management and organizational savvy. Also giving diversity training would provide both men and women recognition and reconciliation of gender differences in work behaviour (Maskell-Pretz & Hopkins, 1997).

2.1.6 Balancing family and work issues

As women are child bearers and primary care-givers challenges between work demands and family demands may create problems of balance. Research points that women engineers reach a turning point in their careers as they reach late 20s to early 30s (their child bearing age); while most engineers begin their upward mobility track at work, women may consider starting a family. This may create psychological conflicts between family desires and advancement opportunities. While this conflict may hold true for male engineers also but as child bearing demands are more on women and many organizations do not accommodate women for this. The underlying belief in societies remains that if professional women want to have children

then they must sacrifice their career. But organizations that subscribe to such beliefs would lose valuable talent.

2.1.7 Sexual discrimination and harassment

In many organizations subtle gender biases exist in recruitment, task assignment, appraisal and promotions. Further along with discrimination women engineers also face sexual harassment and these are frustrating for women, block their progress at work and negatively affect their psychological well-being (Maskell-Pretz & Hopkins, 1997). Fouad, Chang, Wan & Singh (2017) have used the theory of work adjustment to explain why women leave engineering. The TWA used the person-environment fit framework to individual values and needs, which underlie a person's satisfaction and adjustment with the environment and the decision to stay or quit. Thus a need-reinforcer mismatch can act as a potential trigger for women quitting the engineering profession. The researchers found unmet comfort needs like poor or inequitable compensation, poor working conditions and inflexible and demanding working conditions specially, for those women who had young children at home found it difficult to persist in the field of engineering. Also, unmet safety needs in the form of unfairness and sometime illegal organizational practices and policies, discrimination and harassment, non-existent systems to increase engagement, absence of mentoring resulted in feelings of isolation and made it difficult for women engineers to aspire for advancement in the company. The women also experienced that their achievement needs were unmet due to hostile macho cultures, extreme job pressures and isolation in the work environment. Also women engineers described unmet status needs which were reflected in limited recognition and opportunities for advancement. This research suggests that women left engineering as the work environments did not provide them opportunities to meet their needs and hence, they acted in ways to bring their needs and reinforcers in line with each other.

2.2 Women in male dominated environments:

People bring their beliefs about gender unknowingly to the work place and performance influenced by gender is taken for granted. Studies show that women in male dominated cultures either have to act like men to be successful or leave if they are unable to adapt to that culture or remain in the industry not behaving like men but then occupying only unimportant positions (Powell, Bagilhole & Dainty, 2009). Further women in non-traditional cultures were required to permit "*dominant culture expressions*" in their presence, such as being the source of humour and colluding with the dominant group while doing so. This attempt at fitting in is problematic as it reinforces the dominant culture rather than challenging it. The women tend to have only two choices they either face social isolation or become '*one of the boys*'. Further, both men and women undergo cultural adaptation through the process of assimilation in which the both males and females internalize their professional identity and develop solidarity with others in their profession. For women this cultural adaptation involves managing their gender and uncritically accepting the masculine culture around them.

A longitudinal study of women engineering students found that women engineering students attempted to gain acceptance in the field of engineering by being one of the boys, accepting gender discrimination, by achieving a reputation of being competent. They found it more advantageous to adopt anti-woman approach. The women engineering students felt gender resulted in conflict in the work place where women engineers are constantly challenged to manage personal and professional identities, on one hand women engineers who perform in feminine ways are considered incompetent and competent engineers are seen as unfeminine. This results in maintaining norms of masculinity in the engineering profession.

2.3 Attitudes and prejudices towards women engineers

Engineering as a profession has been found to be less tolerant of nonconformist behavior than social sciences, hence women engineers experience challenges in adapting to the teaching style and discourse patterns of the male environment of engineering departments. Women students experience pressures, being singled out, ignored and patronized. Similar stereotypes exist in organizations as well. Women are considered less capable than men, not aggressive enough, too emotional, intimated by the rough, dirty or stressful work environments. At work women are generally given routine and less challenging work than their male counter-parts. Another stereotype is that women will leave and start a family, even though no employer offers employment for life and few employees continue in their initial jobs more than two years. These stereotypes are based on gender schemas and beliefs about appropriate behaviour and preferences of men and women.

Looking at effectiveness of role modelling of women in non-traditional professions shows that while female visibility has an effect of breaking the stereotype of engineering as an exclusively male profession, it does not create an image of engineering as gender neutral. Further, greater visibility of women engineers has both advantages and disadvantages. Visibility is advantageous cause it is an important criterion for promotion and can lead to women becoming known and having a personal reputation; however, it also results in increased expectations of women with their mistakes being remembered more.

High dropout rates of women in engineering is high because of isolation, lack of support and lack of effective networking, overt and subtle discrimination and lack of official recourse and complaints not being taken seriously.

2.4 National culture and women in engineering

In a study by Hersh (2000) examining the position of women in engineering across various countries, the findings show that Bulgaria was the country with the highest percentage of women engineers, closely followed by Scandinavian and East European countries. One probable reason shared by the researcher is a change in images of women and engineering, which needs further investigation. Also, higher percentage of women in the workforce in Bulgaria may result in higher percentage of women in engineering as well.

The low numbers across the world could be due to the mismatch between images of engineers and what is appropriate for women, with engineering perceived as a male field and abnormal for women. Further the increases in the number of women in engineering in Eastern Europe may only have affected the lower levels of the profession, with very little women representation at the senior levels. Also, in Eastern European countries, dramatic changes in the political and ideological system has led to changes in images of women and engineering, making them more compatible. The change in image could be an outcome of ideological support which was motivated by the need to increase technically skilled workforce and was backed up by concrete measures. This may be reflected in representation of women in engineering in Turkey as well. In some other parts of Europe, like Scandinavia a general improvement in the position of women occurred which led to increased confidence and led to wider opportunities. Hersh (2000) has identified various areas for future research:

1) While changes in the images of women and engineering may have led to more women entering the field, has it led to their progression in the field?

2) Has the general situation of women and women's involvement in public life had any effect on women's entry in engineering?

3) Investigate whether a higher proportion of women in engineering move into other careers than their counterparts.

In Malaysia studies show that while higher career motivation translates into higher performance that leads to career success. But nearly 70% of women with science, technology and engineering degrees do not work in sectors that use those skills (Johari, Mat Mat, Othman, Mohamed, 2013). Smith and Dengiz (2009) in their study of women engineers in Turkey found higher participation of women in science and engineering than the western world. One reason that explains this is the founding premises of Turkey which values science and technology and equality for women. On exploring the reasons why women chose engineering the researchers found varied reasons- first was their abilities both mathematical and technical, second was the encouragement and influence of teachers and relatives, thirdly women sought prestige and financial support which this profession provided. While students didn't experience any biases from their teachers and male peers, they did face differences in opportunities. Most women wanted to pursue higher education and then take up academics as their careers, while those who worked in the industry or the government faced differences in job assignment with men involved in line jobs while women were given more supporting roles. The researchers explain this due to complex societal and cultural differences between men and women in Turkey. The presence of other women in the profession was seen as something important by women engineers and those who felt isolated and alienated were more likely to leave the profession.

2.5 Indian Scenario

The vision document of the Inter Academy panel emphasizes that unlike the west, in India the wider social perception does not doubt that young girls and women are incapable of learning or teaching science. Infact, women participate in a major way in teaching science and mathematics in schools and colleges. But the numbers drop significantly for women faculty in high profile institutions. A '*leaky pipeline'* is responsible for the low representation of women

is largely culturally shaped. The 'gender bias ' picked up through social conditioning socializes women to accept certain roles only and behave in certain ways. Secondly women have been primarily seen as the caregiver of children and family with greater demand to stay at home and care for their children. Thirdly the work environment largely discriminates against women at all levels and hence leads to greater marginalisation of women.

Table 1: Brief summary of literature review

Authors	Variables	Objective	Findings	Journal
P.P Parikh, P., & Sukhatme, S.	1. Women in engineering colleges and universities 2. Job status 3. Work profile 4. Barriers in their career paths	1. To track the enrolment percentage of the women in the engineering colleges and universities. 2. To track the current job profile of the women who are presently working in the field of engineering 3. What are women's views on the barrier they face in their job and in their career	The enrolment percentage of women have been rising steadily in field of Engineering. in the previous study the highest rate of women employment was in the field of civil engineering. As per the second study the highest rate of unemployment was in the field of electronics followed by electrical. In the previous study the highest rate of women employment was in the state of Kerala while in the second study the highest rate of unemployment is in the state of Andhra Pradesh followed by Karnataka. Most preferred job profile by women in the field of engineering is teaching followed by Research and Development. Some of the reasons stated by women engineers include lack of opportunities, lack of confidence, feeling of Incompetent, low financial incentives, marital status.	Women Engineers in India. *Economic and Political Weekly*, *39*(2), 193–201. 2004
Goel, S.	Percentage enrolment	What makes women come into the field of engineering what makes women leave the field of engineering	The enrolment of women students in M.Tech was highest in the years 1992-93, 1996-97, 1998-99, and 2004-2005. Some of the reasons stated by women who joined engineering field include good academic records better job opportunities, diverse options jobs and career wise. Better career post-graduation. Some of the reasons stated by to leave the field of engineering include money or insufficient funds, engineering as male dominated field, lack of equal opportunities in comparison to the male gender, lack of infrastructure and technological opportunities,	Women in Engineering in India. *The International Journal of Interdisciplinary Social Sciences: Annual Review*, *1*(6), 49–56. 2007

			rejections of employer companies or biased towards females as engineers.	
Maskell-Pretz, M., & Hopkins, W. E.	Professional aspects like lack of advancement, mentoring Psychological aspects issues related to balancing family and Work expectations and sexual harassment.	1. To study the professional and psychological aspects that create the barrier for women in the Engineering fields. 2. To find solutions to overcome these barriers.	The paper highlighted some of the most common professional and psychological work problems and offered some alternative solutions to these problems. The paper also talks about Corporate Cultural Change Strategy. Some of the professional work problems include advancement wherein women are not given equal opportunities or better work opportunities. To overcome this problem the strategy which can be used is to involve women ingroup work related activities. Another work barrier stated in the article is mentoring opportunities. Women in their work barriers usually do not get Good mentors who can guide them, who can support them, who can motivate them to work better. This can be Overcome by providing good mentors and by respecting women if they want to go ahead in their work place. Psychological barriers include family and work balance. This can be overcome by making flexible and assessing Current policies and make it more favourable and supportive for working women. Another very important psychological barrier discussed is sexual harassment. The strategy to deal this is by making Stricter laws for such behaviours which takes place in work place.	Women in engineering: Toward a barrier-free work environment. *Journal of Management in Engineering*, *13*(1), 32–37. 1997
Beraud, A.		Will combing interdisciplinary fields make engineering a better field?	The paper talks about including of interdisciplinary courses in the field of engineering. Since engineering is considered as highly male dominated field, adapting it according to the females might make engineering a better and favourable career or profession for them. The paper focused on combining socio-economic subjects in the engineering field will attract more females in the field of engineering.	A European research on women and engineering education (2001-2002). *European Journal of Engineering Education*, *28*(4), 435–451. 2003
Seat, E.		What do women themselves think about themselves as	The paper talks about how women perceive themselves as engineers in comparison to the male engineers.	Women engineers: preparing them

		engineers and how they perceive themselves in comparison to their male colleagues?	The results have shown that in comparison to their male counterparts, women do not think too highly of themselves. The paper also talks how women can be made ready for the field of engineering and they can be motivated and taught to work better.	for the workplace. *ASEE Annual Conference Proceedings. 1998*
Baum, E. (n.d.).	The paper talks about the different barrier women face in the field of engineering. Barriers such as the harassment that takes place in the workplace, the family issues that women engineers go through, the getting started are being addressed in the paper from the point of view of 8 successful engineers.	The challenges that women as an engineer's face in the field or at workplace.	The 8 women engineers who did achieve a highly successful career in the field of engineer spoke in an interview and addressed the various issues that as women they themselves as well as other women who approach them face. These women not only spoke about the challenges they faced as they were working in the field. But they also addressed some of the issues that other engineering women have come to them with. Issues such as family issues and gender issues, the getting started (when women decided that they want to pursue engineering as their profession or career).	*ose garden for women in engineering*.
Blickenstaff, J. C.	The paper studies some of the most common reasons why women remain absent in	Major reasons why women are absent from STEM career	Biology: It was believed that there is a difference in the brain sizes of males and females. The study also tried to link the size of the brain with the intelligence. However, it was later discarded. Role models: Many girls in the schools and colleges have said in the interview that most of the role models in the field of science and engineering are males and that they have seen very few females as the role models for the	men and science careers: Leaky pipeline or gender filter? *Gender and Education, 17*(4), 369–386.2005

	the STEM career. Reasons such lack of role models, biology of the men and women body, chilly climate faced by girls and women in schools, colleges and workplace, the culture pressure that women face when they try and fit themselves in the male dominated field of science and engineering are explored.		same. This can be one of the reasons as to why girls do not wish to pursue science or engineering as their career fields. Chilly climate: Most of the girls in the schools and college have reported that they have received less motivation and cold shoulder or very little motivation from their professors and their teachers. Few females have also reported that they have said to take up other courses other than science, maths, engineering and technology.	
Fouad, N. A., Chang, W. H., Wan, M., & Singh, R.	The paper talks about some of the key areas which are said to be reasons why women leave engineerin	1. Do Women engineers decide on leaving the engineering field due to conflict between their occupational needs and the reinforcers provided by work environment. 2. Do They follow the same reinforcement pattern	Some of the most highlighted aspects which were responsible for the mismatch between the achievement, safety, Altruism, stat	Women's reasons for leaving the engineering field. *Frontiers in Psychology*, *8*(JUN), 1–11. 2017

	g field or why do they hesitate to enter the field of engineering.	which includes achievement, safety and needs as described by Rounds et al? 3. Are There any reinforcers which lead to women decisions in leaving engineering which are not described by Rounds et al?		
Haupt, S. E.	The article highlights the demerits of engineering and field of science.	What can be the possible reasons for less number of women in field of engineering? Why is the field of engineering thought as very challenging and not very appealing career field?	Most of the women or girls who wish to pursue engineering or science as their career, they hit the first road block when their parents indirectly ask them to go for other female oriented careers or opt for less technical career fields. This proves to be one of the most important, the first barricade that females face in their families when they want to go for a technical field. Second be it male or female, many people don't opt for engineering because the field rather being a bright career opportunity showcases itself not very appealing and full struggles. Students those who see their professors struggling assume that the field of engineering is more of struggling and tedious field. Thus they opt for better careers. Third, fields such as engineering and science asks for more rather than giving it. A person's time, energy, sometimes the most beautiful phases of his/her life are being invested while pursuing this field. As a result family life and personal life tend to face a lot of backstab. This paper talks about the alternatives to these problems. Women should be encouraged more to take up technical fields as their career options. Engineering as profession should be shown in a better image.	Why Are There Fewer Women in Engineering? *IEEE Antennas and Propagation Magazine, 47*(2), 122–124. 2005
Sukumaran, B., Hartman, H., & Johnson, D.		To look at some of the conditions which has led to an increase in the enrolment of women engineers in Kerala.	Some of the pre conditions which have facilitated the enrolment of women include opportunities and access to education in Kerala. Women status have also facilitated an increase in enrolment of women in field of engineering in Kerala. Other than the preconditions which have facilitated the enrolment of women in engineering, the paper also talks about some of the other favourable	How to improve enrolment of women in engineering: Lessons learnt from the developing world. *ASEE Annual*

			conditions which have facilitated the enrolment of the women include higher gender ratio, primary and secondary education, female role models in terms of faculty, better confidence level of women in the maths and science field, economic and cultural factors, parental encouragement.	*Conference Proceedings*, 2004
Johari, H., Mat, N., Mat, N., Othman, S. N., &Hayati, M. A.	Career success, Personality, Career motivation	1. Is There any relationship between career success and personality. 2. Is There any relationship between career motivation and career success.	The study concluded that there is no significant relationship between personality and career success. However, there does exist a significant relationship between career motivation and career success.	*International Journal of Education and Research*, *1*(11), 1–8. 2013
Patel, R., &Parmentier, M. J. C.		Is engineering as professional is still male dominated and how that has affected the female engineers in India.	The paper talks about how engineering as profession has traditionally been male dominated. Although with changing times, new development and technology more and more women are entering in field of engineering. Although both males and females work in engineering field, women are considered suitable more for jobs such finance and software positions while the heavy lifting and other hardware works are being given to males. Many women have also stated that for interviews too men are considered as compared to them.	Persistence of Traditional Gender Roles in the Information Technology Sector: A Study of Female Engineers in India. *Information Technologies and International Development*, *2*(3), 2005
Pearson, R.	Reasons why women in engineering field drop out the field even after taking course. What makes them take the course of engineering or science?		Number of women in America have taken up engineering field yet like most countries they face barriers while pursuing their career or taking up engineering as their course. Some of the barriers reported in this article include the stereotypical image of scientist which makes the profession of scientist or engineering as boring and 'Nerd'. Most of the women have reported that the basic schooling lacks alot which is why many girls do not take up science or engineering as their field. Other reasons include financial aid, many families prefer their sons to go college and invest their funds of engineering rather than investing in their girls education. The article also talks about other various issues such as The glass ceiling effect, the hostile environment which female students face in	men in science and engineering. *Nature*, *315*(6014), 84.

	What makes them leave the course?		their colleges and working women in their offices.	
Rao, A. J., & Darshan, B. K.	The article talks about the problems Indian girls face while entering into the field of engineering. It also talks about the loss that occurs when girls do not get equal opportunity to study and show their potential. It also talks about the remedial which can help in assessing such barriers.		The reasons stated in this article are from the Indian context. In India, patriarchy still holds firm upper hand in Indian society. Many families prefer to spend the money on the girl's marriage rather than spending it on her education. As females, family, child bearing and social roles are mostly associated with them. Many job opportunities are lost as a result of this. Some of the remedial include reservations for women in colleges and jobs. Working hour's flexibility. Part time job options and others.	Problems of women engineers in India. *ASEE Annual Conference Proceedings*, *003*(iii), 3–5. 1997
Phipps, A.	Reasons why less number of women are interested in the field of engineering.	Why engineering as a field in seen as incompatible for women.	This article talks about why women prefer engineering as lesser career options in comparison to other fields. Few of the reasons listed below are engineering as a profession is quite dirty or needs to do a lot of machine work. The image of males, Engineering as profession will be male oriented if the females do not participated in it. It also provides some of the solutions which can help in making engineering a more favourable career field for women.	Engineering women: The "gendering" of professional identities. *International Journal of Engineering*

				Education, *18*(4 SPEC.), 409–414. 2002
Friedman, S. M.	Reasons why women choose engineering as field for career? Reasons due to which women feel discouraged to come in engineering field?	Why do women choose engineer as their field. Why do women are encouraged to take engineering as filed. What discourages women to not pursue this field?	One of the most important reason stated by both males and females for choosing engineering is a well pay job and a better professional opportunity to build a better career. Another reason stated was influence or presence of family member for choosing engineering field. The article also talks about reasons for discouraging women in engineering. The most cited reason was discrimination against women in the field engineering which happened to most of the prominent reason why women do not opt for engineering profession. Another reason stated was inadequate knowledge of field or job. Not getting suitable job was also one of the reason for choosing engineering as their profession. However many females reported a feeling of positive and accomplishment and also stated that they may not face such barriers and if they face it they can overcome it.	Research report: Women in engineering : Influential factors for career choice. *Science, Technology & Human Values*, *2*(3), 14–16.1977
Wentling R. M., & Camacho, C.	Factors which have been seen as barriers for women in the field of engineering.	The study test for objectives, 1.What are some of the factors that have hinder while females decide pursue engineering field? 2.What factors have known to assist the females in pursuing degree in engineering. 3.What factors have hindered while they were pursuing the engineering degree. 4.What are the factors which assisted them in completing the engineering degree?	The data was mainly collected on four factors, The high school factors, the family factors, the personal factors and the societal factors. The data received from both Survey method and from in focus group was studied with the help of these four factors. High school factors are best described as factors which takes into account the final year of the schooling period and the period where the person is about to enter the university or college. Family factors are mainly associated with the parental and other family aspects which are related to the field of engineering. Personal factors are related to the individuals, their choices. Societal factors are related to the environmental factors regarding the image of the society and the aspects related to the society.	Women engineers: Factors and obstacles related to the pursuit of a degree in engineering. *Journal of Women and Minorities in Science and Engineering*, *14*(1), 83–118. 2008

			Factors that hindered the participants while deciding to pursue the degree in engineering. **1.High school factors** such as limited career options, lack of advice from school counsellor on engineering career options, attended a high school with limited math/science/ technology course opportunities, lack of encouragement from teachers to pursue math/science/ technical field. **2.Personal factors:** lack of knowledge related to engineering careers, low self-esteem/confidence related to math/science/ technology courses, lack of interest in engineering field, lack of understanding of courses needed for getting accepted into engineering program. 3. **Societal factors:** Engineering represented as male dominated field, lack of women engineer role models/ mentors in my community, low expectations of females and traditional views about education/career for women. **4. Family factors:** lack of assistance in math/science/technology homework at home, parents did not support my decision to major in engineering, lack of financial support from parents for college tuition, parents wanted me to pursue a degree in traditional female field like nursing/ teaching. **Factors that assisted females in deciding to pursue degree in engineering** **1. High school factors:** Good record in classes of science/math/technology, classes taken in high school for science, math, technology, excellent maths/science/ technology teachers, encouragement from teachers to pursue interest in science/math/technology and participation in extracurricular activities in high school. **2. Family factors:** parental support for the personal choice of career, parents encouragement to pursue degree in engineering, male engineer role-model	

			in my family, parents provided advice and information about careers in engineering and female engineer role model in my family. 3. **Personal factors:** Liking towards problem solving, personal satisfaction, high aptitude in engineering fields, interested/fascinated by science and technical things/ engineering will give me opportunities to make a difference. 4. **Societal factors:** engineering has many different job opportunities, engineering is interesting and challenging field, High salary field, Has good job market and I was inspired by progress and accomplishments in science and technology. **Factors that hindered the study of participants while completing a degree in engineering** 1. **University factors:** ineffective professors, professors who did not motivate me, low grades in engineering classes, poor teaching quality, too much homework, excessively competitive environment, curriculum too demanding, class material too difficult, lack of female professors, lack of female classmates. 2. **Family factors:** lack of family involvement, support and encouragement, lack of financial support from the family, family too far away. 3. **Personal factors:** lack of free time, doubts about career goals, low self-esteem/confidence, lack of motivation, lack of self-discipline. **Factors that assisted the study of participants in completing a degree in engineering** 1. **University factors:** involvement in campus student organizations, teaching quality/excellent professors, good performance in engineers' classes, enjoyed engineering classes, received scholarship/fellowship,	

			supportive/encouraging/motivational professors and others. 2. **Family factors:** Supportive and encouraging family, family helped financially, family members assisted in engineering homework, family helped me get an internship. **Personal factors:** I make sure my assignments are turned in on time, I study with my classmates/friends, perseverance /determination, I am self-motivated, support from classmates/friends, I am highly disciplined, I study enough to make sure I do well in my classes, I am happy I choose major in engineering and I am rarely absent from classes.	
Tietjen, J. S., & Reynolds , B.		The paper talks about how the position of the women in the field of engineering has evolved.	The article talks about how the status of the women as changed to better in the field of engineering. It also names of some of the famous and earliest women engineering who despite of hurdles did enter the field and made their mark. The article also talks about the some of the reasons why women did not progress in the field of engineering ass these years and how the situation can be improved	Women engineers bridging the gender gap. *International Symposium on Technology and Society*, 206–210. 1991
Singh, S.		To study the growth of women entrepreneurship in women engineers in India.	This article is a review paper where in with the help of extensive case studies of women entrepreneurs the researchers have tried to show the emerging trends of entrepreneurs in Indian women. It also studies what impact globalization has had on women engineers in the entrepreneurship. It also says about few initiatives that have been taken to help the engineering women in their entrepreneurship. Some of the initiatives include **Saha Fund**: Saha Fund has a Mentors Circle that consists of industry stalwarts to help, mentor and guide the women entrepreneurs. **National Entrepreneurship Network (NEN):** It is a flagship initiative of Wadhwani Foundation since 2003. Co-founded by IIT Bombay, IIM Ahmedabad, BITS Pilani, SP Jain Institute of Management & Research and Institute of Bio-informatics and Applied Biotechnology, Bangalore. **NASSCOM INITIATIVE:**	*Globalization , ICT and Entrepreneurship : A Study of Women Engineers in India*. 2018

			It has started a, Girl in Technology Programme for women engineers under its 10,000 start ups programme for technology start-ups.	
Smith, A. E., &Dengiz, B.	Reasons why women choose engineering field in Turkey.	To study why women in Turkey chose engineering as their career field.	The Turkey engineering women cited two reasons as very prominent for choosing engineering field. 1. Their ability to do mathematical and technical work. 2. The influence which their teachers and relatives that made an impact on them and helped them chose the field of engineering. 3. Prestige and income also were cited as other responsible to make women chose engineering in Turkey. However, no reporting of gender bias was seen in the studies. There was positive attitude towards choosing the field of engineering.	Women in engineering in turkey - a large scale quantitative and qualitative examination. *European Journal of Engineering Education*, *35*(1), 45–57. 2010
Hersh, M.	Problems faced by women in field of engineering, Reasons for the increase in the enrolment of women in engineering.	The study focuses on various aspects of engineering as field for women.	The paper focuses on various aspects of engineering. The data collected in from 54 countries. The paper talks about how women have increased their enrolment in the field of engineering. What are the reasons that have led in the enrolment? Political, socio economic factors which have led to the increase. How the situation has changed and have facilitated the growth of the women in engineering field. What are some of the issues that women have faced while working in the field.	The changing position of women in engineering worldwide. *IEEE Transactions on Engineering Management*, *47*(3), 345–359. 2000
Buse, K.		The paper talks about the underlying problems in the field of engineering and science in a new window.	A study done by Wang et al on 696 female students showed that the students with beliefs of self efficacy in maths and science and positive interactions have positive impact which also intends them to motivate to take up the field. Another study done by Fouad et al. On 1,464 women engineers to find out reasons why women leave engineering profession.	Editorial: Women's under-representation in engineering and computing: Fresh perspectives on a complex problem. *Frontiers in*

				Psychology, *9*(APR), 1–4. 2018
Chesler, N. C., Barabino, G., Bhatia, S. N., & Richards-Kortum, R.	Reasons why there are still leaks in the Bio-medical engineering in Gender diversity.	The paper talks about the factors due to which gender diversity in bio-medical engineering.	Some of the barriers as presented in the paper include pipeline, climate, balancing work and bias and unconscious bias.	The pipeline still leaks and more than you think: A status report on gender diversity in biomedical engineering. *Annals of Biomedical Engineering*, *38*(5), 1928–1935. 2010.
Fouad, N. A., & Singh, R.	Vocational interests, job and career satisfaction, work-family conflict, withdrawal intentions and others.	The project talks about career of the women in engineering. Issues while getting into the field, problems and challenges faced during and while completing the course, struggle after completing the course, jobs, career and life post engineering field.	The project was done to study women engineers. The project talks various aspects of life of women in engineering. The projects looks into what makes women take up of field of engineering. Once they have pursued the degree what happens to their career. If they do get the job as jobs are they satisfied or not. If not what other jobs do they go for and what are possible for that. What are the challenges they face and how they can be overcome.	Stemming the tide: Why women leave engineering. *Science*, 64. 2011
Frehill, L. M.		The paper talks about how engineering as profession became male dominated in the years of 1893-1920 in United states.	The paper talks about 3 factors which were responsible for making engineering more male dominated profession. The 3 factors included absence of women from engineering field, sports and outdoors for boys and attitude towards engineering in order to prove masculinity.	The Gendered Construction of the Engineering Profession in the United States, 1893–1920. *Men and Masculinities*, *6*(4), 383–403. 2004
Easterly, D. M., & Ricard, C. S.	Factors associated as to why women leave the academic career and what are the reasons for it.	The paper talks about the reason why women leave the academic career or why are they not able to pursue it or make a career out of it.	Science, academic, maths, engineering are male dominated fields. Although the current situation is changing, yet there are still places which still have the gender practices. The paper looks into why women are absent from the academic careers and what are possible reasons for it. It also talks about the possible solutions that can be offered to try and increase the number of women in academic careers.	Conscious Efforts to End Unconscious Bias: Why Women Leave Academic Research. *Journal of Research Administration*,

				XLII(1), 61–73. 2011.
Escueta, M., Saxena, T., & Aggarwal, V.	Barriers faced by females in the colleges and pre-college barriers.	The paper compares female engineering students in United states and India. The barriers which are faced by these students and some of the solutions too. s	Some of the precollege barriers faced by female engineering students include perception of themselves low in comparison to their male fellow mates, Male stereotyped environment in colleges, isolation, disapproval of family members and others. The data and the barriers reported are taken from both the countries, India and United states.	Women in Engineering: A comparative study of barriers across Nations. *Aspiring Minds. Retrieved March*, *2*, 2015. 2013

Conclusion: Based on the literature we can see various reasons explaining under-representation of women in the field of engineering have been identified as an outcome of the public and private spheres[1] with the role of the women largely in the private sphere with women's role being largely the role of a follower, considerable unemployment & underemployment despite greater enrolment, negative work environment, exclusion and isolation from social groups, lack of opportunities, harassment and feelings of lack of confidence and competence. This shows there is a need for a comprehensive understanding of experiences of women engineers supports and barriers they face.

[1] Role of women mainly relegated to the private sphere like home Patel and Parmentier (2005)

Chapter 3

Methodology

Introduction: This section throws light on the research design used to meet the objectives of the study, the methodology of this study, the sampling design, sample description and the procedure used for data collection. The research design of this study consisted of three studies conducted - a qualitative study conducted using focus group discussions with present female engineering students (Study1); a qualitative study using in-depth interviews with women engineers graduated between 1990-2014 (Study2); a quantitative study developed based on the findings of Study 2 that examined the impact of gender discrimination, family and supervisor support on self-efficacy, job satisfaction, work engagement and subjective life satisfaction of women engineers. Multiple studies were used to get an idea of changing perceptions of women engineers as regards the challenges encountered. Before these studies were conducted Institute Ethics Committee approval was obtained from the Ethics Committee at IIT Bombay vide Proposal No. IITB-IEC/2020/001 titled 'Tracing the Career trajectory of IIT Alumnae'.

3.1 Study 1

This study focused on studying the challenges and supports experiences by current female engineering students. Focused group discussions were conducted with 16 students and their responses were thematically analysed. The researchers relied on a qualitative approach using focus group discussions with undergraduate engineering female students in different years of engineering.

3.1.1 Sample:

To conduct the focus group discussions, a purposive convenience sampling method was used. The sample was selected keeping in mind the criteria of selecting female students pursuing

under-graduation in the field of engineering (all branches) at an engineering college. The researchers, after receiving permission from institute authorities of an engineering college invited students from various branches of engineering to participate in the study. Further, an engineering student working as an intern with one of the researchers helped with snowball sampling by contacting classmates and seniors. Once the participants agreed to participate they were briefed about the purpose of the study and their informed consent was obtained via google form. A total of seventeen students volunteered to be associated with the study. However, one student later withdrew herself from the study and following APA ethical guidelines the researchers obliged with her request of withdrawal and her comments were deleted in the analysis of the data. Thus a total of sixteen students (N=16) were finalised as participants for the study. Participation of students belonging to various branches of Engineering was encouraged so as to get a holistic perspective on the aim in hand. Students were then divided into four groups, each group had four participants. The groups also involved the presence of the interviewer and the student intern to assure smooth management of the discussion. Out of the sixteen, seven students belonged to second year of engineering i.e. approx. 44%, eight students were from third year of engineering i.e. 50% and one student belonged to fourth year of engineering i.e. approx. 6%. The mean age of the students was found to be 19.62.

Table 2: Demographic details of the participants for study 1

Sr. No	Branch	Year	Age
Second Year Students			
1.	Physics	2nd	19
2.	Metallurgy	2nd	19
3.	Electrical Engineering	2nd	19

4.	Computer Science	2nd	19
5.	Electrical Engineering	2nd	19
6.	Chemical Engineering	2nd	19
7.	Chemical Engineering	2nd	20
Third Year Students			
8.	Chemical Engineering	3rd	19
9.	Mechanical Engineering	3rd	20
10.	MEMS	3rd	21
11.	Metallurgy	3rd	20
12.	Physics	3rd	20
13.	Environmental Engineering	3rd	20
14.	Physics	3rd	20
15.	Civil Engineering	3rd	20
Fourth Year Student			
16.	Chemical Engineering	4th	20

3.1.2 Procedure:

Focus groups are group interviews that give the researcher the ability to capture deeper information more economically than individual interviews. Focus groups provide insights into how people think and provide a deeper understanding of the phenomena being studied (Nagle & Williams, 2013). For the current study, a semi structured interview schedule was used. The invitation to participate in the study was sent to students via the Dean's office and while a few

students had expressed interests before the FGD could be arranged the lockdown due to COVID started. Thus after a couple of months we again invited students to participate in FGDs online. Post receiving interest of participation from students via google form, students were grouped into four teams, each consisting four members. Owing to the pandemic conditions, the discussion was scheduled online via google meet and skype platform. Since the FGDs were conducted online a smaller group size was taken to help the researcher ensure participation from all. The students were thus informed about the same. Informed consent was taken from the participants and they were communicated that their participation was completely voluntary. The Informed consent form approved by the Institute Ethics Committee (Proposal No. IITB-IEC/ 2020/ 001) was also communicated. A suitable time for all was decided and the discussion was initiated. The meet was recorded with due permission of the participants, the interviewer also noted down her observations separately. At the start of the discussion the interviewer introduced herself to the group and briefed the participants about the purpose of the meet. To elicit in-depth information from the experiences of the students they were asked questions about their childhood experiences, their phase of entrance exam preparation and their journey to decide a particular branch of engineering. Some of the questions framed were: *"Would you share your story of how you came to choose engineering, if there was an experience or a person in particular that made you to choose engineering and the specific branch that you chose of engineering", "Why do you all think lesser women choose engineering than men and should anything be done about it at all? Should women be encouraged to choose engineering at all?".*

To ensure smooth communications, students were requested to indicate the interviewer with a hand gesture if they wish to contribute to the discussions. Appropriate pauses and probes were administered by the interviewer to propagate smooth discussion. The duration of the discussions varied for around 60-90 minutes. These discussions aimed at exploring all aspects related to gender biases as well as the support experienced by these students.

3.2 Study 2:

3.2.1 Methodology: In-depth interviews were conducted using a semi-structured interview schedule. Mails inviting participation were shared with different alumni offices and consent and support was provided by IIT Bombay, IIT Madras and IIT Delhi. Interested participants wrote back to the PI and expressed their interest, a convenient time was set for a meeting. As the data collection largely began during the pandemic under lockdown conditions, except 1 interviews all the rest were conducted using zoom, google meet and Teams meeting. The objectives of the study were shared with the participants, the informed consent was sought and the participants were assured of confidentiality and anonymity of their responses. After oral consent was taken the interviews were recorded and the participants were also give the informed consent forms to fill later.

3.2.2 Sample description:

Twenty female engineers of different engineering branches and age groups were interviewed, whose work experience ranged from 3 years to 20 years. The participants were from different engineering colleges in India having graduated between 1990 to 2014. The participants were approached using alumni networks of different engineering institutes in India. Hence, convenience sampling and later snowball sampling was used with participants, who were requested to connect us with other similar contacts. Out of a sample of 20, 90% were married and 10% were unmarried. The participants included were mostly married (90%), however few were unmarried (10%). Some of the participants had kids (70%), while others did not (30%). The participants' size of the organisation varied, as well as whether they were currently working in India (40%) or abroad (60%). However, all participants were of Indian

origin and had received their under-graduate degree in engineering from an institute or university in India.

Table 3: Demographic details of participants for study 2

Sr. No		Age	Year of Graduation	Branch of Engineering	Position	Total years of experience	Marital Status	Children
1	PI 1	40	2003	B.Tech Civil	CEO	17	Married	1 Son
2	PI 2		1997 1999	B.Tech – Instrumentation and control MBA	IT-Division, Manager	20 +	Married	1 Daughter
3	PI 3	45	1995 1999	B.Tech-Electronics MBA	Customer Success Manager	20+	Married	2 Daughters
4	PI 4	44	1995 1998	B.Tech- Chemical Masters	Engineering Program Manager	6 years in current organization	Married	1 son
5	PI 5	43	1998 2004	B.Tech – Electronics and Communication PhD – Computer and Electrical Engineering	Faculty	15 approximately	Married	1 son, 1 daughter

6	PI 6	45	1997	B.Tech – Metallurgy & Material Sciences	Project Manager	23 years (14 years in current org.)	Married	1 son, 1 daughter
7		28	2014	B.Tech- Metallurgy and Material Science	Co-Founder, leading the team on revenue verticals	2.5 years in the current firm	Married	No
8	PI 7	46	1996	B.Tech -Civil	Head of Water Team	24 years	Married	2
9	PI 9	43	1998 2001 2006	B.Tech – Electrical Masters PhD- Machine Learning	Portfolio Manager and Researcher	12 years (3 years in current firm)	Married	No
10	PI 10	50	1990 1992	B.Tech - Computer Science Masters- Computer Graphics	General Manager- Android TV		Married	1 son, 1 daughter
11	P 11	44	1997 1999	B.Tech- Electrical and electronics MBA	Data engineer and development team lead.	approximately 13 years (2 years in current org.)	Married	2 children

			1995	B.Tech – Metallurgy				
			1997	M-Tech – Metallurgy	Head of	21 years (9		
12	P 12	47	2003	MBA	Treasury Department	years in current org.)	Married	1 son
			1999	B.Tech – Chemical Engineering				
13	PI 13	42	2001	Masters- Chemical Engineering	Chief Mechanical Engineer	18 years same organization	Married	1 son, 1 daughter
			1991	B.Tech- Mechanical Engineering	Software	21 years in total (15 years in		
14	PI 14	50	2001	PhD- Computer Science	Engineer, tech- lead	current organization)	Not Married	No Children
			2001	B.Tech-Physics		3 years in the current		
15	PI 15	41	2007	Masters, PhD-Physics	Scientist, tech lead	organization , Approximately 7 years overall	Married	1 son, 1 daughter
16		33	2009	Aerospace Engineering, B.Tech	Principal	Approximately 9 years overall and 8 years in	Married	1 child

	PI 16		2012	MBA		current organization		
17	PI 17	29	2013 2021 -	B.Tech+M.Tech-Mechanical Engineering MBA Masters - Chemical		6 years	Not Married	No Children
18	PI 18	31	2012 2015	B.Tech - Mechanical engineering MS- Industrial Engineering and Operational Research	Regional Demand Planner located in Pune	3 years in the current org, 5 years overall	Married	No Children
19	PI 19	29	2014 2016 approx not mentioned	B.Tech-Mechanical Masters-Mechanical PhD-Program	--	3 to 3.5 years in Tesla	Married	No Children
20	PI 20	33	2010	B.Tech - Electrical	Senior Manager -		Married	No children

			2016	Mtech - Energy Science	Battery Management System	2 years in Tata Motors, 6 years overall		

[2]

3.2.3 Data Collection

The participants were briefed about the details of the study via emails and were invited to be a part of the study. The data interviews were scheduled to be conducted face-to-face or through video conferencing. The interviews were recorded after taking oral consent from the participants. An informed consent form was also shared with the participants that provided more details of the study and the ethical issues thereof. The interviews lasted between 30 minutes to an hour. After conducting the interviews, they were transcribed by researchers and the data was analysed using thematic analysis.

3.3 Study 3

3.3.1 Rationale and Development of Hypothesis

Examining factors as to why women engineers leave engineering organizations would help policy makers identify points for intervention will help plug the substantial loss of talent from the workforce. Most previous research in India on women engineers have (Parikh & Sukhatme, 2004; Goel, 2007) touched upon social and psychological barriers to their career progression.

[2] Details of the institution of graduation not revealed to protect identity of the participant

However, no one has comprehensively investigated factors related to women's satisfaction, engagement or intention to leave engineering as a profession. Some previous research that has investigated various psychological and organizational factors have been conducted on white American population and authors call for a need for more such studies on other racial and ethnic groups before generalizing their findings. Also, a need to conduct mixed methods research to throw more light on the complex relationships is emphasized.

The findings of our second study highlight the discrimination because of one's gender an important challenge that women engineers face in their career progression. Further, the two critical support that women experience are family support and supervisor support. Our third study attempts to empirically examine the effect of gender discrimination and family and supervisory support on self-efficacy, job satisfaction, work engagement, subjective well-being and turnover intentions of women engineers. The next section briefly discusses the rationale and development of the hypotheses.

The social cognitive career theory by Lent (2013) predicts self-efficacy, outcome expectations, interests, choice goals and choice actions affect the career development process. Confidence one has to accomplish a task, expectations one has about results predict how one develops in a particular area. Singh et al., (2013) argue that organizational context may be sources or inhibitors of self-efficacy and outcome expectations. Organizations that provide a supportive work context may lead employees to experience greater mastery to do the tasks related to their professions and have positive expectations of outcomes in those tasks. The absence of a supportive context and/or greater experience of barriers by employees shall both make them confident of their ability on tasks related to their occupation. While women who have pursued education in engineering may expect positive outcomes in their professions however, the under-representation of women in engineering shows how the organizational context may be providing barriers to women's success. Organizational support theory argues

that employees who encounter a supportive work climate as concern for employee well-being, recognition for their contribution, opportunities for recognition, promotion, training and development are more committed to their organizations and satisfied with their jobs. Research on women engineers have identified work context as an important source of barriers for women engineers. Our previous study shows lack of opportunities, having to repeatedly prove one's abilities and commitment, paying a price for availing flexibility in the workplace etc. is the kind of work context women engineers work in. Study by Cadaret et al (2017) found gender stereotyping bias reduced academic self -efficacy in American women engineers. Further, previous research (Maskell-Pretz & Hopkins, 1997; Singh et al., 2013) identifies practices like developmental opportunities lead to higher self-efficacy, and work attitudes like job satisfaction. Hence, the challenges associated with gender discrimination would negatively relate with self-efficacy and job satisfaction while supervisor support will positively associate with self-efficacy and job satisfaction. Bakker et al., (2008) further identified that job resources such as social support from supervisors, performance feedback, autonomy, learning opportunities etc are positively associated with work engagement. Many of these job resources are part of the work context. Hence, the challenging work context experienced by women engineers would negatively associate with their work engagement and the supervisor support will positively relate with work engagement.

Further, subjective well-being is the favourable assessment of the individual which depend on global life satisfaction, experience of lower negative feeling than the experience of higher positive feeling (Diener et al., 2009). McAuley et al., (2004) state research on SWB has begun examining different behavioural influences, including people's motives, goals and strivings, and their adaptation and coping strategies as predictors of SWB. This study proposes that women engineers because of discrimination in the workplace would experience challenges in fulfilling valued goals. Hence, discrimination would negatively relate to their SWB. At the

same time supervisors who support women engineers would facilitate motives and goal achievement and hence enhance their SWB.

Finally, our participants spoke of the importance of family support in their career progression. Studies on work-family intersections have examined work-family enhancement (Ruderman et al. 2002), work-family facilitation (Hill et al. 2007, Tompson & Werner 1997, Wayne et al. 2004), and work-family enrichment (Greenhaus & Powell 2006). While distinctions between these constructs may not be clear how researchers do emphasize the benefits of combining multiple roles for an individual (Allen, 2012). Extending some of these findings to our work we propose that family support will positively associate with self-efficacy, job satisfaction, work engagement and subjective well-being.

Hypothesis 1: Gender discrimination will negatively relate with self-efficacy.

Hypothesis 2: Gender discrimination will negatively relate with job satisfaction.

Hypothesis 3: Gender discrimination will negatively relate with work-engagement.

Hypothesis 4: Gender discrimination will negatively relate with satisfaction with life.

Hypothesis 5: Perceived supervisor support will positively relate self-efficacy.

Hypothesis 6: Perceived supervisor support will positively relate job satisfaction.

Hypothesis 7: Perceived supervisor support will positively relate work-engagement.

Hypothesis 8: Perceived supervisor support will positively relate satisfaction with life.

Hypothesis 9: Family support will positively relate to self-efficacy.

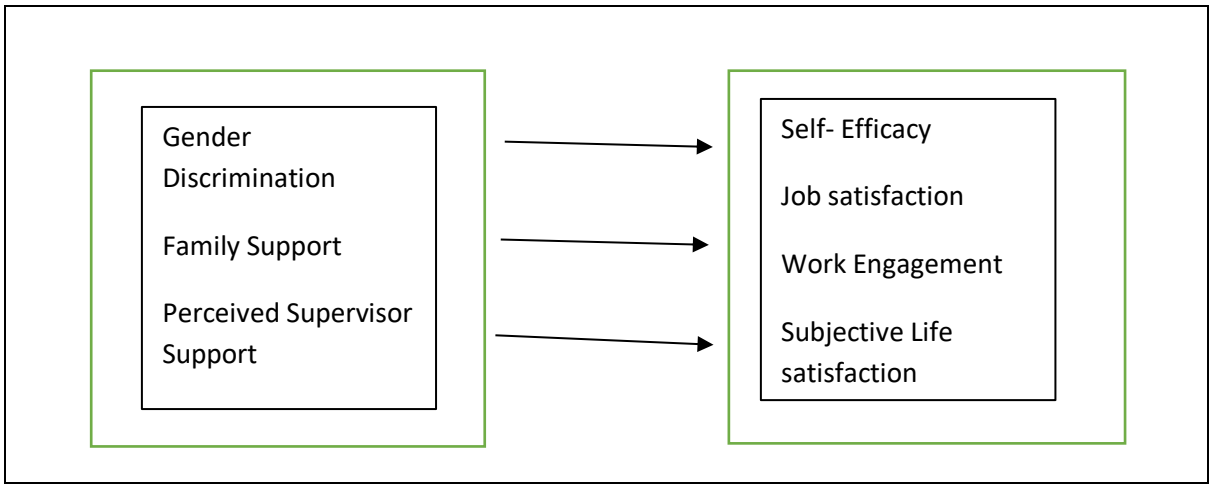
Hypothesis 10: Family support will positively relate to job satisfaction.

Hypothesis 11: Family support will positively relate work-engagement.

Hypothesis 12: Family support will positively relate satisfaction with life.

Fig 1: Proposed model of the Study 3 (relationship between the variables):

The figure is a representation of the relationship between the variables:



3.3.2 Operational Definitions of variables:

1. Gender discrimination: Unfair treatment of women because of their gender
2. Family support: Different forms support received from parents, spouse, in-laws and any other family members
3. Perceived Supervisor support: perceptions of employees about the extent which supervisors value their contributions and care about their well-being. (Eisenberger et.al., 2002)
4. Self - efficacy: is an individual's self-belief with respect to one's achievements and one's ability to shape one's destiny and confidence in achieving goals. (Singh, 2016)
5. Satisfaction with Life Scale: Overall judgement about life in terms of one's satisfaction with it (Diener et.al, 1985).
6. Work engagement: a positive, fulfilling, affective-motivational state of work-related well-being. (Schaufeli et.al, 2006)
7. Job Satisfaction: one's positive perceived emotion on the appraisal of his/her job. (Locke,1976)

3.3.3 Sample description:

The questionnaire developed was circulated within college networks. Google forms was opted as a medium to gather data from the questionnaire. A total of eighty-three responses were received from the circulated forms. Out of the received data, the age range of the participants was observed to be between twenty- three to fifty- nine years (23-59 years). The sample belonged to various branches of Engineering namely chemical, mechanical, electronics etc. Of the total participants, eleven women held PhD degrees (13.2%) seven women had MTechs(8.4%) and sixty- two had only a B.Tech/B.E degree (74.7%) and three participants had MBAs (3.6%).

Out of the sample, sixty-three were married while twenty female participants were unmarried (including widowed, divorced, separated and single participants). The range of work experience was approximately from one to thirty-seven years.

3.3.4 Educational Qualification of the parents of the participants:

Out of the sample of 83 participants, only 82 shared data on parental education. Of the data, six had passed grade 12 (7.2%), thirty-eight were graduates (45.78%), thirty were post graduates (36.14%) and eight held PhD degrees (9.63%). As regards mothers, eighteen mothers had passed grade 12 (21.95%), thirty (30) were graduates (36.58%), twenty-two (22) were post graduates (27.82%) and nine mothers held PhD degrees (10.97 %).

3.3.5 Measures:

1. ***Gender discrimination***: A scale of 33 items was created based on the responses of the participants in study 2. Participants were instructed to respond to the items based on the interaction experiences with their co-workers. Responses were obtained on a five-point rating scale where 1 = Strongly Disagree and 5 = Strongly Agree. The Cronbach's alpha for the scale was .92. An example of the questions added to measure Gender discrimination is, 'At work, I have heard negative comments about women's abilities as engineers'.

2. ***Family support***: The scale to measure family support consisted of two items, Participants were instructed to respond based on how supportive they perceived their family members to be. They responded on a five-point rating scale where 1 = Strongly Disagree and 5 = Strongly Agree. Cronbach's alpha for the scale was .92. An example of the questions added to measure 'How supportive family members are or would be in helping you cope with work demands.'

3. ***Perceived supervisor support***: The scale to measure perceived supervisor support had four items, where participants were instructed to respond in agreement to the statements based on their experiences with their supervisors. The rating was on five- point rating scale where 1 = Strongly Disagree and 5 = Strongly Agree. Cronbach's alpha for the scale was .73. An example of the question included in the measure is, 'I have had a supervisor(s) who really cared about my well- being.'

4. ***Self – efficacy***: The scale to measure self-efficacy had sixteen items. Participants were instructed to respond to statements based on their perceptions of themselves, on a five- point rating scale where 1 = Strongly Disagree and 5 = Strongly Agree. Cronbach's alpha for the scale was .90. The example of the items included in the scale is, 'I feel that I have accomplished things in my life.'

5. ***Work Engagement***: The scale to measure work engagement had three items. Participants were instructed to respond to the items based on their experiences at the workplace on a five-point rating scale where 1 = Strongly Disagree and 5 = Strongly Agree. Cronbach's alpha for the scale was .79. An example of the item included in the scale is, 'I am enthusiastic about my job'.

6. ***Job Satisfaction***: The scale to measure job satisfaction had five items. Participants were instructed to state their agreement with the statements based on their perception of satisfaction with their job. They responded on a five- point rating scale where 1 = Strongly Disagree and 5 = Strongly Agree. Cronbach's alpha for the scale was .89. An example of the items included in the scale is, 'I am satisfied with the success I have achieved in my career.' The questions were taken from Michigan Organizational Assessment Questionnaire.

7. ***Subjective Life Satisfaction***: The scale to measure subjective life satisfaction had five items on a five- point rating scale where 1 = Strongly Disagree and 5 = Strongly Agree. Cronbach's alpha for the scale was .86. An example of the items included in the scale is, 'In most ways my life is close to my ideal.' Participants were instructed to respond to the statements based on their life experiences. The questions were taken from Diener's scale for satisfaction with life.

Chapter 4

Analysis

4.1 Method

Corbin and Strauss (2008) have discussed how, qualitative analysis understands "how meanings are shaped through culture". As culture plays a significant role in understanding the experiences of Indian women engineers the qualitative method would be appropriate. Also, according to Hesse-Bieber (2010) qualitative research methods empower the respondents whose stories become the central reality for the researcher. They argue that the qualitative paradigm gives a nuanced and multi-layered understanding of social reality, without any biases toward those who occupy positions of power in the society. Qualitative inquiry which gives an in-depth understanding of the narrator's experiences may empower women to talk about their subjective realities different from those constructed by male perspectives. Therefore, this type of enquiry may be more relevant in answering the present research questions. Further, Holstein and Gubrium (1995), provide that through the process of interview, reality of the respondents is actively constructed and meanings are made by the researchers suggested by Devault (1990), that while using an in-depth approach of interview for understanding the realities of women, it is important for the interviewer to be a woman as well, because they say "I can listen 'as a woman' filling in from experience to help me understand the things that are incompletely said." (pp. 102). More recently, studies on women's professional issues (Anderson et al, 2019; Hellum & Olah, 2019; and Maji & Dixit, 2020) have used the interview method to understand their issues in detail. This shows that the interview method may hold good when trying to investigate women's professional experiences. In both Study 1 and 2 semi-structured interview schedules were used and the questions were developed based on previous literature, and probing was done depending on answers given by the participants. The recorded FGDs and

interviews were transcribed and the qualitative data was analysed using Thematic Analysis technique.

4.2. Thematic Analysis (TA)

According to Braun and Clarke (2006) thematic analysis refers to "a method for systematically identifying, organizing, and offering insights into patterns of meaning across a dataset" (Braun & Clarke, 2012, p. 57). Thematic Analysis is often used for its accessibility (Braun & Clarke, 2006). The present study uses a hybrid approach, which combines the deductive and inductive approaches of TA.

Thematic Analysis is often used for its accessibility (Braun and Clarke, 2006). The 6 steps of Thematic Analysis proposed by Braun and Clarke (2012) which were used in the study: interviews were read and re-read to understand what was said by the participants; preliminary codes were created; the codes identified were grouped together to generate a similar theme; the themes were read for gaining clarity; the final themes and conceptual relationships were generated; finally, the report was written.

4.2.1 Thematic Analysis of Study 1

The key themes that emerged from the analysis of the FGDs are given below:

1. **Social Messaging towards gender appropriate choices**

Social messaging that our participants received as young girls was to make career choices that were appropriate and safer fields for girls. Many of the girls while growing up were advised to make career choices that were gender friendly. This guidance stems from gendered stereotypes,

rooted in the belief that certain career choices are not a 'perfect fit' for girls. As seen in the extract here:

"*…here was a person, the invigilator and he was, he said that I would just want to give you a piece of advice, means in general, that girls should rather go to a medical college, that's a better profession.*" (P7)

Decisions influenced by such messages result in lesser number of girls opting for STEM subjects thus causing poor representation of women in STEM. This was recognised when a participant shared,

"*according to me, in our Indian population the females are quite less first of all and even lesser women choose engineering because kind of the predomination that it's better to do medical if we are going in science branch for women or its better to do anything else than engineering*." (P 9)

Social messaging plays an important role in shaping ideas for young girls for making the choice of subjects to study and professions to pursue. It also promotes association of some subjects being 'too difficult' for women. Women thus are subjected to make career choices in the influence of these social messages. As seen in the excerpt below:

" I have been told by my peers that you don't do good in mathematics course only because you are scared of maths. So I think its got to do with mathematics requiring a lot of confidence that women sometimes lack. I mean I don't think I am under-confident otherwise, but its just that when it comes to maths….. So maybe simply the nature of engineering being too mathematics heavy is something that discourages women and they take up humanities, Arts or medicine." (P5)

Thus, it can be seen that female students are primed with stereotyped cues when it comes to making decisions related to career choices. The guidance received by them is also influenced by their gender and thus limits their choices at the start of their careers.

2. **Required to justify choices**

On not making what appear to be '*gender appropriate'* choices the girls are frequently called upon to justify or explain those choices. They are frequently subjected to clichéd assumptions owing to their gender. This is evident in the quote,

"*Most women in Science tend to do Chemistry and Biology, so it is something people have questioned me and when I talk about being a scientist, a lot of people have assumed passively that I would be studying biology or chemistry simply because I am a girl.*" (P3)

Within the STEM fields also some fields are seen appropriate for girls while others are seen to be predominantly male dominated. It is presumed that these choices will assist the girls later in their careers with better opportunities of getting jobs. As seen in the excerpt,

"*A lot of people expect you to take a minor in CS or go towards CS related fields because those jobs are you know, they are easy to get into and Physics is very traditionally, very male dominated, both in India and abroad. In basic sciences you will find far more women in chemistry and biology as compared to physics.*" (P3)

3. ***Social exclusion that result in filtering of resources***

Challenges for girls increase when these stereotypes seep into the behaviour of different people with whom they interact with. In India, admission into engineering colleges is done through different entrance exams. Students undergo rigorous preparation for these exams, part of which is attending coaching classes for the same. Right from the moment girls become a part of this preparation journey for competitive exams they experience exclusion and isolation. In such

classes, given the skewed ratio of male to female students, groups are formed influenced by gender. As a result, girls are excluded from the core groups of male students. They are excluded from the benefits their male counterparts enjoy like the informal discussions with the faculty members. As one participant shared her experience, " (talking about a male teacher at a coaching)…….

"He went out of the class and then he came in and after the class was over he was like tum dono ladkiya nikal jao ye ladkio ki baat nai hai (you girls leave; this conversation is not for girls)". (P13)

Further, girls face exclusion under the garb of personal safety specially in attending late night classes or clarifying doubts after class, or being part of informal discussions with male classmates/teachers late in the evening. As visible in the experience shared, "..... (the male tuition faculty)

Like whenever we had a break he would call the other boys and play with them sometimes they would have informal discussions and to me he would say like you do what you want to do, I cannot really help you out, I cannot have any extra discussions with you after class hours because that is not something I am supposed to do." (P14)

This results in the girls getting only limited inputs possible during class hours, while shared learning with class mates during discussions is not available to them due to the social exclusion.

4. Limiting of choices of courses and colleges

Choices, of courses to take and colleges to study in are further limited because of parents' insistence on primacy of concerns regarding safety and convenience while deciding preferences for college. Be it late night timings of the coaching classes or selecting a college that is near

home, the options for girls are scrutinized from a gender sensitive lens. A participant shared her experience,

"....I actually chose chemical here in IIT-Bombay, the reason was it was near my home as I live in Nashik, so Mumbai is pretty close to Nashik and my parents were not allowing me to go anywhere else like all other IITs are pretty far away from Nashik, so that was the main reason to choose IIT Bombay." (P16)

Thus, it can be seen that women are not given a free and unfiltered hand in making choices or decisions related to their future. Their decisions are primed with social messages that influence their choices. After all, when these women demonstrate the courage to opt for choices different than the usual norms they are made to feel obligated to justify these choices.

5. The Conspicuousness of Gender with discounting of achievements

Even after a systemic push (via supernumerary seats) to increase the representation of women, girls continue to be a minority in the institute campus with male students being its predominant residents. The following quote highlights the severity of gap in the proportion:

"...it went from something like 8% to 15% in our year, so there was almost a doubling in the number of girls, but that still barely makes a dent in the percentage of students." (P3)

As a result, female students generally tend to stand out from the crowd and while it does not hamper their learning process, developing a psychological sense of belonging and gaining social acceptance becomes difficult. A participant puts it succinctly:

"*… so particularly during the classroom, I don't think it has mattered as much, but there are certain things like you technically tend to become just the girl of the class and not the person of the class*." (P5)

Gender conspicuousness at times takes the form of 'benevolent sexism' wherein some professors pay extra attention to the girls or '*cherish a different opinion'* just because it is put forth by a girl. The participants look at such special treatment as an indication of lower standards or a surprise that '…*being a girl you can think'* and therefore would prefer to let go of special treatment and be treated on par with the other students of the class. Sharing her experience of the coaching class, a participant shared her displeasure at being considered not on par with her male classmates,

"*Some profs were i think in the over diametrically opposite which makes you feel bad kinda thing where they are extra sweet to you because they think you are not going to be able to like so, they won't go as hard on us as they would go on our guy friends which was worse in some ways*" (P13).

Similar experiences are also found in the institute as another participant shared,

"…even professors, who are like supposed to treat everyone equally, they offer help more to girls, I have seen this in my labs" (P4).

This extra attention follows the girls even out of the classes, in social spaces such as gyms wherein the other gym goers as well as staff tend to give advice or offer help to the girls that they have neither asked for nor need. This ultimately restricts her freedom to exercise as she wills and in peace. A participant shared her thoughts on this matter,

"*so I visit gym very frequently, but being a girl, I do not want to be recognized specially. But I don't know why, all of them, people there are just IITians and there is this different perspective which people have towards girls...do you need help with any equipment, do you need… this is just different perspective that men have because whenever I go to gym for workout, it's basically like, mostly there are, I don't know, I have never kept a count, but mostly it's just me*

and someone else and I have seen 1 or 2 girls in the entire gym, so probably that gives a different recognition, which I don't think there's any special reason, I mean if boys are given that freedom to choose whatever they want to do, even girls should have been there and there is no reason why we should be treated differently. I have observed that by the trainers and other people, so.. " (P6)

Conversely, having one's gender continuously in focus creates certain problems especially in interacting with fellow classmates. Participants reported that it was difficult to even make good friendships in the initial years, as any contact with a male classmate would be misconstrued as an indication of romantic interest! A participant recalled her experience:

"*…to put it very crudely in their words, ki 'Bandi patani hai' (slang for I have to get a girlfriend), so it became very uncomfortable in the first sem to like talk to guys because you know that over here people think that…*" (P3).

The idea that a girl is a rarity and something to be pursued is an idea that seems to percolate down from the coaching institutes where many students prepare for Joint Entrance Examination (henceforth JEE). A participant shared her experience of how her coaching class teacher's congratulatory message came coupled with an impish comment:

*"…post JEE once you went there to celebrate there was one prof actually he started like ki tum log, ladikya itni hi hogi , tumhare piche bohot saare ladke padenge. (*There will be only a few girls, so there will be many boys pursuing you girls*) Etc etc..started this whole thing where, so yeah you don't expect this kind of stuff from prof right". (P13)*

However, over time, for the boys this excitement around interacting with a girl fades and the girls are then able to forge good friendships as they became one of the many. A participant shared her journey of getting a mix-gender group:

"*…so for the first time I had more friends who were girls than guys because of this thing (boys' preoccupation with romance and getting a girl), but yeah after that they matured a lot and now again we have a pretty balanced group and a friend circle of both boys and girls, but first semester specially around salsa night time is the time when things aren't taken at face value" (P3).*

Further, certain well-intentioned policies such as supernumerary seats or internships designed especially for female students add to the importance attached to one's gender. A participant shared how such policies backfire in the absence of clear messaging about the intent of these policies. Based on what others wrote on social media she commented:

"*there were so many confessions that they are hiring only girls, not boys. Guys were very much pointing it out. Like why don't they hire boys? But the google step program was only meant for girls, girls in engineering field to come up from the background. so I guess sometimes guys point out without understanding the whole situation or the intention behind the program or the internship that the company provides*" (P10).

Another participant voiced her thoughts about the negative implications of the way the reservation policy is being communicated. She said:

"*Yeah, I think the government should you know stop highlighting that women are being given special quota, because then those who are actually deserving, even they fall into that category where men look down upon and just make up the mindset that ye to quota se aaya kind of stuff…*" (P6)

Thus, the participants suggest that it is this mis-information and lack of awareness about the processes and purpose of gender friendly policies that is giving fuel to the perception that their gender gives female students an easy pass or lesser competition than male students. However, as a result, any achievements, may it be getting an internship, good grades or a leadership position is viewed with scepticism and labelled as an outcome of one's gender and not abilities.

A participant shared *"...whatever I do, is really my achievement as a woman and not my achievement as a person"*.

In reality however, the girls have to work extra hard to get to positions of responsibility that require peer support such as institute elections. Not only that, they also have the extra pressure of proving that they 'deserve' the post and have not just been given it because of their gender. This puts the women on the back foot and creates an uncomfortable position for them as one of our participants shared:

"*…I have indeed at like every point proven myself and obviously made it clear that I am the right choice for the position but it just feels like, it just doesn't feel right that I have to prove myself at every point. If there was a guy at my position, no one generally questions every decision that he takes." (P8)*

Interestingly, over time just as friendships get forged, the focus on their gender reduces, the social backlash over accomplishments is also moderated when the girls are looked at from the lens of friendship rather than their gender. As a participant shared:

"…like the circle again that we have chosen, the friends we have who are males are completely supportive of anything and everything we do" (P12)

Thus, in their initial journey as engineering students, the individual attributes of female students such as ability, personality often get shadowed by the most visible attribute- gender. All the girls' achievements are connected to special treatment being given to them because of their gender.

An important challenge that gets impetus because of gender conspicuousness is that of discounting. The female student's ability, their achievements and any social capital they may possess gets questioned, dissected and undercut owing to certain gender stereotypes and biases against gender specific policies like supernumerary seats. While some discounting is apparent in the form of direct taunts, at other times it can be seen via spreading of gendered rumours and online harassment. This sentiment is quite clearly reflected in the deliberate opposition to female students by their male counterparts when trying for a position of responsibility. A participant shared her outrage in this regard:

"*As in when the girl stands, boys will just stand up so as to stop her from getting the POR (position of responsibility) or the designated position. And the worst part of all, when a guy loses against the girl, he trolls the people who are campaigning for the girl, I mean what the hell is that?…"(P7).*

Another participant echoed these views and added that female leaders have to not only prove that they have earned it but also doubly justify their actions, something, male students do not have to contend with. She shared:

"*And I have seen that people are just not comfortable with seeing a girl in a high position. I have indeed at like every point proven myself and obviously made it clear that I am the right choice for the position but it just feels like, it just doesn't feel right that I have to prove myself at every point. If there was a guy at my position, no one generally questions every decision that he takes. But being a girl, it's something that you know that isn't very acceptable to people*" (P8)

Participants have shared that all their achievements, academic or otherwise, are always perceived as contingent on their gender instead of their ability. Further, these perceptions are considered and shared as '*facts*' in casual conversations with their female counterparts even in the face of contrary evidence. For instance, a participant shared her experiences of how her male friends would casually undermine her basketball potential and insist that her gender helped her get in the team, even though she had worked hard for her spot. She shared:

"*I have seen it a lot of times… everyone says that you are gonna get to the entire team, its very easy. It was my fresher year and I was on the court for 5 to 6 hours each day and then if I get into the team I don't think it's wrong. But then there were boys telling me you got into the team just because you are a girl – when I was the person who used to work out equally as boys.*" (P7)

6. Compounding effect of social media

Participants report prevalence of multiple Facebook pages, blogs wherein untoward, baseless opinions are expressed as facts in the form of confessions. Knowing about this phenomenon makes girls uncomfortable and vary of their every move. The following quote captures this succinctly,

"*she asked me to stick close to her and I asked her why and she said if I ask a guy to play a game with me or if I play TT with someone or if I go and get a ball from them or I give them the ball then they are think that I am interested in them and the confession goes up the next day and they think I am interested in them*!" (P3)

These confession pages besides spreading gossip are also used similarly for downplaying the achievements of female classmates and misattributing their successes to feminine attributes. A participant shared her shock at discovering her peers' thoughts on an online platform,

"*The whole thing that girls need to look pretty to get internship, even stuff like that came on the page and those were people we know, like those were people we interacted with, we have sat down with and talked with, so even they said things like that on the net and we were like do you guys not know why this is needed…"* (P13)

As the previous quote suggests, the online semester has brought about a change in the quality of interactions that the participants would have with their peers. While the offline semester afforded them a chance to carefully choose their peer circle and avoid interactions with less-informed peers, the advent of COVID and the shift of teaching methods to an online medium

has in fact revealed a side of their classmates that the participants were not privy to before. A participant shared,

"*…in the online sem now everybody has the internet to put or dump whatever they have in their mind, so that has brought a major change like at least the way I think the peer group is." (P13)*

Thus, the anonymity afforded by the relative distance and security of the internet has made social media a powerful platform for spreading biases, unsubstantiated rumours, and gendered humour.

7. Social ineptness of male classmates

A pertinent theme that recurs from the narratives is that of the social ineptness displayed by the male students. A gender sensitization workshop meant to inform the students about the boundaries of gender harassment resulted in some male students repelling even from talking with girls. A participant shared,

"*I remember at the end of the sensitization workshop I heard this guy make a comment that oh my god I thought I would get a girlfriend when I come to college but now there's no way I will get one because I am scared to talk to them and if I talk to them, if I try and ask them out, it will be harassment. So the point of the workshop was kind of lost on a few people.*" (P3)

Supporting this assertion, participants have also observed that some male classmates are indeed quite shy and unable to talk to girls freely.

"...but I do find that some people, some boys you know, vo aise jyada discussion taalte hai.. (they avoid discussing at length) they are just you know not really open to a lot of discussion with girls rather than their boys counterparts. So I have had such experience where they are not really interested into a very, you know broader discussion, so it really is somewhat noticeable that way, but not really discouraging". (P6)

"I think there are a bunch of people in every classroom who are usually not really comfortable in speaking to girls in general. So usually when they are paired up or in a group where there are women present, then they just stop voicing their opinions. So, the other way round is not very popular" (P5)

As the above quote suggests, such social awkwardness results in breakdown of communication, though it isn't directly harmful for the female classmates. However, it is when this lack of ability to communicate results in indirect trolling, discounting of abilities or even misinterpreting the social signals that it creates problems for girls. For instance, a participant shared,

"*... And the worst part of all, when a guy loses against the girl, he trolls the people who are campaigning for the girl, I mean what the hell is that? I was like, I thought you are IITians, I thought you were mature, what the hell are you doing there?"* (P7)

"...they don't know how to take a perfect No, I don't know why. And they don't know how to accept a defeat, never. Even in home matches, they are like, they don't look at developing themselves, they don't take it as an opportunity to develop, they just take it we have to win, whether it is a home match or anything, we don't care… If you don't take the defeat, then you

go for other ways. In case of experiments its good but when it comes to real life its bad, means when you are dealing with people, perhaps you should be a bit more cautious" (P7)

As the above quotes suggest, lack of social skills results in inability to express their frustrations or engage in constructive discussions in a socially acceptable manner and often resort to unconstructive trolling or spreading of rumours. The following quote is informative in this respect,

"….on the toxic pages on Facebook like on confessions page and meme pages, these kind of things are there like, 'oh a girl asks the TA, suddenly 100 marks increases, but if a guy asks then only this much or they even get negative or they don't even listen' So I don't know how it was in the actual class, but definitely on the internet you can see and hear rumors of this happening." (P3)

Thus, it is observed by the participants that their male classmates when faced with a defeat or a confounding fact such as losing against a girl or seeing a female student perform better than them, engage in disrespectful trolling and discounting of the girls rather than finding ways to better themselves. Furthermore, with respect to the male students one observes two extremes wherein the boys are either shy to interact with girls or roguish that they troll the girls. Interestingly, it is only a small proportion of male students who would fit the latter description. There was a consensus that,

"*only a small proportion like 20-25% (of boys) don't support or point out or give negative remarks but talking about the rest are quite supportive and encouraging*." (P10)

However, despite being a small percentage; these male students who are quite vocal and unabashed in expressing themselves that it results in disagreeable experiences for their female peers. Thus consequently, the 'complete' institute experience including but not limited to participating in institute elections, extra-curricular activities and off-campus internships is substantially marred with gendered humor and taunts on one side and unsolicited help and romantic overtures on the other.

8. Experiencing self -doubt and self-censorship

An important personal challenge that our participants shared was self-doubt, regarding choices and decisions they are required to make, and self-censorship where they do not express their opinions or speak up. For example, a participant shared how social messaging around her affected her decision-making process:

"*I did want to explore CS but I was kind of scared too because its mainstream to go for a CS minor or something like that so thinking about people's opinions in that kind of did affect me."*

At the same time, some girls may find a particular situation to be personally intimidating, leading them to choose to not voice their thoughts, particularly in classroom interactions.

"*So not for me specifically, but I have seen people around me… I have seen my friends who are you know not so comfortable in asking questions in class or interacting with professors that way*." (P6).

Another factor that contributes to some of the girls' self-censorship, is a feeling of not belonging or not deserving their place at the institute. Being beneficiaries of policies like supernumerary seats along with lack of awareness about the process of this policy, it's

advantages and disadvantages, the girls often question their place and feel guilty for taking up a seat that rightfully belonged to someone else. A participant shared:

"*I don't know the feeling but i feel like I should not have been here if I were a boy. So having some friends who had better ranks than me and are at a lower branch, sometimes talking to them these things come up like i had gone on reservation or something. That does not feel good*" (P17).

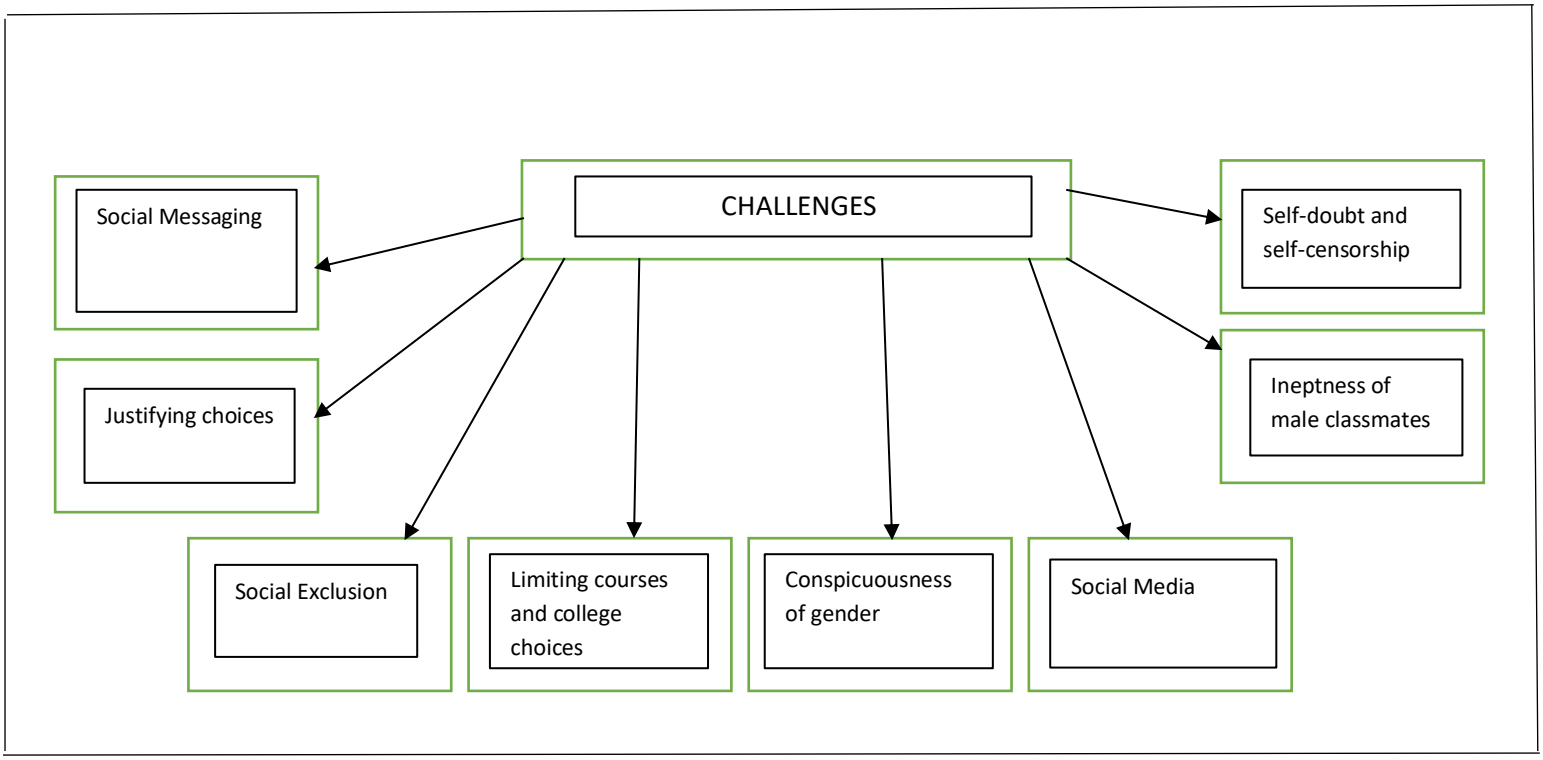
As another participant shared a need to promote and encourage girls as they are very hesitant. : "*girls restrict themselves actually than boys do. Like if we give an opportunity to a girl and a the same opportunity to a boy, then Boys are really eager to take that opportunity than girls. So girls should be promoted, I don't know how but they should be promoted to be in power or to be on a higher level so They can promote junior girls because I think girls restrict themselves*." (P11)

Thus, in making their choices and decisions, girls are acutely aware of the gender stereotypes at play, of the social situations that they are operating in and the possible negative consequences. As a result, consciously or unconsciously, they self-censor themselves. Whether this censoring is an attempt at maintaining the status quo or escaping the negative consequences or completely different motivations are at play, is something that needs further examination.

The diagram below represents the challenges faced by the students in their pursuit of engineering.

Figure 2: Representation of challenges faced by female students of engineering

The figure is a representation of the challenges faced by female students in their engineering



Themes regarding Supports of female students

The following set of themes bring out the various supports that female engineering students find helpful in following their career aspirations.

1. ***Liberal parents who stand by***

Support received from unorthodox/progressive parents is the starting point for helping girls pursue careers in engineering. Parents not expecting gender appropriate ways of behaving from the child help young girls develop their natural curiosity in science. As recounted by a participant,

"my parents are very liberal and open minded and so when I was a kid I played more with cars and I had a remote controlled helicopter and trains and stuff and my sister liked dolls and my parents never really cared about that my parents were different and they bought all the science stuff and megatronics stuff and I got interested in science from a very young age.." (P3).

Further, support from parents is also integral in facing the stereotypes from society. As established earlier girls are subjected to social messages about gender appropriate career choices and stay the course of age related milestones of getting a safe job, getting married or embracing. When parents firmly stand by their daughter's choices, not pressurizing them to follow societal norms, they become a big support to the progress of their girls. This is reflected in the below excerpt shared by the participant,

"*So people start just telling you ki ladki hai baadme shaadi karni hai and tum engineering le rahe ho, so even its not very fruitful, toh aise log, they just say… but okay my parents rose above all of it and we finally chose engineering"* (P6)

In their course of exploring interest in science, the daughters have also benefited from the experiences of their mothers. The challenges faced by the mothers during their educational journey, their strife with the perspectives and stereotypes of the society helped the mothers contribute to the journeys of their daughters in a sensitized and supportive manner. The stated quote is the testimony to this support.

"... Mom is also an engineer so at her time her dad had faced a lot of opposition from everybody he knew to make her study as an engineer. So she had already gone through the whole drill so of course because of that they were very sensitized towards the issue. So my parents and all my relatives and everyone was like completely like go for it if you like it thing" (P13)

2. Guidance provided by Informed teachers

Teachers play an important role in guiding choices of students, they can be a source of inspiration, information and exposure to the field of interest. Teachers also help their students address the confusion regarding choice of subjects that align with their interests.

"So the thing is till my 10th standard I did not know anything about IIT and all after 10 I was still confused what to do next. Even to take science or commerce as a further degree that was even like difficult. After some discussion with my school teachers I decided to take up science because by taking science you can like get a lot of exposure to what exactly the world is heading towards, and i am not saying that arts or commerce won't do it but i got this advice from so many of my teachers so I took science stream first". (P16)

While parents give them the freedom to opt for a subject they like, teachers educate them to make an informed and correct choice. They also raise students' awareness about the premiere academic institutions to boost their morale and help them prepare to the best of their

potential. One of the participants shared how her interactions with her teachers helped her choose her domain.

"*So till 10th standard I didn't know what IIT was, like from seniors also, like when I got into 11th standard whatever environment was there in the coaching class, all the professors and all, they told what IIT and BITs all so I got to know from there itself and then I started preparing*." *(P10)*

3. Camaraderie with peers

After bearing the fruits of their hard work in exams and getting into a reputed engineering college, our participants felt life on campus brings with it a different set of pressures and challenges. In this students are aided and encouraged by their friends and peers. After sometime, the lines of gender fades when it comes to supporting a friend on campus. As shared by one of the participants:

"Yea so the experience in IIT was really good. The friends I have right now are the best ever. And there is nothing like girl or boy with my friends, they are awesome and I love talking to them and they do not really think this stuff like this is a girl, why should you talk to her with this topic? ..... like suppose I am having periods, I can share it with them also, I am that comfortable with them. I really like all of them." (P16)

They also candidly shared that while building such supportive friendships, they do face initial hesitation but eventually find their tribe of support. As seen from the shared experiences, since the students are adjusting to the new to college life the introductory conversations take time. The skewed ratio of lesser girls in certain branches of engineering adds to this hesitation. However, eventual exposure and time bridges the gap of these gendered interactions. As seen in the below mentioned quote:

"..... But ya, initially, I hesitated for first or second time but then I was comfortable as we knew each other. In our mechanical lab and in our other lab also, I was the only girl so we got to know each other, like there were 9 boys out of 10, but they all were supportive, I didn't hesitate after that. After 2-3 labs, it was ok. But initially of course I hesitated because everything was new and it was the starting of like the whole journey." (P10)

Thus, support in all aspects plays an important role in the journey of these students. It influences their choices, helps them to meet the challenges associated with societal prejudice and to find solace in the friendships that are built on campus.

Need for creating awareness amongst girls about science and engineering careers:

Our participants also insisted that the picture painted by the society about 'appropriate' fields for girls owing to prevalent stereotypes influences the choices of the girls. Thus a need for creating awareness arises to better understand the prospects of a particular field. Girls would benefit if they are given an unfiltered access and a complete picture to explore their field of choice. One of them shared:

" ...the whole hype of engineering and everyone just wanting to take CS and money-minded kind of thing, that's not completely true, it's not the whole picture and there are people who are more research oriented and I actually learnt after coming to college, there is a lot more in Physics that I just have no idea about." (P2)

Once establishing this awareness, women would get the confidence to explore their interests and fields without fear of judgements. This spread of awareness will also decrease the persistent bias in the society, thus encouraging women to pursue careers that demand women to be dynamic. The participants also shared a need to create greater awareness on gender equality is also important.

"There should be a general awareness created you know amongst people about why women are entitled to choose what they want to pursue and there shouldn't be any kind of bias earlier on."

Participants also believe that girls should be encouraged to develop self-belief from a young age so as to help them be more confident while taking decisions. Awareness will empower women to stand for their choices, not fear judgements and follow their calling. One of the participant shared her thought:

"it should be in every woman that they are strong enough to fight for themselves and they will fight for what they want to do in life, rather than just you know letting someone impose ki tumhe ye karna hai, ye karna hai.. so (P8)

A step taken in the direction are measures taken to uplift and support women in Science in the form of internships. In college (during internships placement) certain companies frame policies that would provide support to the girls exploring the field. One such policy adopted by a company is to provide internships to only girls so as to encourage the pursuit of Science by women. However, such policies are perceived by their male counterparts as 'favours' granted to girls or privileges that only these girls can enjoy. As evidently shared by the participant,

" .....there were so many confessions that they are hiring only girls, not boys. Guys were very much pointing it out. Like why don't they hire boys?." (P10)

This leads to generating a feeling of discontent and unfairness in their male counterparts. However, in retrospect the participants felt that the primary need for such policies is overlooked without understanding the intentions of the policy makers as well as the turmoil of the recipients of the benefits of these policies. This is seen when the participant adds, *"But the google step program was only meant for girls, girls in engineering field to come up from the background. So I guess*

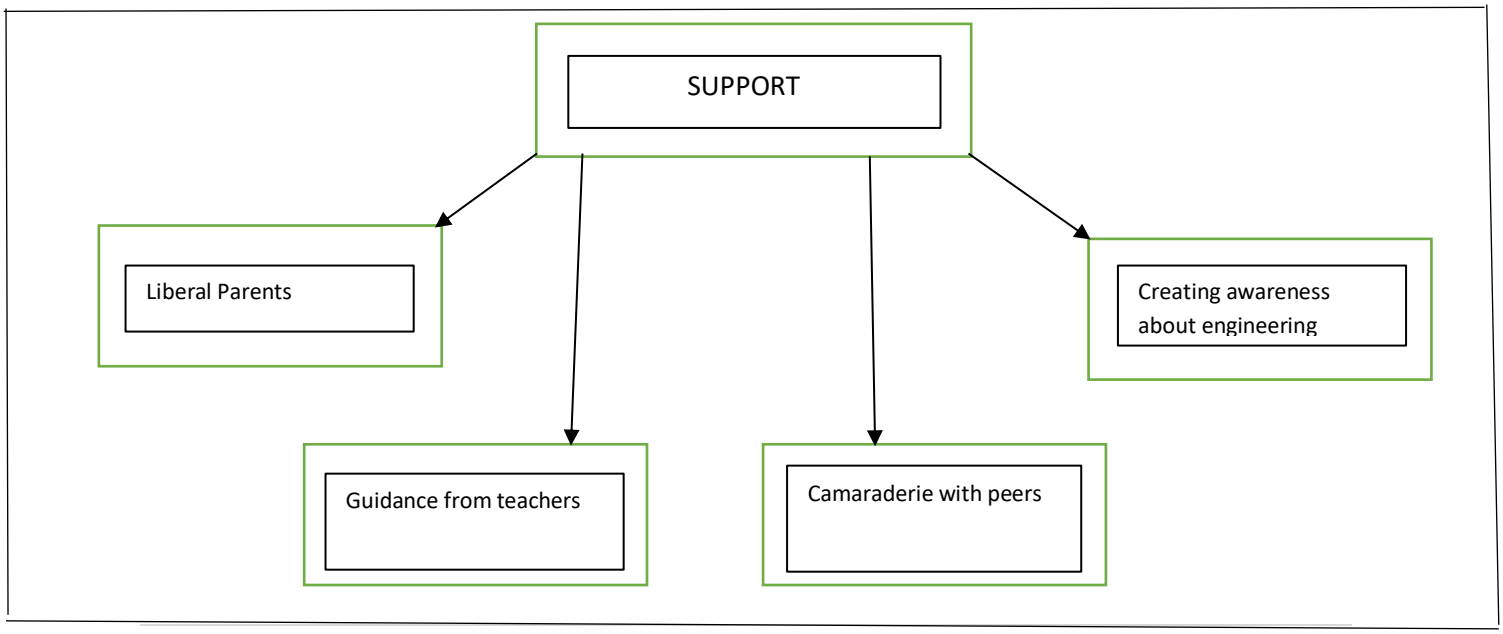
sometimes guys point out without understanding the whole situation or the intention behind the program or the internship that the company provides." (P10)

Thus spreading awareness in the form of open discussions is needed. It would address the misunderstandings of the male students while also initiating a conversation for the need of such policies. Discussion addressing the challenges of women in science is essential for initiating change in these fields. Women in power must be celebrated so as to encourage the younger girls who aim to excel in STEM fields. Spreading this awareness will encourage more girls to pursue the field of their choice. It will also give them the freedom to work on their skills so as to outshine in their future.

The diagram below represents the support received by Female students pursuing Engineering

Figure 3: Representation of sources of support received by female engineering students

The figure is a representation of the sources of support experienced by female students during their journey before and during engineering



Thus from the above elaborated themes it can be seen that the journey of these female students encompasses challenges of myriad nature coupled with support from their surroundings. The shared anecdotes are a testimony to the still prevalent thought of 'Engineering is for boys'. When girls take the step of exploring this male dominated field, their perceptions, choices and decisions are coloured with social messages. Girls are encouraged to opt for fields that are generally 'safer' and are 'female friendly'. Despite such messages, if a girl opts to pursue the route of these gender skewed areas of work, she is made to feel obligated to justify her choices and decisions.

Understanding that such fields are male dominated, it was seen that such a skew resulted in girls (students) experiencing self-doubt and self- censorship. Thus the access to resources available to their male counterparts was not equally enjoyed by these female students. Right from their preparation phase to after entering college women are made to face challenging situations owing to their gender. The steps and provisions taken to help deal with these situations are also interpreted as 'favours' by their counterparts thus making gender conspicuous in nature. These favours result in others overlooking the abilities and achievements of the women engineers thus resulting in discounting. Owing to these situations women themselves are seen to self-censor so as to ease out the process for themselves.

They however also acknowledge the presence of support in their journeys in the form of parents backing their decisions, teachers educating and encouraging them as well as peers sharing a spirited camaraderie with them. These female students also shared the need to spread awareness to better understand their journey and their challenges.

4.3 Thematic Analysis Study 2

The findings of this study bring out specific themes on the challenges faced by our participants while working in organizations, challenges associated to work life balance, different support systems that helped overcome challenges and the ways in which they coped with different challenges. The organizational challenges are about their widely prevalent stereotypes about women and the engineering profession which influenced organizational structures and treatment towards women engineers. Themes on challenges associated with work-life balance bring out the pressures of demanding work and clashing identities. The themes on support bring out both family and organizational support and themes on coping bring out trade-offs, learning and prioritizing by women engineers.

Challenges experienced by women engineers

1. ***Prevalent implicit biases lead to discrimination:***

Stereotypical perceptions about women and what should be their life journeys continue to abound in people's minds even today. Equally strong are the stereotypes of what engineering is and how an engineer should be. Such stereotypes then combine in the form of implicit and explicit bias that women in engineering have to deal with on a regular basis both in the workplace and society in general. In our interviews we found that young women engineers face discrimination right at the start of their careers where employers' actions are guided by the belief that young women would abide by conventional norms, give less priority to their work. One participant shared how in interviews women were actively rejected, despite being capable of focusing on things other than their abilities. As seen in the excerpt below: -

"*In hiring people are passing up a lot of really strong female candidates. They would never do that if they were male and these are real things that are happening even in my company. My mentor told me she was so frustrated because there were some strong female candidates and*

as a group you know when you decide whether you are hiring or not so the guys were bringing up stuff they would never open up if there was a male candidate." (PI , Physics, 2001)

Sometimes they were questioned on their choices as well, specifically studying engineering.

".....uhh the interviews went well. They were very difficult. The first time I talked to my manager, this is a very senior person, however he is an Indian, the first question he asked me before he asked me my name was how come you picked Mechanical Engineering being a girl!? And it was extremely shocking for me and it took me aback and I was like stuck with that for the whole interview. (PI 20, Mechanical, 2014)"

This bias not only operates in the fresher's recruitment but also persists while considering women for promotions and senior positions. The following quote highlights the frustrations of another participant while interviewing for a CXO position.

"..my interviews are very different. And I wonder whether my male colleagues are asked those questions. They tell me you won't get any work-life balance here……why will I ask for a work-life balance? I am applying for a job! The CXO. If I am coming for a CXO role, do you think I am that lame? And I don't know what it means. And did you ask my other colleagues who were also… (Ip: males) interviewing for the CXO role? No. And interestingly, in my last organization, I was the only one who was not cribbing for a work life balance. All my male colleagues were cribbing for a work life balance. That is a bias!! Ladki hai…iska beta hai (She is a woman.. has a son); she will have to go home! It doesn't end there." (PI 1, Civil, 2003)

Further, the participants have suggested that often they are not considered for senior roles especially if it involves travelling, relocating, field work or supervision or even dealing with office politics. The prevalent conviction being women would be unwilling to take on such roles/ promotions that require compromising family time or relocation.

Knowing that confidence doesn't come naturally, what is it that you can do differently as a support system? That is the point. Unnecessary biases- Are vo different location hai, nahi kar payegi, traveling hai… nahi kar payegi, isme bahot saare bande honge, nahi kar payegi; this is a very masculine role.. Nahi kar payegi, this needs someone with a lot of aggression, she is too weak for that- you don't know what she can do. This whole concept, this whole bias thing is so strong that you don't pick us." (PI ,Civil, 2003)

In fact, our participants received social messaging advising them against taking up engineering before they did their degrees, which was guided by the stereotype of engineering as a male occupation. Women face such biased perceptions from family members and 'well-meaning' neighbours and relatives who tell young girls that engineering is not a profession for women. Participants have reported that they were discouraged from taking up engineering for a variety of reasons ranging from "*will be too old*" (for marriage) by the time they finish to "…..*girls don't get into IIT…*" "*or saying she won't be able to work on the shop floor*. However, such statements are made based on the memories of bygone times without taking the efforts to cross-check with the ground reality of contemporary situations. The result, as the next excerpt suggests, is an uninformed bias against women's abilities to deal with the present-day situations.

"*The first thing is just people telling women that it's a man's world and so you can't do it which also implicitly assumes that a man's world is something difficult and a woman is not made up to cope with it. Uhh I've mentored so many girls uhh right after their JEE when they are deciding branches uhh they call me and they say all their uncles have told them arey mechanical engineering me shop floor par kaam karna padta hai tumse nahi hoga mechanical engineering mat lo (one has to work on the shop floor in mechanical engineering, you won't be able to do it, so don't take mechanical) and I think it pisses me off big time, these uncles don't know what Mechanical engineering means these days; so it's just all these stereotypes*

made by people who are not really up to date with what goes on in the world these days; that is a big barrier." *(PI 20, Mechanical, 2014)*

Our participants also reported affirmative action or policies to increase diversity in organizations, resulting in women's abilities being discounted and all their achievements written off, with emphasis on allowances for a diversity candidate. Participants have reported that their male colleagues have developed a bias in their mind that women get hired or promoted only because they are 'women'. Thus, men often discount the experience and expertise of their women colleagues either directly expressing their reservations or sometimes indirectly through jokes.

"*And then a conversation happened, wherein a colleague, male colleague said 'Mch, kya hai; ladki hai na, (diversity?) Ban jayegi' (The deal is she is a girl, diversity!!, will get it) and the moment he trivialized that I was like mujhe nahi banna. (I don't want to do it). And then I was like, I don't want to be this. I don't want to get somewhere, wherein I am in a charity case. I refuse to be a charity case" (PI 1, Civil, 2003)*

At the same time employees (particularly senior), clients and other related personnel like vendors in organizations interpret female gender as symbolic of '*incompetence and inefficiency'.*

"when a woman presents a good idea, you need to be 5 times smarter than the guy for them to take note. ……at a company like NN which is young, the average is 27-28, so I think this generation has no such problems. I think they are growing up knowing women are equally smart and at a place like Facebook. But even now, if I go to a panel discussion where these older people who are experts at finance, it doesn't matter. And I think I also look a little young, so they just ignore you as if you are some junior person, even though I am the main person presenting. Or they only look at the men, they won't even look at you. So all of that still exists

even in countries like the US but I feel there is a definite difference between the younger ones and the old and by old I mean really, 55, 60+ and they just can't accept that a woman can be smart. (PI 12, Metallurgy, 1995)"

"*But there are some male colleagues who are actually not that much capable but they feel very competitive, inferior capability, uhh inferior complex so they used to bring me uhh pull down in meetings so whenever I speak anything before completing my sentence they come in between and start speaking. Although my manager understands because he is a very senior person; other colleagues like who are supportive but they also tell girls to get preference; but this leg pulling sort of thing only those guys do who have inferior complex with respect to a girl connected, 'how can she perform so well'!? Because like if I'm leading one work completely, like I have got a huge financial budget allocated for one of the projects and I am leading that project, so one or two male colleagues they are not ready to accept that how she can get that much financially big project? Whenever they are meeting I feel that they are disturbing. They are not supporting that stuff even in front of outsiders. Also like if any outside supplier is there or any third party is there, they also try to prove that I am not worthy of this project. (PI 21, Electrical, 2010*)"

One of the participants reported that she had trouble getting her juniors to follow her instructions as they looked at her as if she were their '*mothe*r'. Another participant reported that as a young technical manager she found it difficult to get the men on the shop floor to listen to her ideas and suggestions as they dismissed her saying '*she is like their daughter'*. Yet another participant said that she felt that even if she were in the meeting, it was others who took the decision. Such incidents, to cite a few, reveal how women, especially young women are denied the rightful respect and acceptance that is due to their role.

Thus, the above comments of our participants show that one important hurdle experienced by women engineers is the stereotyping of engineering as a male profession. Women are not given acceptance and no real attention is paid to their actual abilities.

2. **Organizational Structures, Practices, Culture accommodating yet not accommodating**

These are the institutional and organizational structures and practices that result in the under-representation of women. To begin, women engineers face limited opportunities in core companies and guidance on possible career opportunities with various specialization results in blocking their career growth.

"*When I came back to India from the US, I was very excited about getting into a chemical company like HLL or PG&E or something like that. And that's when I realized, that wasn't that easy to get into a research lab, not unless you have a Ph.D. or something or if you are a hardcore chemical engineer person, I had kind of gotten into a field where it was a computer simulation of a process and it wasn't a hard core chemical engineering so then I pretty much, I mean that's when I took my break and I kind of worked with my dad" (PI 4, Chemical, 1995)*

Infact, for their male colleagues the support they receive is much more.

"*…definitely I have seen men given a lot of bhav in the sense that more resources are spent on them, even role models, for women it's like whatever, anyway you are going to get married, why; that was the environment I grew up in but then it never bothered me per se..(PI 5, Electronics 1998*)"

Further, the talent profile of engineers is always designed for hiring males in most organizations. As a participant shares in her views about employing women engineers - '*you*

won't get a woman if you are not looking for her'. The excerpt below highlights the problem with hiring practices.

"*I have had conversations with my CEOs and CFO wherein they said, 'we should not hire women!' Just imagine! I went to an HR strategy discussion wherein they said 'we should not hire women'…and this was an unconditional bias, ok…matlab seedha bias, you are gender (inaudible)…we were making the talent profile, typical talent profile-gender-male, kyu bhai? (Why so) 'Milegi to dekh lenge'(We will see if we find 1); it's not about milegi to dekh lenge (we will see if we find 1)…you have screened there already. You already have said that you want a male, you are not looking for females. So how are you going to get female candidates?" (PI 1, Civil, 2003)*

Or sometimes women are brought in for client meetings without really contributing to the project to show greater diversity in the organization.

"In fact, sometimes it's the other way round, they make a show, they intentionally bring women from other teams and during the client visit they want to show (I: Diversity..)that we have so many women. So off late, in the last 2-3 years, I encountered some situations like this where they were asking us to just join some client meetings, even if we were not very much involved with the client and all of that (PI 2, Instrumentation and Control, 1997)"

Another practice that women find tricky to deal with is that of being pushed into Human Resources and Sales and Marketing roles. Many participants shared incidents of being assigned to roles that were client facing or asked to do more client interaction tasks, sometimes even when they are not part of the projects.

"I mean even when I was at the start up as a research engineer building this amazing instrument which was the research work they constantly were putting me in front of customers

and I always thought it's because I had good communication skills and I'm sure there is a little of that but its only its after a couple of other people other women who faced similar things, they pointed out they constantly try to push women in these marketing customer facing roles because then you know customers want to come back and talk to them cause they are women so umm that part hadn't occur to me so but yeah I do feel like umm no matter which role I was in I definitely felt a lot of push to do more marketing and sales and customer facing stuff." (PI 15, Physics, 2001)

"Umm I did constantly feel a push umm from men to again because I'm a woman so pushing me into more marketing like roles I would go in and interview for a technical position, a research position, and at the interview somebody would say oh you will be so good at the marketing role" (PI 15, Physics, 2001)

The organizational cultures also tend to be aligned to male ways of behaving in the organization, speaking more, giving visibility to one's work, highlighting one's achievements etc. Women on the other hand may do the work and expect that work to speak for itself which our participants found was not enough. The participants shared their realization that just doing the work is not enough, but to 'talk' about it is important and gain visibility. However, women have to walk a tightrope as they try to balance between adhering to the corporate culture of being vocal and 'highlighting their achievements' for getting promotions and yet not sound 'braggy'. Thus, as the next quote highlights, women sometimes change their inherent nature in order to navigate such corporate practices, however that often leads to a different set of challenges.

"…and women they are very quiet they don't say stuff and what happens is to that manager all he is hearing is this guy who is doing amazing stuff while you know the girl is not saying anything and so that's when I was like oh my god I do the exact same thing and so I had to be

change and I was like I start touting and you know talking about my accomplishments you know I did this and did this and you don't wanna sound braggy because a woman cannot be braggy, so you have to do it in a subtle way where you are telling them hey you know what I got this result I wanted to talk to you about it you know. I totally agree I would not have done there, these are not intuitive to me you know but these are the things we need to learn to survive in the men's world because that's what men are like yeah." (PI 15, Physics, 2001)

Further, the nature of certain tasks in engineering may require standing on the shop floor for long hours. Common perception in organizations is women may not want to do the physically demanding roles that require standing or bending over for long hours for supervision or lifting heavy equipment. Our participants have had to ask to be given those challenging roles which would be denied to them due to the common perception.

" *I had a project in which I had to travel back and forth to vendor you know and stand in the uhh they were doing casting and casting is a very heating process and it's just very dirty so they were just ok maybe XYZ can't so let's give it to someone else I said why can't I do it I would go everyday. And it was difficult but I did it because I liked it so that feeling comes. Infact some of my peers in Bajaj they would say maybe after some time you would want to join HR, so I said why, do you think my technical knowledge is any lesser than you, we will meet in next 3 years I would say*." *(PI 19, Mechanical 2012)*

Our participants also shared experiences of practices in organizations like flexi-timings the intent of which has been to help employees lead a better work-life balance. However, these have created challenges, as mostly women take advantage of these in an attempt to balance both work and family responsibilities. As a participant observed,

"*I always work through lunch because I don't have time to stay back in the evening. I need to get home, I have other things to be taken care of…*" *(PI 13, Chemical, 1999).*

However, on the contrary organizational culture of working long hours, generally work longer hours often seemingly working overtime. The participants report however, that the overtime is necessitated because a good amount of actual work hours are spent in 'socializing' instead of working and women who leave earlier than that are treated as 'slackers'.

A participant claimed "*Guys spend a lot of time at work. They are putting in 12 hours, 14 hours, out of that mostly 6 hours, 8 hours is gossiping*" *(PI 1,Civil, 2003).*

"I was leaving work on time and there were still people working on the project, there were still people sitting late and doing their work and I had a young child at home, I had to get home, you know I didn't want to leave him at daycare for so long, so I left on time and the guy who entered the elevator with me, he was going from one project floor to another floor and I was going all the way down because I was going to my car and he sarcastically made a comment saying 'Oh, you are leaving on time!' and now I was really like ok! You are not my supervisor, you don't know what work I have done throughout the day, you don't know if I am on track or not on my deliverables, so, that time I did not stay silent and because he made a sarcastic remark at me, I went back at him and I said "you know some people are more efficient than you would think!" And that's all I said. I kind of went back at him saying you are here because you have not finished your work, you are not as efficient as…, I am efficient, I am done and I am going. So that was another incident. "(PI 12, Metallurgy, 1995)

"*.....But our male employees who still work till 10 o' clock in the office, but women can't do that just not possible for safety, also she has to manage her house, there is a baby also right so those things then it becomes uhh perception you know uhh ok she is just taking it easy but she is not taking it easy she is trying to manage everything you know so that pressure comes along*

from the peers also because you know peers try to work more to I don't know so that is there I mean and it's not spoken of but we know it's there." (PI 19, Mechanical, 2012)

Further, as the following quote highlights flexi-timing is also used by the corporates as a tool to enable coordination with international partners resulting in unnatural work hours and fast paced delivery requirements which further creates more demands on women

"But the whole IT industry itself is very demanding on time, so that's how this place works. It needs your time. The on-site part of the IT industry and, which is what creates all the late nights, evening calls, early morning calls; I think that part, making that work while you take care of your other commitments is not easy." (PI 6, MEMS, 1997)

Another structural challenge faced by freshers or new employees was lack of female washrooms in their workplaces. In those setups where there were female toilets these were still definitely lesser in number than male washrooms. While this situation is slowly improving with an increasing number of women, the existing structures of the corporate work life are still not very conducive to starting a family. Frequent travel, field work, lack of even basic infrastructure like adequate toilets, lactation rooms and crèches or childcare facilities for women who are–back after maternity break make it very difficult to continue working and performing at the same level as before. Companies also have a casual and sometimes inappropriate attitude towards maternity. While one participant narrates that her company classified maternity leave as a 'short term disability', another participant reported that work from home facility for pregnant women isn't easily approved since a woman is supposed to deal with the 'consequences' of her choice to get pregnant. The maternity leave in itself is greatly limited ranging from 6 weeks (in international companies) to 6 months (Indian companies), barely enough for the physical recovery of childbirth but not enough for being able perform while attending to the demands of caring for a new-born baby.

"*Before that I was traveling like crazy and I couldn't travel anymore because of my son and I wanted to take up an office kind of a role, proper office. During those times there were no systems across, in place which would allow that, agar company ko aape taras ata hai or opportunity hai at all then you will get it. There was no fixed way of actually managing that transition because everything was built for men. I went into projects, working around factories, where there were no ladies' toilets. I was the only lady in the full factory. (PI1, Civil, 2003)"*

As the above quote highlights, lack of proper systems that will help a woman to transition to a less demanding job-role coupled with ineffective maternity policies also add on to the difficulties.

Organisational practices create unequal work spaces resulting in women not getting required facilities in terms of working conditions especially at sites like lack of washroom facilities or even within offices absence of lactation rooms for nursing mothers.

One participant reported, "*The challenge actually, one challenge I had was at the workplace. Umm so I, I was going to, I was still breast feeding him, right, so I had a breast pump that I needed to carry to work, pump the milk over there and at that time, they did not have any, now this is in 2006, they did not have any maternity room in the office, zero. So then we went to management, we went to HR and we said you guys need to do something about this, then they gave us 1 room and then when I went to the room for the first time, it was like a storage room. It had stuff everywhere and then in one place they had a chair and a table and an electric outlet, because the breast pumps are electric, but the atmosphere you know, where you need to be in a good place, it wasn't, it wasn't there." (PI 13, Chemical, 1999)*

A mid-way solution out of these difficulties, is to take an extended maternity break. However, due to the ever-changing nature of the field in IT jobs, women find themselves under pressure attempting to keep pace with the newest trends and technologies. They find it difficult to keep upskilling themselves in order to stay 'relevant'. They face a major discounting of their skills and abilities acquired so far when they try to re-enter the workforce after an extended period of break. With no systems specifically designed to absorb their returning to the workforce, they have to compete with the new entrants for the same roles and face difficulties like being too old or too experienced for the available job roles. For the roles more suited to their expertise level however, they are denied because of the missing period in their resume.

"she went on a maternity leave and came back it just uhh.. her infrastructure that she built on her experience and her you know work, it just crumbled you know it just changed everything you know, and she was not looked after for the next…for the next role you know so that is there, that is definitely there and it scares me also a bit, to tell you the truth." (PI 19, Mechanical, 2012)

Further efforts by organizations that aim to help women who may have taken a break also target younger women. Such options do not exist for women in senior roles.

"There is a lot of pressure in the IT industry today to go on upskilling yourself, these are moving too fast in the IT industry… Very few I have heard who have been very compassionate to actually consider reskilling people. So that is one big area where people must say that you can teach the same people, it doesn't take as much time as going out retraining themselves, and then it becomes very difficult to come back. And I looked at a lot of websites when I was trying to get back, reboot, ….. (I: I think Tata's have a website) all of them are entry level jobs or a 5-year experience, nothing for senior women, or like digital marketing, there was nothing for senior kind of women, that is what I found." (PI 3, Electronics, 1995)

3. Exercising Voice: challenging yet essential

Women speaking voice and exercising voice is important, to stand up for themselves however, many participants shared in their initial experiences they did not engage in exercising voice. But over time they realised it is important for them to speak up and fight back for themselves.

"...there have been instances where sometimes you think a lot of things, but you don't say or do anything about it right away. I think it's important to do it, but at that time, I didn't do it, I just took it in my stride. It's like sometimes you get teased on the street, you can choose to go back and fight, or you can ignore and walk away. So I have mostly been the kind who has ignored and walked away; now I feel I should go back and fight or I should have fought."(PI 8, Civil, 1996)

However, there is a downside of women engineers from freely speaking up, they are judged by colleagues as typical women who are complaining.

"*…we just felt that we had to put up with it, and it was us, it was on us to have a thick skin and just let it go and if we complain, people are like, ugh, she is just like, a typical woman." (PI 10, Computer Science, 1990)*

While our participants acknowledged the importance of speaking up they accepted internal hesitations that held them back. This hesitation may emerge from the socialization in the Indian culture that girls receive that expects girls to speak less or not speak irrelevantly. Hence the hesitation about what would be the right thing to speak.

" *in India, how we grew up, the culture is bekkar ki cheeze mat bolna, logoke saamne ulta pulta mat bol dena , so you kind of grow up with the notion ki accha mai bol dungi to bevkoof toh nahi sound karungi na, so now what I have made peace with myself is mujhe jitna aata hai, I know that and utna hi mai kar sakti hu. I will never claim that I know too much, mai sab kar*

dungi, lekin jitna mera capacity hai, I will try to deliver my best within that capacity, so know that and do not…" *(PI 11, Electrical and electronics, 1997)*

Sometimes organizational practices that don't value contributions, opinions of women engineers can make it difficult for the women to speak up.

"And you know sometimes people don't speak up because they feel that their opinion is not valued. If you make them feel that way then you know then that is a problem. Yeah and then we can't blame the women you know why did you not speak up. So I think it's a balance, I am not saying that it's always the fault of one side or the other side, but I also feel like umm sometimes people default and believe that others are not going to value my opinion and don't speak up, so you know that should never happen." (PI 16, Aerospace Engineering, 2009)

A participant reiterated that even for those who are quieter they also need to speak up for themselves.

"So there are people who are very outspoken and aggressive and they want to make a point. I don't know, so I think it all depends, I think if you go overboard also, it can go against you, but its very important at a minimum, when somebody tries to make it seem that your point is silly or that its not valid, you have to fight for yourself." (P 12, MEMS,1995)

Also, our participants bring out that in comparison to male colleagues they find they have to work harder to get their point across in meetings.

"I wouldn't say something harsh, but as simple as, let's say there is a meeting and you are proposing a really important point and an idea; it takes so much for a woman to get noticed. But if the man says the same thing, of course it is a great idea and everybody pats him on his back. So these are the small things which are prevalent even at Fk." (PI 12, MEMS, 1995)

But then male colleagues can interrupt, cut their sentences or talk over them and they have had to set boundaries with their managers about the same.

"*I know there are certain times when people try to talk on top of you and peeche se jaake kisi se baat karte hai. Mere sath bhi aisa hua hai ek do baar. So I have told my manager. Itna mujhe aata hia, itna mujhe kaam do, jyada expect mat karo but I don't want people to come and step into my work. So now I am very clear*." *(PI 11, Electrical and electronics, 1997)*

A participant iterated that teaching women what to speak, so as to effectively assert their contribution in the company is important. For some this may involve being taught to make the '*elevator pitch'* ready, whereas for others learning to talk about their achievements '*in numbers'* like percentage increase, profit value, etc.

"We have to do it ourselves also, because sometimes there are.., especially when we were growing up there was this thing right oh she is behaving like a man, or whatever, there are these set templates. So, you are also torn between you want to be liked by everybody, you want to save face. To have a clear sense in your head, that wasn't there, so I think yeah, you should (I: speak up more). It seems logical now, to think of where to speak up and where to shut up." (P 8, Civil, 1996)

This theme brings out the importance of speaking up, standing up for themselves, for women engineers in the workplace, however, the traditional Indian nurturing, the attitudes and biased perceptions of their male colleagues do create hurdles in their being able to exercise voice. The scenario our participants described seems to show that women need to try harder, louder, more assertively to get attention and at the same time they are judged as too aggressive, complaining unwoman like or typical women. Summarizing out participants still emphasize the need to encourage women engineers to be more vocal.

4.**Encountering Benevolent sexism: protecting and *unabling***

This theme highlights the experiences of our participants that point to benevolent sexism faced by women engineers both as students and later in their professions. Benevolent sexism points to the idea that men behave in ways, shaped by their stereotypical beliefs, to protect women engineers from struggles that accompany doing *laborious* work. This *laborious* work can be protecting from physically challenging work or physical safety while meeting client. The underlying stereotypical belief would be a product of gender role stereotyping of women as being physically weaker than men in performing certain types of tasks. Our participants shared that as students their male classmates, or lab attendants would offer to do physically laborious tasks for them guided by the belief that women may not be physically able to do such work.

One participant who had pursued computer engineering reported,

"…there were some men, some guys, who I do remember that at one time you know we were doing this micro-processor coding and this guy who was my partner said, you don't worry about it, I will do it..." (PI 10, Computer Science, 1990).

However, our participant acknowledged that at that young age it might seem like an easy solution but in retrospect she realized it was also a loss of learning opportunity as well as it resulted in reinforcing sexist belief in their profession.

"*so when we were doing machine drilling on the lake, the guys would always say, 'hey don't worry, we will do it for you' and that time I always felt that yay, nice yaar, you will do it wow, that's great! But if you reflect that it takes away from the learning and there is that discrimination- both in the guy's mind but also in my mind, you do I will stay, that's the danger of these stereotypes." (PI 10, Computer Science,1990)*

Such instances of benevolent sexism may not only be restricted to classroom scenario but is prevalent largely within the culture of the organisations which do not permit women to take up

certain kinds of work role. The most prominent instance would be not having women employees talk to external vendors or not permitting women to stay late in the office for work mostly due lack of facilities like proper transportation. As one participant shared:

"*Still like girls are very less there if any complaint happens it will come on their record, so they don't want to compromise on that. so this is the situation, for local vendors I am not allowed to go outside but if anybody is coming from Germany, I can meet them inside the plant but for lunch and dinner someone should be there with me, I am not allowed to go alone in meetings*" *(PI 21, Electrical, 2010).*

"*Ya, like so if there is a requirement of going outside from XXX Plant or Office, like I have to go interact with vendors or with some supplier he(supervisor) prefers to send from the male group not me. It's because he is a bit caring towards me. That is also one of the reasons it's not because of only gender, it's back in their mind it goes to a very senior person 55 years old that if she is a girl I should not send her outside.*" *(PI 21, Electrical, 2010).*

The above comments of the participants bring out how classmates and co-workers' behaviour of helping emanates from the stereotypical beliefs that women need protecting and help. Despite the goodwill of these male co-workers these are sexist practices which limit the growth and learning of women engineers, only furthers their dependence on others.

4. Experiencing Micro aggression

The participants shared receiving different forms of micro-aggressions during their journey of becoming an engineer and while working in organizations. They experienced micro-aggression in the form of hooting from classmates when they entered their classes in the engineering colleges or other forms of inappropriate behaviour like encountering remarks passed at them on campus often making them uncomfortable.

"*like when we walk past hostels right..., so we might walk past hostelM (name changed to protect identity) and the guys would like call out the names of our class, so like if I was walking past with a friend from civil engineering or something, the guys would call out names of like the mechanical and civil engineering guys who were from our year there so kind of like teasing them about us" (PI 14, Mechanical, 1991).*

Within organisations participants reported other subtle forms of aggressive behaviour from managers and colleagues where jokes were made about women's abilities or their contribution to work. Belittling women, questioning their abilities are some common acts that are done by men to establish their superiority over women in a male dominated set-up. Many of these aggressive acts might be subtle, that many people may not call it for what it is. As our participant shared:

"*I had just joined X TV and another team sent out an email to his team saying,' oh my god, that team they don't know what they are doing, do they have good engineers? Do they know how to test? Do they even know how to hire people? and you know it was totally like a micro-aggression, if he felt that he could have reached out to me and asked me. Isn't that what you would do to any colleague of yours, but he felt the need to malign the team in this underhanded way which in part you could say, he was overreacting S and it was what most people told me, you are overreacting. But I don't think it is over-reacting, I think it is micro-aggression." (PI 10, Computer Science,1990).*

These micro-aggressions leave women feeling less valued and inadequate in the profession, as shared by a participant:

"*Ki I am like itna ghasa maine life mai.(I have worked so hard in life).. I had to go through such grind in life, even your bloody interviews were such torturous that it would make me feel*

what I don't want to feel which unfortunately is being a woman and being the one who doesn't have that, whatever, entitlement."

5. Experiencing Micro-inequities

Our participants shared experiencing micro-inequities at different stages in their careers. These involve not being allowed to work on projects that might involve long hours with the excuse of lack of infrastructure like transport facilities for their safety or being offered roles which are human relations based despite holding technical degrees and interest to work in technical profiles. As the following extract shows:

"*In fact some of my peers in X, they would say maybe after some time you would want to join HR, so I said why, do you think my technical knowledge is any less than you, we will meet in the next 3 years I would say." (PI 12, Mechanical, 2012).*

The following quote by a participant shows the stereotypes that organisations often hold while recruiting women. It also points out that women are assigned roles in the organisation that correlate with the general stereotypes of their gender.

"*Most of the HR managers tend to be women uhh so in order to have gas sales pipelines very well our team was heavy on women on our team as well like there were more head hunters on our team working over there uhh and also because we were reaching out to job seekers like anything which involves calling ops, calling customer service I think they tend to like to have women because they have a more soothing effect like this is what I would put it out crudely." (PI 17, Mechanical, 2013).*

Other forms of inequities would include, questioning the competence and commitment of women, or judging their performance inadequate because they are women. As seen in the extract below:

"*He used to make life really difficult for me no matter how much I get my hands dirty he just always assumed that because I am a girl I am not putting enough efforts and I need to do more so I would always hear things like you need to get your hands dirty, you need to get like every time you go to a test you need to get under the car look at all the bolts and oil and what not and like really rubbish advice just to make me feel like I am not… I'm being girly and I am not doing enough." (PI 20, Mechanical,2014)*.

These quotes do bring out the inequalities that women engineers face in their professions only because they are women, their abilities and effort put in performing a task are always judged not enough because of their gender and more demands are created on the women to prove their worth.

6. Exclusion from informal networks resulting in isolation and loneliness

Exclusion of women from informal networks can be seen throughout the career trajectories. Instances of exclusion start early on in the career, when they start their engineering education. Most participants reported being a numerical minority in their class, they were often excluded by boys from their groups while informal interactions took place.

"*The first year when I was there, I was totally overwhelmed by the number of boys in the institute, it just totally overshadows women over there. One, we all were there from such a protective environment, we are not confident about ourselves, we are not ready to stand for ourselves at that point, that all kind of makes it really difficult. But yes, I survived there (laughs)." (PI 4, Chemical, 1995)*

Further, there is a lot of social awkwardness amongst boys in interacting with the girls. Also, as the hostels for boys and girls are located away from each other, few opportunities for social interaction are there. Hence, girls face the drawback of missing out on all group learning opportunities.

"*You know if I think about why I was sleeping only 4 hours a night, it's because I did not get to learn by discussing with anybody. I could not, and so, if I had to do well, I had to sit down and do it all by myself.*" *(PI 3, Electrical, 1998).*

Sometimes being singled out and rejected because of one's gender was a painful situation faced by girl students.

"*Actually the worst experience that I had was probably, when we had to do practical training in the 3rd year or something. I was supposed to go to Godrej which was down the hill and I was with 2 of my classmates who were also, and the person who was there looked at us and was like no no go back, talk to your professor and they didn't tell us anything. And what they told the professor was they don't allow women on the shop floor and so they didn't want me and so then it was like ok fine others can go back and start next week, but find me something else as a.. and which was kind of, I mean I sort of can see their point of view, I mean but to me that felt pretty bad as a person in the class right. So, in that sense then, there were no signs of you know like protesting that or taking a stand or anything. So, I don't think that anybody supported us." (PI 14, Mechanical 1991)*

Such forms of exclusion continue even within the organisational set-up however, the costs of such exclusion may be different. Participants have reported that a lot of organisational information is shared over informal discussions at dinners and drinks after work. As shared by a participant,

"*There definitely is. You know going after work for happy hours for example, having drinks and I will go once in a while too, but I will just want to come home because I want to be with the kids and so I, yeah I think some work does get done over drinks as well. There's that."* (PI 10, *Computer Science, 1990).*

The consequence of this, as reported by women, is impeding of career growth as a lot of opportunities may open up during such discussions. In support of this one participant has stated, "*So I have never enjoyed socializing in the evening and like I said for the longest time I used to come home early. Umm, I never bothered to do those. And that also may be the reason I could have risen to the top much earlier than I did."* (PI 10, *Computer Science, 1990).*

Women are either intentionally kept out of such networks as men may not feel comfortable with women around while having informal discussions or would like to maintain boundaries identified by social norms. However, whatever the reason the end result is women feel isolated and excluded.

"In some ways I feel like India was actually better in dealing with technical women, but definitely there were situations where they would go and shake hands with everybody and like leave me out of the thing because they don't want to touch women. And again you can sort of understand all this but it doesn't make you feel better or at home and you feel excluded." (PI 14, Mechanical, 1991)

Women have reported certain coping strategies to deal with such exclusion by making a conscious effort to initiate conversations and increasing their social interaction but doing it in ways that are comfortable for them. One participant commented:

"*I put in a lot of effort myself to like to go out and have coffee with people like whatever works for me, so I will have breakfast with them or have coffee with them, so those are the things that work for me." (PI 10, Computer Science, 1990)*

The exclusion from peer groups largely composed of male students and from social networks at work many women engineers shared, facing a journey where they experienced isolation and loneliness at many stages.

Firstly, as students, sometimes being the only girl in the class resulted in isolation, their journey into the field of engineering was a lonely academic journey with no opportunities for group work or shared learning. Due to the skewed gender ratio in the class, they did their projects individually as the boys formed their own study groups with hostel mates, while the girl, sometimes the only one in the class, would be automatically be left out.

"*So while nobody was like, I don't feel like anybody was particularly trying to discriminate against me, It was obviously difficult because there was nobody in the hostel nearby to ask for homework or do homework with or pick for projects and so on, it was kind of difficult. And again, I felt like I had to attend all my lectures because if I missed nobody would tell me that there is a quiz next time, it may not occur to them… I don't know." (PI 14, Mechanical 1991*)

Also, even if they wanted to include their female classmates, most of the ideas and discussions happened after class, late at night, in boys' hostels which were far away from the girls' hostel. Therefore, it became difficult to discuss ideas and projects with male classmates post class hours and especially late at night. As seen in the extract below:

"it's just like, groups form around our hostel, so like you walk to hostel together, you sit together, you do homework, projects together, you land projects together and again Hostel F(name changed to protect identity) is like at the other end of campus so it's definitely inconvenient to work with me compared to other somebody who is in your hostel or in and around.." (PI 14, Mechanical, 1991)

Apart from this, there were only a few senior girls in each department to whom these girls could look up to due to the skewed gender patterns across years. Thus, girls would find it difficult to manage most of the projects on their own and often felt that they were missing out on group learning experiences which sometimes lead to better conceptual clarification.

"*Even the seniors in the hostel, there would be like 0, 1 or 2 over the remaining years. so even things like finding textbooks or copies of notes and just learning about which advisors to pick and stuff like that, you have much less networks of information." (PI 14, Mechanical, 1991)*

This isolation at a young age while they were student's exclusion resulted in many girls losing interest in a particular topic and the subject in general due to lack of sharing of ideas or getting a variety of perspectives which is only possible in a group set-up. One participant said,

"So, as I said I was the only girl and very harsh environment, so there was no way to start to love the subject by working together with everyone, because you keep doing everything alone, there's only so much you can say that is fun or you keep going to the professor; and some of the projects at IIT are so cool, even the ED stuff or the workshop stuff". (PI 12, Metallurgy, 1995).

This isolation made the entire academic journey of engineering a very lonely one for the girls, where in the IIT's the rigors of course work was faced by the girls largely being secluded and lonely. As one participant reported,

"So I was the only girl in the class of 40 and my IIT experience was not pleasant at all". (PI 10, Computer Science, 1990).

Not having friends or classmates to support for academic and non-academic purposes make it a challenge to survive through engineering. Further, as many girls come from conservative homes and their reticence and reserve results in a lot of hostility towards them. As shared by our participants:

"*I told you I had an arranged marriage, I come from a conservative background, no desire to have a boyfriend so if that's your outlook when you come in, my God, its hostile. They treat you with so much hostility, its literally, oh she thinks too much. So, one category will say you are arrogant and you kind of think too much about yourself which is why you stay aloof or*

*there's all kinds of things they will say and the only way to defend yourself is to be super independen*t." *(PI 14, Mechanical, 1991)*

"*…overwhelmed by the number of boys in the institute, it just totally overshadows women over there. One we all there from such a protective environment, we are not confident about ourselves, we are not ready to stand for ourselves at that point, that all kind of makes it really difficult. But yes, I survived there (laughs) (I: which is a big achievement, I have to say that). yeah. But you know when I look back at it, I kind of feel I wish I was a little bit more confident in the institute, and I probably would have done way better if I was. (PI 4, Chemical, 1995)*

Looking back at their experiences as young engineering students, a number of our participants shared that they felt isolated and lonely as they would be the only girl in the batch. This meant they were not included in group assignments, discussions and projects. Doing everything on their own. Later in their careers they still experience exclusion from the '*boys club*' as they are unable to join after work drinks and dinner due to their personal commitments. However, some of them have devised their own ways of dealing with it by having coffee and breakfast interactions whenever possible.

7. Token service to diversity causes more problems

As the focus on diversity in organizations has increased in the last few years our participants shared some challenges they experienced with attempts at bringing in diversity in organizations. Our participants share that while diversity hiring may happen, not much is done to help include the person in the organization, and if that person leaves it confirms the stereotypical beliefs.

You did a diversity hire, fantastic initiative. What did you do to make sure that they didn't leave? You kept proving the point that "ladki hai na isiliye ye…she couldn't last…..When you

hire a diversity candidate, be open to the fact that views will be different. Are you open to that? Are you okay with seeing something different than the normal. So aap sirf diversity ka fund rakh ke hiring karke you are not going to solve the problem (PI 1, Civil, 2003)

Others also point our that such drives may not really have much concrete actionable items that really help women grow in their careers keeping in mind harsh realities of life.

Although now many companies have this diversity drive and this and that, but I have not seen anything concrete, you know, like something which I liked, where how to integrate women back into the workforce after having a child, after having a break because of a child or a marriage or anything and how to support them and how to make sure that they are still able to grow their careers, so that is something which I feel is missing. (PI 2, Instrumentation and control, 1997)

And even if the organization desires and attempts to bring in change, however, the field of technology is still male dominated and other external entities may not be open to working with women.

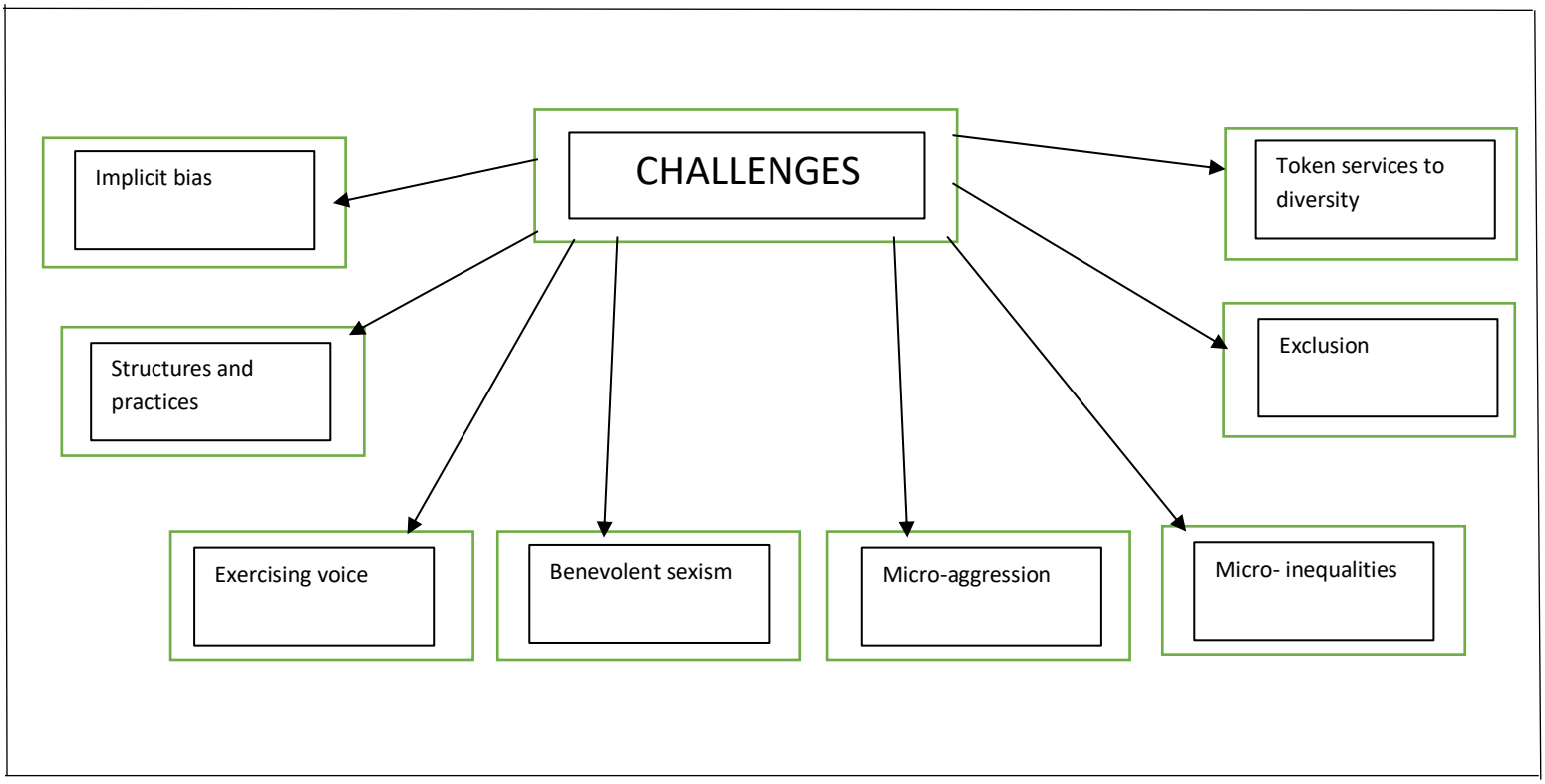
"But you know, still, it's a bit limiting. So that will be one challenge. I think, sometimes you know, while B is very inclusive, uhh, you know wants to have diversity, clients, at the end of the day we are in a service sector, clients are not necessarily like that. For example, you find a client who is not very interested in what women have to say then it's going to be a tough sell and you know there's no way to crack it. So that's the other thing. Third thing, challenging is the sector which I have chosen, technology as it has less women, you know, working with CIOs or Digital heads, mostly it's the male dominated field, unless you know you are talking about startups. So, yeah, in that field getting a women's perspective or bringing diversity to the conversation, just making sure people are open to the idea is difficult, people are a lot more

open minded now for diversity, but within technology you know, it might still, there might be still some men's clubs, I feel." (PI 16, Aerospace, 2009)

The diagram below summarizes the themes under 'challenges'. It is a representation of the challenges faced by women engineers.

Figure 4: Representation of the challenges faced by women in Engineering

The figure is a representation of the challenges faced by women in Engineering



Work Life Challenges

The next set of themes talks about the challenges associated with work-life balance of women engineers. The challenges that women have faced to maintain an effective balance is not just limited to their own expectations about finding a balance between work and personal lives but is also heavily influenced by the societal ideas of gender roles. Further, as women engineers become mothers she experiences conflicts between her identities one of a mother and a "primary care-giver" and the other her professional identity.

1. ***Shifting base for the partner and resultant loss of career opportunities***

An important challenge woman face as part of the work-life balance is shifting bases, in line with the spouses' career moves. Often this involves the spouse getting a job abroad or moving to a different city due to better work opportunities, while, for women these shifts result in leaving opportunities and starting at lower levels in the corporate ladder. Despite poor career opportunities but due to social norms, women shift locations as part of their familial responsibility. Those who have undergone such shifts have reported difficulty in getting job roles of their choice, commiserating their qualifications and seniority, and experiencing hardships in getting acquainted to different work cultures. For those, who have shifted countries, a major difficulty has been getting proper work Visas, compromising on salary and other perks, apart from not being able to get a desired work role as per qualifications. One participant reported,

"then I decided to get married and my husband was in the US. At the point where my career was really going upward, but I couldn't get a transfer and all, so I had to put in my papers and

move to the US. For about 2 years I was cooking and cleaning and totally frustrated and I thought if I don't get a work visa. (PI 3, Electronics,1995)"

None of our participants shared instances where their spouses moved for a better role for the wife's career.

2. ***Re-strategizing with less demanding job roles for work-family balance.***

Another challenge frequently shared by women was compromising on their desired job role to meet the demands of motherhood. Most of these women have emphasised their identity of being the primary care giver to their children took priority and thereby they chose a job role to suit that identity. Such role provided flexible work hours and less/no travel demands. One participant noted,

"*I changed my role and I found a QA role which was never really my dream role, but it was something that would allow me flexible timings, work from home and it will allow me to look after children, so I thought temporarily I will just do that for some time".*

An important factor that have been given due importance by women are the travel demands associated with a job role; this is especially prominent for married women and even more for those who are mothers. The primary idea behind choosing roles with less travel is to avoid staying away from the child for longer durations. A woman engineer, mother of two reported,

"*Also I had children, so I didn't want to travel outside of the country, stay within the country and preferably not travel much. The technical role was driven by both of these factors, that kind of guaranteed you the opportunity to not have to travel, work independently, work from home and all was not there, but there were different offices".* (PI 8, *Civil, 1996).*

The identity of being a primary care giver taking a central position in their life is further confirmed by the fact that women acknowledged they were willing to take up travel for their jobs if they did not children. Hence, women chose more job roles that allow meeting demands of motherhood instead of those job roles that are interesting, match their expertise and give them career growth.

3. Role expectations post marriage to follow traditional gender roles as a wife

A persistent pressure that women feel is the society's expectation of gender role for women that entails prioritizing familial responsibility. These expectations may be internalized by women or pressure may also come from external sources from immediate family members like in-laws or parents. One married participant who shared the same profession as her spouse reported about her in-laws expectations of her,

"*Just that, when I was with my in-laws, so once you go home, 'khana banao, breakfast banao' (prepare lunch, prepare breakfast) and 'khana banana nahi aata hai!(Doesn't know how to cook!)' and I was very bad, I didn't know how to cook. So initially, that was the, I think more than the work, it was, to manage house and you know rishtedaar (relatives) and I got married so people had some expectations." (PI 11, Electrical, 1997).*

4. ***Psychological struggles to of new mothers conflicting with work demands***

The participants also shared experiences of psychological struggles they underwent like post-partum depression. Participants have reported of struggling through post-partum depression along with hectic work schedules. A participant's comment highlights this struggle:

"*this happened at the time my son was born and I also had a post partum depression as well which is again a topic which everyone knows now; at that time no one knew (laughs)..and with*

a PPD if you are working 12 hours and you have in laws at home whom you have got for the first time at home and uhh have a cute kid whose born and you are always scared for him, because you were never trained to become a mother, right?"(PI1, Civil, 2003).

5***) Demanding work cultures and absence of facilities like day care***

The policy related challenges that women face most frequently are hectic work schedules and absence of day care facilities at work. What comes across through the findings is that having proper day care centres in place within an organisation can ease the work-life challenges for women. However, most organisations do not provide such facilities, even if they do, they are very expensive and therefore becomes very difficult for these women to use them. Women therefore look for these centres outside organisations which may come with its own share of complications. A fitting day care centre may be located at a distance from the office space, which makes it difficult for women to keep a continuous check on their children or constant commute to these centres result in physical exhaustion. Other than that, finding a reliable day care centre outside organisations have been a constant source of worry for these women and these stressors spill on to their day-to-day performance at work. Finally, a lack of internal day care centres may compel women to leave their jobs if they do not want to leave their children out of their sight for long durations. One participant shared:

"*And we didn't want to really have a maid and we didn't want to just leave AA by himself and I took almost a year's break at that time". (PI 4, Chemical,1995).*

To compound on to these struggles are the long working hours that women put at work. The hectic work schedules make it even more difficult for women to distribute their time at home and work evenly. The work culture of a particular country may also complicate issues of work life balance. In this context, one participant working in UK reported,

"*Oh, the work culture is very very different in India vs UK. I think in India, the society is organized very very differently. 1 because of the support system you get at home, 2 the work life balance expectations are very different in India.*" (PI 16, *Aerospace, 2009)*.

In India, availability of help for housework often allows for extended hours of work beyond the stipulated office hours which may not be the case in countries where availability and using such help is not common. To support this, one participant experience of working in both cultures shares,

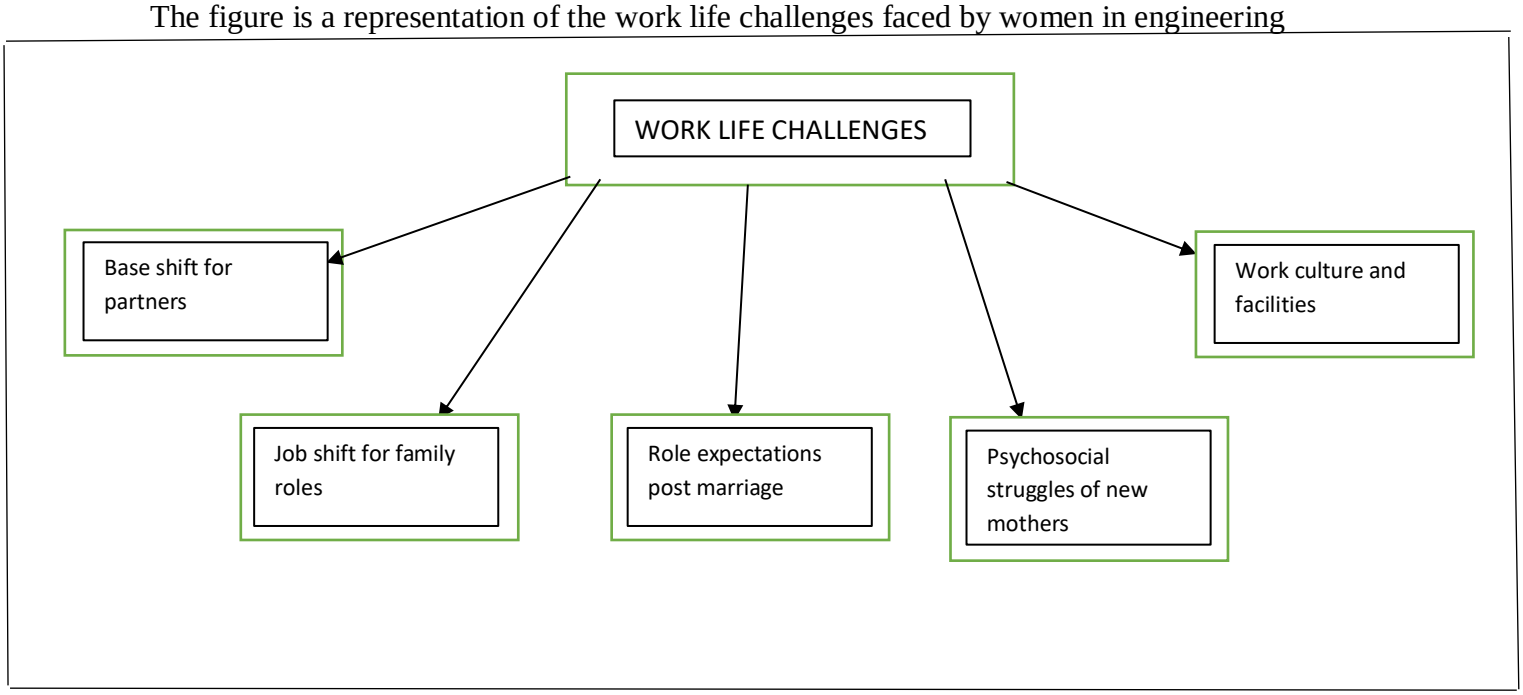
"But you know for whatever reasons, our country we have people who are very very passionate about things like career and they are happy to spend a lot of time working hard and progressing ahead in career versus spending time on things like that. Also labour is cheap in India right, like associates here, I can't ask them to spend, you know even 10 minutes over a weekend to help me in problem solving something, because they have to do their own laundry, they have to clean their own houses, it's not the situation in India at all. Like you know everyone has a maid who comes home, cleans their utensils, things like that. So you know the perspective that way. (PI 16, *Aerospace, 2009).*

The challenges associated with work-life balance show that women face varied demands while balancing work and family demands. Firstly, as the husband's role is traditionally seen as the bread winner the wife's career is secondary to the spouse and hence women are required to relocate in response to husband's career demands. However, this often is at the cost of their career growth. Also becoming a mother brings additional challenges, ranging from coping with postpartum depression and hectic work schedules simultaneously and absence of day care near or at the workplace. In response women take up less demanding roles at work yet again compromising on their growth.

The diagram below summarizes the work life challenges faced by women engineers

Figure 5: Representation of work life challenges faced by women in Engineering

The figure is a representation of the work life challenges faced by women in engineering



SUPPORTS

The next set of themes talk about different supports that have helped women engineers in pursuing their careers. Family support is the mainstay with different organizational policies providing further assistance in helping women engineers pursue their careers.

1. **Family Support and Encouragement:**

In this study, women engineers report that an understanding and encouraging family is one of their essential support systems. Women rely on their family not only for practical help but also for emotional support. Parents and in-laws sharing household responsibilities or as one participant puts it, '*picking up the slack*' when the women are unable to contribute to household chores is a highly appreciated form of support.

"*My mother has been a great support. I mean a lot of, as I said, a lot of slack that I don't she picks up. I mean she is a great support, helping out, even to this day, a lot of things, she oversees, that way I think in an Indian environment, parental support is a great thing."* (Electronics 1998)

'Unbiased' treatment from in-laws in terms of not gendering the household chores and not discouraging their sons from contributing to the chores is especially acknowledged and appreciated by the participants. Women also pointed out that in-laws were cognizant of the fact that the daughter-in-law also works late and has work demands which may be equal or more than that of their son. Such understanding helps women to focus on their work and meet the role requirements.

My in-laws are also... I mean they keep coming here and going back. So 1 month they will stay here then they will go back and come again after 3 months. Bhaskar is an only child so they keep popping. They are also extremely understanding and supportive. I am fortunate that way, even my mother in law, even though N (husband) does a lot of household work when they are

here, she has never told me it is your job; why are you making my son, nothing like that, she is very supportive. That way I am very very fortunate. (Electronics 1998)

Parental support is most felt in the postpartum period. Participants especially those living abroad stated that parents coming to stay over especially immediately postpartum is of big help. Their presence helps most prominently in ensuring that the new born baby can be cared for at home instead of being put in a creche at a very young age. As the next quote suggests, knowing this helps women deliver better results at work.

"*When you know that the child is taken care of, you can go full on. One is peace of mind and one is how well you recover physically, two things, if those are in place then it's a level playing field...*" (Electronics, 1995)

"Thankfully, I got a lot of support from my in-laws. They were there for the child. They were supportive of the fact that both son and daughter in law were working and I think it was only lately, about 3-4 years ago that they started looking at me in a different avatar…. (Civil, 2003)

Another important support from mothers is helping their daughters deal with working mother's guilt. Women reported turning to their mothers to look for reassurance as well as support in their decision to re-join work post maternity leave. A participant suggests that it was only because of her mother's reassurance that '*the child is fine'* that she did not quit immediately postpartum. An interesting observation is that those mothers, now grandmothers, who were working women themselves are quite insistent and supportive of the new mothers re-joining work soon. As another participant shared, her mother-in-law insisted that she may hire help if needed, but she should get back to work soon.

"*His mom, my husband's mom, was very supportive. She herself worked all her life. She, my husband, they are 3 siblings, 3 brothers, they also had a cousin staying with them, a boy. She*

had 4 boys and she worked all her life. And she said if you want, you keep maids in the house, get people to do your work, but if you want to go out work, you work, so she was very supportive. For women of her generation, she was extremely supportive." (Metallurgy, 1995)

Another interesting support mentioned by our participants are children, who appreciate the demands on their mothers and learn quickly to take care of themselves and become independent. A participant proudly remarks that her children are very supportive as they '*step up'* knowing that their '*mom's not gonna be around'* and they won't '*get pampered'* probably as much as their friends whose mothers stay at home. Sometimes older children also give a new perspective to mothers' experiences at work. Remarkably, women have also reported that healthy children and conscientious children who take care of themselves and not waste time '*playing video games*' are a big source of support.

Thus, women engineers found support not only directly in terms of sharing of chores and childcare, but also acknowledged that good health of children and elders and an encouraging, supportive attitude of family members towards women's careers is equally important. Thus it's evident that they need support from all elements of their family on both sides. The support that links these elements together, spousal support, will be discussed in the next section.

2. Spousal Support

"Thankfully, marrying the right guy helped me. That is something which even Sherryl Sandburg also says that 'Who you get married to, really, put some thought into it'. And I think I married the right guy (Civil, 2003)."

The above comment of our participant brings out how crucial a role the spouse plays in their successes. It has been one of the most recurrent forms of support talked about by the participants of the study. Spousal support generally ranges from sharing household work to partnering with career advice and providing psychological support on work issues to their

wives. Division of household responsibilities eases the participants' burden of dual responsibilities at work and home and provides for an easier work life balance. In this regard, a participant emphasised about the role of spouse in division of household work,

"So support from family is very important, like my husband was very supportive, although we were just staying in a nuclear family… he was always very supportive, we shared equal work at home, so that was not a problem; because I see some women struggling with work at home, meeting expectations and all that, but that was not the case for me." (Instrumentation and control,1997).

Active motivation from spouses towards these women to continue their career or upskill themselves professionally have played an important part in supporting the participants' career journey. Some women have also reported how they have received crucial advice from their spouses in getting a perspective of a "*man's world*". In context to this, a participant responded: *"Ya, ya all the time and it helps discussing things with him because I get a man's perspective from him sometimes if I maybe misinterpreting something he might help me understand how a guy would be looking at it so yeah we discuss about work place stuff very openly" (Mechanical, 2014).*

This highlights that spousal partnering helps women understand better the nuances of male dominated corporate culture. Spouses have been instrumental in providing the needed support for bouncing off career related ideas, almost like a peer mentor, supporting them maintaining a career.

3. Organizational Support:

Organizational policies and practices that help women engineers successfully navigate demands of work and male dominated culture of engineering also provide support. These are: personal development programs, establishing women's groups, mentorship and sponsorship programs which help women shape their skills and outlooks to better assimilate in the organization. As an example, a participant suggests, these groups introduced her to '*elevator pitch*' that helped her project herself better. Thus, organizations providing mentorship is a vital support.

"*So early in my career I had learnt about elevator pitch. So when you get in the elevator you say, you should always have a 30 sec pitch about who you are to a new person which then expands to 2 mins and then expands to 5 mins, you should always have this ready. And I found that very useful when I learnt that*." (Electrical 1998)

A strong Human Resources department which can help women deal with interpersonal issues as well as open discussions about sexism and ways to report and tackle it have also been reported to be of great help for the women engineers. As seen in the data extract below:

"…*HR was always very supportive. They would instruct, they would coach me on how to talk and they would say you know you should, don't go back on what your requirements are, you don't step back, just keep pushing and assert your, assert the requirements for the job, they are reporting to you which means you are paying them and they have to deliver some value*." (Electrical, 1998)

Besides assimilating better in the workplace, women engineers also require organizational support in maintaining work-life balance. For this, policies such as flexi-timing, flexi-schedule or part-time work schedule help women to arrange their schedule according to their priorities and important events in non-work life. Interestingly though, participants report that these

policies become truly supportive when they are not penalized for using these policies by their colleagues or supervisors. A participant shares her thoughts:

"*I think at VV atleast I feel very supported cause I have colleagues who also have little kids and umm they do understand its challenging my manager is very umm he does not have kids but he is very supportive when I say I leave after say 4'o'clock… if I had to pick up the kids from school you know at 4:40 and nobody says no you can't do that you need to stay for longer*." (Physics, 2001)

Another remarkable feature of the organizational structure, i.e., intra-organization mobility plays an important role in ensuring that the women continue their association with the organization. Participants have reported that intra-organizational mobility has helped them to choose projects based on their interests, comfort levels with colleagues or as the next quote suggests, based on other non-work commitments:

"*…And then when my daughter grew up and I felt I had more time, I again wanted to take up something more challenging so I went back into Project Management in the same organization*" (Instrumentation and control, 1997)

Another support from the organization is fair treatment specially while evaluating performance of women. A participant shares her relief in knowing that she will be evaluated fairly-

"*So no manager will monitor when you come, when you leave, its purely like I said impact. And I had never seen a company like that before. So its very liberating for a woman…*" (MEMS, 1995)

As the above quote suggests, being cognizant of the person's other life commitments and not holding it against them constitutes a major, albeit indirect part of fair evaluation for women. A

more direct measure includes '*stripping out the person's race or gender when you do your evaluation*' thereby ensuring support for women's merit irrespective of their demographics.

"So when we do performance assessment, you are supposed to strip out the person's race or gender when you do your evaluation. And every manager has to do that otherwise it is held against you. So at least there is a conscious effort to strip out these kinds of bias and discrimination. That we all know. "(Metallurgy, 1995)

Also organizations engaging with the issue of diversity in an open and conscious approach is also appreciated as a step in the right direction.

> *"the gender diversity is not great but the company is very very open to being... we don't have a great gender diversity, we are somewhere around 20% or so when I joined BCG but then the company is very very inclusive, they are very open in terms of you know what they are doing to make people feel inclusive and you know to promote diversity. Everything is based on merit but then you know diversity is something they are very very conscious of. So that helps." (Aerospace Engineering, 2009)*

4. *Important Socio-Structural Supports*:

Women engineers find various sources of support in the surrounding social environment such as day care centres, domestic help and even technology-enabled resources like online blogs that aren't necessarily a part of their familial or organizational support systems. For support in domestic chores like housekeeping and cooking women hire a domestic help and especially finding a *'good cook'* imbue feelings of great support amongst women. A participant shared '*Finding a cook, a good cook, that has helped me so atleast in the evening, at night, I don't*

have to.., once they come and the instructions are given then I can focus on my work; so the external help has also helped'. (Electronics,1995)

Another vital source of such external help is a good daycare right from infancy that lets mothers resume work soon after maternity break.

"*My daughter has been in day care since the age of 4 months and you won't believe this is the first time in 7 years that I am literally staying home."* (Electrical, 1997)

In the absence of such organized facilities, women have also relied on schools, in the form of after-hours care facilities, parents and in-laws as well as nannies with personal-recommendations. As the next excerpt highlights, recommendations from other working mothers are important.

"*I didn't want to leave X in day care, but then I found this Indian lady who two of my friends, their kids a year older than my son, were going there for child care. So I decided to put my son there as well… She was an Indian lady, she was doing it at home and I knew her from before, like before my son was born I knew her. So I decided to keep him there*". (Chemical,1999)

Women's networks or informal social groups are important in helping women find a sense of belonging and shared experiences, from nanny recommendations to emotional support, or spiritual practices to get "*wider life perspective*". Sharing one's experiences with others who can relate with those experiences has also helped women get motivated to carry on with their work despite struggles and not give up. On a more practical front, the expansive information available on the internet has played a huge supportive role. Women are harnessing such technological advancements to find solutions to their problems by looking for 'quick recipes' to connect with the multitude of women bloggers and or inputs for personal advancement. As

one participant succinctly put how her new role emerged from trying something she learned on such a blog:

*"...believe it or not, that's how I actually ended up where I am! I went out, put out the word, so all these blogs and ted talks where women come and talk and give ideas, I found those also very helpful in my life. All these groups are not just talk talk, they do help" (*Electronics 1995*)*

5. Mentors and Supervisor's role

Managers and mentors have been an important source of support for women engineers. Sometimes the mentoring role may be performed informally by the manager itself, or formal mentors have supported women's career growth.. The career related support extended to two aspects- pushing the women to achieve more professionally by helping them get opportunities or giving crucial and timely advice about work and encouragement. One participant in this context has said,

"*I had a lot of mentors and a lot of great leaders who supported me and pushed me and told me you deserve this, you are capable of this, you can do it, I believe in you and putting me up in places where.., you know just to give me opportunities. And that's happened to me time and time again. (Computer Science, 1990).*

At a more psychological level, small gestures of appreciation on good performance or lending an ear to women's opinion have given these women much needed confidence. Finding good managers therefore has been found to be crucial for women's success within organisations. Additionally, these relationships were not terminated immediately but have continued despite a change in

"*A lot depends on the supervisors that you get, the managers that you get and within BBB since we work on so many different projects, every 2 years or so, you move from 1 project to another and your supervisor changes, the person you report to changes every time, so you get to work with a whole lot of people. Fortunately, I have had a very supportive supervisors, who put in a good word for me with my managers. I have had promotions come in when I wanted them to. They have given me opportunities when I wanted them to, so it's been, it's been fantastic with BBB."* (Electrical and electronics, 1997)

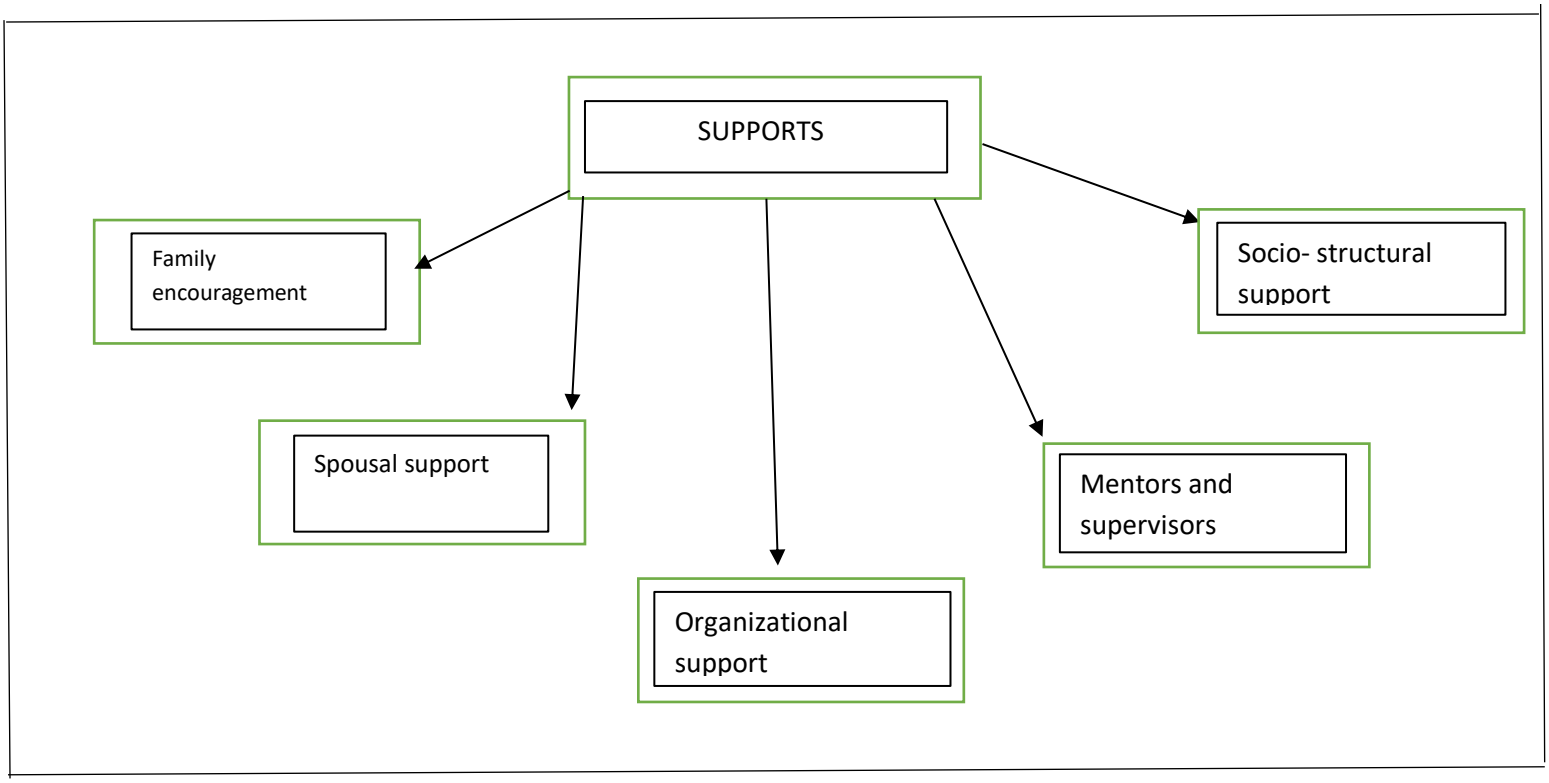
"I have had very good managers, managers it's very important to have a good manager they can sometimes they can ruin your career and they can maybe support you in their career uhh because whatever you do nobody else knows, your manager is the direct person who knows everything, what you are doing, how you are doing and if he is very supportive of you then you can go miles definitely you know so, it really helps if you have a good manager in your career and ya I've been lucky I think I have had very good managers who have encouraged me a lot." (Mechanical, 2012).

The above themes bring out the different supports for women engineers, from family to spousal support that are the mainstay in helping women balance work-life demands. Further, different organizational policies, encouraging and guiding mentors and managers go a long way in helping women progress in engineering. Our findings also bring the contribution of socio-cultural supports, like domestic helps in India to social networks where women with similar experiences share different solutions, in resolving various challenges faced by women in engineering.

The diagram below summarizes the support received by women in engineering

Figure 3: Representation of the support received by women in Engineering

The figure is a representation of the sources of support received by women in engineering



Themes on coping strategies used

In this theme we discuss different coping strategies used by women engineers throughout their career trajectories to deal with challenges associated with being a woman in a man's world. Along the way, within their career journey women have adopted certain mechanisms through which they have dealt with the stereotypes, discriminations and other forms of challenges. Broadly, these can be divided into three main heads: growth and change- where women have used learning and upskilling their technical and social skills to fit in better at work; Priorities, trade-offs and contentment, where women have prioritised between different identities, made trade-offs and derived contentment from those decisions as regards their professional positions. The final one pertains especially in context to dealing with stereotypes and discriminations to manage and deal with them by actively adapting themselves by changing their own behaviour or through resigned acceptance towards the existing situation.

1. Growth and change: Learning and upgrading oneself

Learning makes an important way which leads to constant addition to one's existing resources which may serve as an important coping mechanism for overcoming challenges within work set up. Most of these learning has brought about positive changes for these women in context to their professional life. Women engineers have resorted to three important ways by which they have embraced growth and change within themselves and their external environment: through learning and upgrading their technical and social skills; through seeking external support and finally learning to make their voice matter within the work set-up.

Learning and upgrading skills is one of the most commonly talked about coping mechanisms that women engineers have reported. These skills may be related to new technology in their field as well as soft skills needed to work efficiently in a global scenario. One participant in this context reported,

"*I am on this stage; I feel like technical is something that I have to learn definitely but there are soft skills also that one needs to keep on building. Uhh people because you know we are all global now so you have to, I mean keep learning actually and that is what I am doing (Mechanical, 2012).*"

Along with learning and growth, our participants also suggested the importance of speaking up and in ways relevant for the organization.

"So you have to. I am not saying you have to learn to be aggressive and start fighting, but at least to make your point clear, you have to learn to speak up. So you have to work on something that tangibly touches these metrics. So either come up with a great idea or come up with a solution on how to implement it, so you can't just say I am smart and just sit there. It has to become what the company wants." (Metallurgy, 1995)

In the context of seeking support, both within and outside organisational context, women have used these support systems for a better understanding of the corporate culture and to embed themselves within it, both same and cross gendered, internal associations have acted as anchors for women to stick to their workplaces. In context of seeking such peer support, one woman commented,

"*So I created my, so for the CXO role, I made sure I had a … so within the peers, there's a few guys who became my best buddies. That is how I used to get de-stressed. And you will be surprised. The moment those guys left the organization, I couldn't anchor in the organization anymore." (Civil, 2003)*

Sometimes women have such support systems and use it to bring about changes in the organisation's culture to make it more congenial for women. For instance, one participant said:

"*So in 2005-2006, some women got together and we really pushed the organization to set up a day care centre and towards the end it was set up like maybe in 2006, late 2006 there was a day care centre in the same building that was set up (instrumentation and control, IITB, 1997).*

Sometimes, these support systems have been personal where women have reached out to their husbands to learn the ways of a man's world.

"I started creating my support system actively, whether it was at work, friends, or home. "So that also meant that I would ask my husband, even if it meant getting over your ego like can't I solve my own problems, right? because it makes sense. If you want something in the men's world, understand what the male is thinking." (Civil, 2003).

Finally, the above quote points out that learning to step up and seeking their legitimate positions within organisational set up has been an important lesson for women. There has been ample evidence from interviews to support the contention that women have considered asking for opportunities at work as an important coping mechanism in male dominated organisational cultures. Placing their demands successfully and articulating them in a careful manner has been an important way of coping to get counted in a room full of men.

2. Priorities, Trade-offs and seeking contentment

Women engineers have often used clarity of thought regarding their priorities in life and thereby choosing roles that were more suited to their priorities. Most of these priorities have been the focus on their roles as a mother or wife. When such roles take a position of prominence within these women's life, the resultant effect is their professional life taking a backseat. To this, one participant reported, *"I actually went part-time for a while even after taking 2 years off, I went part-time and then I quit because I just didn't feel like I was being fair to my daughter*

and to my career. So I was feeling kinda stuck in the middle, so I took a step back, umm I did slow down a little bit at work" (Computer science, 1990).

However, what comes across as an interesting finding is that most of these women are conscious about the choices that they have made professionally, and have also emphasised about tradeoffs that they had to do as a result of their choices. For instance, one participant talked about the costs associated with growth by stating,

"*Career wise, I mean, growth wise if you ask me, someone else could, I mean with my kind of degree and interest, would have grown a lot more; but the growth always comes at a cost. So if you are consciously willing to set aside that cost, then you are good; but if you are not willing then as well go a little slower. So it's a matter of choice is what I feel." (MEMS, IITB, 1997).*

Other forms of trade-offs were keeping themselves from joining informal gatherings after work due to responsibilities back home or simply learning to deal with comments of the colleagues regarding the number of hours a woman puts at work. In this context of making conscious choice, one participant reported,

"*but I never cared. It was so important for me to be home for my son, that it was held against me that because I am a woman I left early, I didn't bother. Because that was the deal. Its only when it bothers you is that you are neither here nor there, it is unfortunate and we wish the world were more fair, but every woman has to make a choice." (Metallurgy, 1995).*

As discussed in the quote above, such an attitudinal stance on the part of women engineers may give them a sense of contentment about their life: both personal and professional. *I have made peace with myself is mujhe jitna aata hai, I know that and utna hi mai kar sakti hu. I will never claim that I know too much, mai sab kar dungi, lekin jitna mera capacity hai, I will try to deliver my best within that capacity. (Electrical and electronics, 1997).*

Apart from this, other women have talked about the importance of self-awareness, in general regarding what one's interests are in life and thereby knowing the gains and costs associated with pursuing such interest. This has been illustrated by the following quote, *"I have found that I like to explore and I when I find something new and interesting, it usually takes something..., it's a loss of your, you lose something by moving, you lose your seniority but then you get to learn and be in a different world and when that world seems interesting, I just move there and I pay the cost. So basically I moved. (Electrical, 1998).*

Therefore, having a clear idea regarding the goals in one's life and how one can navigate through their professional and personal life to achieve them has been an important source of coping for women engineers in our study.

3. Accepting and Adjusting to existing situations

Accepting and adopting to biases within the work front has been a persistent coping technique for women in engineering. As one participant pointed out "*developing a thick skin*" (Computer science, 1990) was a coping strategy that she had chosen to deal with constant instances of bias she had faced for being a woman in a man's world in her profession. Remaining silent or walking away from the situation when a discriminatory act or remark has been passed has been a widespread practice that these women engineers have reported as their coping strategy. As pointed out by one participant, "*And a lot of times, you know, my daughter now, for example she has just graduated and she will tell me things that have happened to her and I think wow, that thing happened to me too, but I never thought about it, I just got used to it. Or there was no awareness you know, it was like, this is how it works and you have got to deal with it. And I just have to adjust, like I have to put up with it. Those are nasty things, and I hear this from all women closer to my age, we just felt that we had to put up with it, and it was us, it was on us to have a thick skin and just let it go and if we complain, people are like, ugh, she is just*

like, typical woman" *(Computer science, 1990)* this can be a result of social conditioning where women are taught to accept things the way they are or maybe consider them to be a part of everyday life.

Sometimes women engineers also make attempts to blend in and be part of the group adopting various social behaviours and practices to be part of the larger group.

So, something that I had to change in my attitude in order to fit in was I was strongly opposed to alcohol just because the way I had been brought up in India but after coming to United States uhh specially after joining TT I realised that I will have to start drinking to fit in and that's something that I had to change in my attitude I started social drinking just so people didn't think I was an outsider or that I didn't mingle.(Mechanical, 2012).

The idea of adapting in ways to be accepted in the men's club seems to be another coping strategy, in fact, a participant of having worked in both Indian and western cultures felt while speaking up more may be possible in the western culture while in India adapting, by giving more attention to the person's intentions, may work better. Though women do feel conflicted about adapting as well.

"*always think the intentions are okay it sort of helps me adapt cause my career has predominantly been in a male dominated society and uhh I think in US I have become more cognisant about women rights, equality and biases but in India I think I felt that maybe gelling in is better than voicing out and uhh this is the thought which I still continuously debate myself with like I don't want to be taken for a ride (Mechanical 2013).*

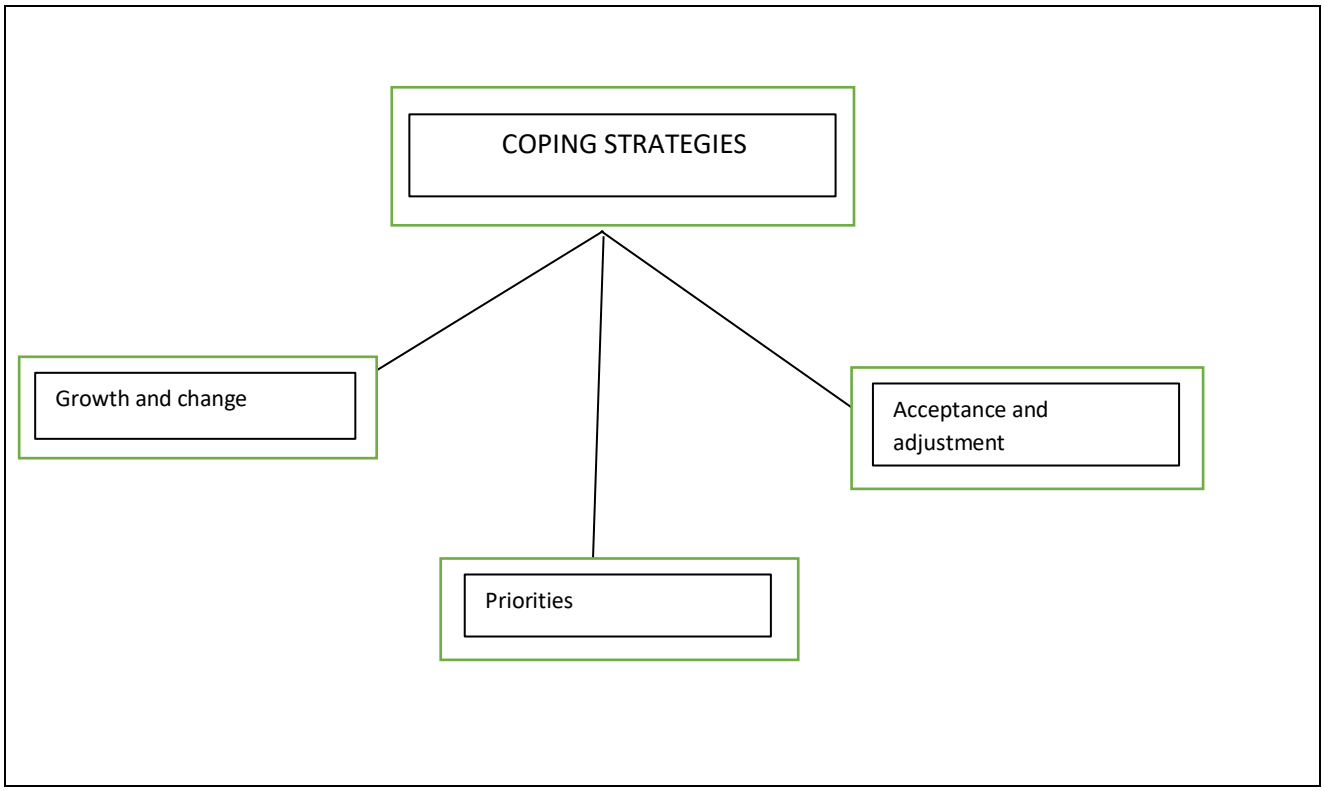
It was also noticed that our participants also changed/evolved as individuals in how they dealt with many issues as their careers progressed. While in the earlier parts of their careers they

attempted to deal with the situation, as they matured they expressed their objections clearly to the other party, sometimes even filing formal complaints.

The diagram below summarizes the coping strategies administered by women in engineering.

Figure 7: Representation of coping strategies used by women in Engineering

The figure is a representation of the coping strategies used by women in engineering.



4.4 Analysis for Study 3

Multiple Regression analysis was used to examine to study the effect of gender discrimination, perceived supervisor support and family support on self-efficacy, job satisfaction, work-engagement and subjective well-being. Table 1 reports the intercorrelations between these variables. The pattern of correlations provides some support for the hypotheses. A significant negative correlation is seen between gender discrimination -perceived supervisor support,

gender discrimination -job satisfaction, gender discrimination-work engagement and gender discrimination-subjective life satisfaction. A significant positive correlation was seen between family support and job satisfaction, work engagement and subjective life satisfaction. Perceived supervisor support correlated significantly with self-efficacy, job satisfaction, and subjective life satisfaction. Finally, amongst the outcome variables self- efficacy correlated positively with job satisfaction, work engagement and subjective life satisfaction. Job satisfaction positively correlates with both work engagement and subjective -life satisfaction.

Table 4: Means, standard deviations and correlations among the variables studied. The Cronbach alpha are given in the parentheses along the diagonal.

Variables	N	Mean	SD	1	2	3	4	5	6	7
Gender Discrimination	83	87.63	21.26	.929						
Family Support	83	8.40	1.93	-.195	.929					
Perceived Supervisor support	83	15.94	2.91	-.529**	.192	.739				
self- efficacy	83	65.48	8.86	-.195	.206		.909			
Job satisfaction	83	17.27	4.72	-.438**	.459**	.552**	.422**	.893		
work engagement	83	11.31	2.27	-.209	.315**	.648**	.533**	.527**	.799	
subjective -life satisfaction.	83	17.29	3.84	-.446**	.447**	.552**	.488**	.679**	.490**	.862

Notes: *p < .05; **p < .01

Four regression analysis were used to test the hypotheses. A multiple regression was carried out to investigate whether gender discrimination, family support and perceived supervisor support could significantly predict self-efficacy of women engineers. The results of the regression indicated that the model explained 10.1% of the variance and that the model was not a significant predictor of self-efficacy, $F(3,79) = 2.967$, $p = .037$. While perceived supervisor support contributed significantly ($B=.664$, $p< .10$) to the model, however, gender discrimination ($B= -.020$, $p=.699$) and family support ($B=.710$, $p=.161$) did not. Thus Hypotheses 1 and 9 were not accepted while Hypotheses 5 was accepted. The final predictive model was:

Self-Efficacy=50.465+(-.20 Gender discrimination) +(.710 Family support) + (.664 Perceived Supervisor Support*)

A second multiple regression was carried out to investigate whether gender discrimination, family support and perceived supervisor support could significantly predict job satisfaction of women engineers. The results of the regression indicated that the model explained 33.8% of the variance and that the model was a significant predictor of job satisfaction, $F(3,79) = 13.429$, $p = .000$. While gender discrimination ($B= -.075$, $p<.01$) and Family support ($B=.944$, $p<.01$) contributed significantly perceived supervisor support ($B=.045$, $p=.797$) did not. Thus Hypotheses 2 and 10 are accepted and Hypotheses 6 is not accepted. The final predictive model was:

Job Satisfaction=14.436+(-.075 Gender discrimination**) +(.944 Family support**) + (.045 Perceived Supervisor Support)

A third multiple regression was carried out to investigate whether gender discrimination, family support and perceived supervisor support could significantly predict work engagement of women engineers. The results of the regression indicated that the model explained 12.2% of the variance and that the model was a significant predictor of job satisfaction, $F(3,79) = 3.651$, $p = .016$. While family support (B= .336, p<.01) contributed significantly to the model gender discrimination (B=-.016, p=.209) and perceived supervisor support (B=-.007, p=.941) did not. Thus Hypotheses 3 and 7 are not accepted and Hypotheses 11 is accepted. The final predictive model was:

Work engagement=9.876+(-.016 Gender discrimination) +(.336 Family support**) + (-.007 Perceived Supervisor Support)

A fourth multiple regression was carried out to investigate whether gender discrimination, family support and perceived supervisor support could significantly predict subjective life satisfaction of women engineers. The results of the regression indicated that the model explained 33.5% of the variance and that the model was a significant predictor of subjective life satisfaction, $F(3,79) = 13.267$, $p = .000$. While gender discrimination (B= -.061, p<.01) and family support (B=.735, p<.01) contributed significantly subjective life satisfaction perceived supervisor support (B=.067, p=.644) did not. Thus Hypotheses 4 and 12 are accepted and Hypotheses 8 is not accepted. The final predictive model was:

Subjective life satisfaction=14.772+(-.061 Gender discrimination**) +(.735 Family support**) + (.067 Perceived Supervisor Support)

Conclusion: This chapter provides the detailed data analysis of each study. For Study 1 and Study 2 the themes that emerged after the thematic analysis of the qualitative data were presented. In Study 3, a quantitative study, multiple regression analysis results were presented.

Chapter 5

Results and Discussion

Introduction: This chapter presents the results that emerged from the analysis of the data in the previous chapter. These results have been discussed in light of the literature on barriers to women's success in STEM professions.

5.1 Results

The thematic analysis of Study 1 shows that stereotypes and beliefs about engineering prevalent in society are about engineering as a male-dominated profession. Hence, female students are discouraged from taking engineering as a career choice. Also, those who do choose engineering frequently encounter pressure to justify their choice repeatedly. Our analysis also shows that their educational journey while preparing for engineering entrances and in engineering colleges is marred by exclusion and isolation. The exclusion may be from group learning with their classmates or sometimes in coaching, getting help from teachers after class. Another important issue is being a small percentage in engineering courses; they are a minority and hence very conspicuous because of their gender. At the same time diversity promoting initiative like supernumerary seats creates more challenges as in a highly competitive environment they are perceived as taking a scarce resource despite being undeserving. These beliefs of society and male classmates show that engineering has a masculine image and women do not fit in because the female stereotype is dominated by communal traits. Such treatment creates self-doubt and lowers feelings of competence amongst female students. Another important finding was also the socially inept behaviour of many male students towards their female classmates often resulting in micro aggressive behaviours towards them. Parents, teachers and friends are seen as sources of support by female students.

The thematic analysis of Study 2 revealed that gender discrimination and biased treatemnt exists in organizations today towards women engineers. Women are treated to different forms of microaggressions, micro inequalities and denied voice in organizations. All these aspects create a chilling and negative work environment for women engineers. Further, while organizations do provide various forms of accommodations to women to assist in their work-life balance specially for young mothers, however, since these are used only by women their career growth in the organization gets derailed as they are perceived as not fully committed to work. These experiences tell us that work family narrative is not the only reason for women's career growth in organization, in fact may not be a reason at all. Secondly, engineering is a profession where different biases exist towards women not because of their lacking technical abilities but because of their communal traits, which are not aligned with agentic traits like competition and assertiveness, goal attainment needed to succeed in engineering. The stereotypical beliefs about women and their preferences guide managers and organizations which do not believe women can be agentic. Another important outcome observed from the qualitative data is about the token service towards diversity initiatives in organizations. In many organizations it is about giving lip service only by hiring women, however, no changes are made to retain them in the long run. The work family conflicts emerged from traditional division of labour in their homes, where the husband's career is the primary career as the breadwinner. Women are expected to prioritize family and child care responsibilities above work and sometimes these expectations are internalized by women themselves. Women manage these demands by re-strategizing careers with less demanding roles, or letting go of opportunities. All this slows down the career progression of women engineers. Further, family support and supervisory support (mentoring) are seen as important sources of support by women engineers. Also organizational policies and practices that allow for work-family balance are useful too and in the Indian context help from part-time full-time house helps,

grandparents help in taking care of children are useful. Some important coping strategies used by women are learning and upskilling oneself, prioritizing and accepting trade-offs between family and work demands. Finally, they learn to accept these challenges and find ways to work around them and continue their journey.

The multiple regression analyses (in Study 3) was conducted to examine the effects of gender discrimination, family support and perceived supervisory support on self-efficacy, job satisfaction, work engagement and subjective life satisfaction. The results show that perceived supervisory support influences self-efficacy in women engineers, while gender discrimination and family support relate with job satisfaction and subjective life satisfaction. Work engagement is related to family support only.

Another important finding on examining the level of growth women have had in their careers we found in study 2 and 3 the maximum number of participants were middle level managers in organizations. Some comments of our participants had also shared that their growth was slower than their male colleagues.

The next section discusses the findings of the study in the context of existing literature.

5.2 Discussion

Challenges experienced by the participants

The findings from our study show that gender discrimination and gender derogation are commonly experienced by both women engineers and women students of engineering. This further has negative consequences for women's job satisfaction and life satisfaction. Whether it is social messaging that attempts to dissuade girls from taking engineering as a profession or encountering biased questioning during interviews our participants experienced various forms of discrimination. This reflects that in the Indian context as well engineering has a masculine

image - a 'gendering' of professional identity (Phipps, 2002) which results in the prejudice and discrimination towards women who enter the field. The discrimination begins from the hiring stage where talent profiles are designed around male employees, later promotions, assigning of roles women engineers are always compared with masculine identity. The discounting of achievements of women students and the pressure to work doubly hard for women in the workplace shows they are highly visible tokens who experience greater performance pressure and are seen a representative of "women" as a group (Settles, 2014; Lyness & Heilman, 2006). Similar to other studies by Settles et al., (2006) on experiences of women in academics in STEM, our participants reported experiencing gender discrimination related to hiring, promotions and greater tolerance to disparaging comments about gender (Settles et al., 2013; Dasgupta & Stout, 2014). This can be viewed as behaviours that penalize women for working in male-dominated fields, communicating the message that they are not welcome (Settles, 2014). Further, similar to implicit biases that exist regarding women in management (*Think Manager-Think Male*) (Schein, 2001), biases also exist in engineering- think engineer-think male. The biases emerge from stereotypical believes communal traits being closely associated with women and engineering as a male dominated profession associated with agentic traits. Hence, because of these conflicting beliefs, women are discriminated against in engineering. It is not because of absence of competence or ability to do science but absence of agentic traits that a good engineer should have. Previous research (Fuller and Narsimhan, 2007) shows the beliefs about gendered science and technology are not applicable in the Indian culture, our findings take this further and explain the unsuitability of women because of communal traits. We also see men do not take it easily when they see women getting ahead or getting opportunities before them. The agentic stereotype creates a pressure on them to succeed and for women to have a lower status than them which results in their undermining women exercising agency.

Further, while societal, legislative and organization changes have attempted to increase the number of women in engineering these changes have created another set of hurdles for women. Our participants spoke about receiving derogatory remarks about their accomplishments which would be attributed to their gender. This reflects a form of reverse discrimination that Crosby, Iyer and Scincharoen (2006) refer to as a negative consequence of affirmative action. Further along with this some of the female students spoke of experiencing self-doubt and other undermining effects of "affirmative action privilege" (Crosby, Iyer & Sincharoen, 2006).

Many previous researches on women engineers have highlighted the work-family narrative as responsible for underrepresentation of women in engineering. Many participants also shared women actively asked for policies that enabled better work-family balance. In response to these demands organizations have come up with policies that allow for greater flexibility to employees. However, this research shows that such accommodations (flexi-timing, remote working etc) are largely used by women only and not be male colleagues and women are penalized in different ways for using these accommodations or may experience exclusion (Shagvaliyeva & Yazdanifard, 2014). Ely and Padavic (2020) in the article on what's really holding women back argue that the work-family narrative is a oversimplified explanation, women who take advantage of accommodations are stigmatized and their careers derailed. Also, the culture of overwork is detrimental for all but women generally are penalized for it. In our study similarly, many women acknowledged that they had to compromise on career growth, had fewer opportunities to work on promising roles or projects. Thus, the work-family narrative may be only part of the problem that hold women engineers from progressing in their professions.

Gender stereotypes are structured around 2 themes- *communion* (orients people towards others*) and agency (*orients people towards one's own mastery and goal attainment).

The social messaging received by young female engineering students to make gender appropriate career choices and organizational climate that suggests or assigns women engineers to non-technical roles reflects the presence of occupational segregation. Eagly, Nater, Miller, Kaufman and Sczesny (2019) argue that horizontal segregation in occupations conveys men's agency in occupations that require competitiveness, physical prowess and robustness and women's communion in occupations that require social skills and yield social contributions. Our findings show that while occupational segregation did decrease allowing for more women in engineering, an internal desegregation (Eagly et al.,2019) seems to be occurring where women are given more client interaction roles that have more communal variants. Further, these gender stereotypes also result in emphasis on women's communal traits, many of our participants spoke of being treated as a mother/daughter by co-workers which meant less value and attention given to their technical and agentic abilities. This also highlights that while there is an increase in number of women taking engineering as a profession, engineering still remains a male-dominated profession and the patriarchal role distribution continues and women's participation is required to adapt to these gender roles (Patel & Parmentier, 2005; Martin & Barnard, 2013).

Another important finding that emerged from the experiences of our participants was the isolation and loneliness experienced by women engineers as students being outnumbered by male peers. Similar to findings about female students in America (Dasgupta & Stout, 2014), thoughts, feelings and perceptions of their branch of engineering of female students in India were affected by such social exclusion while coping with the tough and competitive environment of a premier educational institution. However, in our study of current female engineering students after the change in policy - supernumerary seats for female students, while the number of female students has gone up it "*barely makes a dent*" and the student stands out as "*a girl of the class not the person of the class*".

Further, sometimes extra attention given by teachers to the girls in the class "cherishing a different opinion" can reflect benevolent sexism faced by women. Our participants working in organizations also spoke about experiencing where supervisors in attempts to protect women do not send them alone for meeting external vendors. This subtle form of sexism may be difficult to recognize by the target as sexism because of positive valence (Kristen et al. 2014). Literature identifies this subtle form of sexism is damaging for women in various ways- it undermines their self-efficacy (Kristen et al., 2014), it reinforces traditional gender roles and reinforces gender stereotypes for women more than hostile sexism (Barreto, 2010). Our participants also shared experiences specially where as young they willingly accepted such help from classmates but later recognized it was a loss of learning opportunity. Sometimes it may be learning essential for their career growth which women would lose out on because of subtle sexism like *protective paternalism*.

Powell, Bagilhole and Dainty (2009) state that one way by which women, who enter into male-dominated cultures, adapt is by acting like men to be successful. Many of our participants also realized that doing work was not enough. They need to align to male ways of behaving-speaking more and giving visibility to their work.

Our participants also spoke about facing micro-aggressions in the workplace in the form of jokes, or indirect comments on mails challenging their abilities or as students hooting from their classmates. Plester and Plester (2013) describe such dark humour in the workplace as insidious manipulation; it protects the protagonists who express sexist views and is difficult to be challenged by the target. Both female students and women engineers speak about facing such micro-aggressions in the environment which reflects an unconscious desire of men around them wanting to establish their superiority.

Examining the work-life balance challenges experienced by women engineers we find that women encounter traditional role distribution in the homes, where husband's career is given primacy over the wife's career and women still are the primary caregivers to the children. Similar to other studies (Hynes & Chandler, 2008) these family demands are many times the reason for discontinuous careers of women engineers. While none of our participants spoke about quitting the work space they did acknowledge taking up less demanding roles, slower growth in their careers and giving up opportunities.

Supports for female engineers

Previous research on Indian engineering students argues that while engineering has a masculine image in India, female students are challenging the patrifocal structure by entering the field with parental support Gupta (2012). These findings are supported by our research where both female students and women engineers spoke of parental/family support in their choice of career as well as in the progression of their career. Research by Fernando, Cohen & Duberley, (2018) emphasizes role of supportive peers, opportunities for growth and higher responsibility and role models who demonstrate work-family balance important reasons for women engineers continuing their profession. Along with the role of parental support and teacher support the student participants spoke of friends both males and females who helped and supported them on campus. Hence, supportive co-workers and supervisors are important in aiding and encouraging women in their journey in the engineering profession. Further, in line with Fernando et al. (2018) we see our participants emphasized the importance of opportunities to develop skills and expertise to be more impactful, an involved HR that helps resolve issues and tackle sexism, and organizational practices that support for better work-life balance as key factors for helping women continue. Additionally, our participants highlighted the organization's open and conscious attempts to increase gender diversity; fair treatment and not being penalized for maternity breaks or flexible working hours in appraisals are important

reassurances. The role of the supportive managers who sometimes acted as mentors also was stressed upon by the participants. They provided advice, encouragement, gave opportunities, heard women's opinions and appreciated good performance. The role of study also brings out the role of mentors and supervisors whose varied actions can help women develop confidence.

Coping Strategies

Some of the important strategies to cope with various challenges that women have encountered many participants shared the importance of learning and upgrading both technical and social skills. An important learning is learning to speak up and highlight their contributions to the organization. Over time as women develop an understanding of organizations and work cultures, the importance of building one's own network with co-workers, spouses, other women in the profession that provides anchoring and support was realized. Another way of coping strategy our participants shared was deciding priorities and choosing roles that aligned with those, making some conscious choices and trade-offs and finding contentment within those. Mostly, family is given priority which reflects broader cultural notions that family is primary for women (Ely, 2020) and most women do comply with that schema. Though our participants recognize the cost of these choices they do make peace with those as well.

Self-efficacy, work engagement, job satisfaction and subjective life satisfaction of women engineers

Findings of study 3 show that perceived supervisor support influences self-efficacy of women engineers, while gender discrimination and family support do not affect self-efficacy. This result is in line with findings from our qualitative study where supervisors who listen to

opinions, give appreciation and encouragement lead to higher confidence levels in women. Singh et al. (2013) have argued that supportive organizational context may lead employees to experience greater mastery. However, in our study we also find that gender discrimination does not have a significant effect on self-efficacy. This could be because the supervisory support may be an immediate context that a woman engineer would experience/interact with regularly. Gender discrimination may be something more abstract and less immediate aspect of the work environment. Hence, perceived supervisor support positively influences self-efficacy.

Job satisfaction and subjective life satisfaction are negatively affected by gender discrimination and positively by family support. Thus, we can see that on experiencing different forms of gender discrimination at work reduces their satisfaction on the job as well as their satisfaction with life in general. Perceived supervisory support did not affect both job satisfaction and subjective life satisfaction. Singh et al (2013) found the positive affect of work environment on job attitudes of women engineers and or findings extend these to show that gender discrimination does negatively affect job satisfaction. Settles (2014) highlight that women face structural bias and negative interpersonal interactions across male-dominated work settings in general and specifically in STEM which results in lowering job satisfaction and psychological well-being. Further some studies have found different forms of micro-aggressions negatively impact the psychological well-being of women (Marcie & Nadkarni) thus gender discrimination on subjective life satisfaction of women engineers.

Work engagement is affected only by family support not be gender discrimination and perceived supervisory support. These findings are contrary to Bakker et al (2008) that argues job resources as an important antecedent of work engagement. Aspects like social support, supervisory support, feedback were important for an individual experiencing engagement with work. In our study it is only family support that is an antecedent. The reason in this could be provided by the comments of one of our participant who spoke that if things are taken care of

at home it helps her go full steam at work. This comment may shed light on the fact that for women the identity as a mother is an important one and if those aspects of her responsibility are well taken care of it lets her fully immerse herself in her work. It also emphasizes the importance of personal resources (ability to control and impact their environment) more so than job resources.

Chapter 6

Findings and Recommendations

6.1 Summary of findings

The findings of our study show Indian women engineers experience biases and gender discrimination in their profession. This prevents women from being hired, able to perform and succeed in organizations. While the number of women entering the field of engineering has increased, gender equality is still far away and for women the struggle for attaining equality is not over. Further, the stereotypical image of engineering as a masculine profession remains strong in society, even today resulting in social messages to girls discouraging them from taking engineering as a profession. The basis of these biases lie in the stereotypical beliefs about associating communal traits with women which are not aligned to the agentic traits associated with engineering. These experiences were noted by participants in both Study 1 and Study 2.

As engineering is a male-dominated profession, women who enter the field face many challenges-their abilities are repeatedly challenged, they have to work harder to prove themselves, they have to speak loudly to make themselves heard. Along with this there are many forms of subtle sexism that women encounter, from gender derogatory humor to benevolent sexism. Such treatment is hard to call out in the workplace and sometimes can reinforce stereotypes for new entrants in the profession.

Women also experience exclusion -as students they would not be able to participate in social learning by interacting after class with their classmates and at work being unable to join after work drinks they are left out of the '*boys' network'*.

Another important finding that emerged from this study are concerns regarding diversity improving initiatives. Previous researchers have raised concerns regarding affirmative action being a medicine that may harm its patients, promoting beliefs that those who benefit can not make it on their own. Our participants shared it resulted in undermining their confidence resulting in self-doubt. It also results in reverse discrimination where their achievements are undermined by others and put down to tokens of diversity initiatives.

Many previous researches have spoken of the importance of work-life balance in career progression of women in the workplace and various accommodations like flexible timing, maternity leave etc are seen as ways to help women balance both. However, our findings also show that these accommodations are used by women only. Hence while men continue growing despite having a family, women on the other hand get penalized for using such accommodations and their career growth is stalled or slows down.

This research also shows the effects of experiencing gender discrimination on reducing the job satisfaction and subjective life satisfaction of women engineers. Family support on the other hand improves job satisfaction, subjective life satisfaction and work engagement of women engineers. These findings also show supervisory support enhances the self-efficacy of women engineers. Thus different employee level outcomes are related to different antecedent factors in the organizational context.

Our findings also bring out some new insights about challenges experienced by female students, in a still largely male dominated environment. Our participants spoke of male classmates who are socially inept and engage in various immature forms of behaviour towards their female classmates. However, these behaviours, hooting in the class, passing comments as girls pass by etc are varied forms of microaggressions that leave young girls very isolated and uncomfortable. Such microaggressions have become even more pronounced with the advent of

social media where things like confession pages are freely used to write such remarks about female students, however, there is no recourse for those about whom things are written.

6.2 Recommendations

Based on the above findings I would like to bring out certain recommendations for policy makers and organizations so that engineering is a profession identified with gender equality. Firstly, organizations need to recognize and accept the presence of various stereotypes about engineering and about women that operate through various biases both implicitly and explicitly. It is important to increase awareness through programmes and workshops on how these beliefs influence one's decision making and behaviour and ways one can use to avoid these stereotypes.

Also starting right from schools' different kinds of exposure- through workshops, extracurricular or designing teaching content so that boys learn to be more gender sensitive in their behaviour and more aware about unconscious forms of aggression. Along with it such micro-aggressions should be called out as aggressive/unwanted behaviour publicly and educational institutions and organizations should move towards having zero tolerance for such behaviour.

Diversity programmes have been cited as an important way of improving representation of women in engineering. At the level of educational institutions like the IITs 20% supernumerary seats are being assigned for female engineering students. Also, organizations do attempt to hire women more consciously to enhance diversity in organizations. However, implementing such programmes is harming the very women it has been made for. Hence, I recommend that organizations and institutions should make explicit the qualifying criteria for any seat/position that makes clear how well deserving/qualified all applicants are. Also, clear messages should be communicated about prior and continuing barriers to use of all talent and

how intended programmes will help remove such barriers. Further the goals and mechanics of such programmes should be communicated to all, stressing the wide range of relevant criteria considered to make decisions.

For long the work-family narrative has been cited as an important reason for low representation of women, for which various accommodations like flexi-timings, remote work are recommended as a means to help the balance. However, our findings also showed that women are penalized for using such accommodations. Thus, I recommend organizations to revisit these accommodations and pay attention to not penalize women for using these different accommodations. Also, encouraging male employees to shoulder greater responsibility at home, using such accommodations would bring in greater equality at home and at the work place.

Many participants shared the need for women to speak up more, to present one's achievements at work etc. Many of these behaviours are in contrast to the socialization women receive and their natural way of being. While I do not recommend women become someone that is not authentic for them, those who would like to develop different skills to be more impactful at work should do so. Also an important coping strategy used is learning and upskilling oneself, therefore, organizations should provide opportunities for different training programmes that would help women. Further, encouraging networking amongst women through different communities would give opportunities to share insights, learnings from experiences and sharing of experiences all of which can have various positive psycho-social advantages for women.

Research Summary

This study titled “Tracing career trajectories of IIT Women alumni” by Prof. Pooja Purang at IIT Bombay, 2022. The study attempted to examine the challenges faced by women engineers in their career progression, along with the sources of support and coping strategies. The study found wide spread gender discrimination experienced by women engineers which is because of stereotypical beliefs about women fitting more communal roles and engineering profession that aligned with masculine agentic roles. Thus, women did not fit in because they did not have agentic traits. Women also experienced different forms of micro-aggressions, micro-inequalities, benevolent sexism, denial of voice and exclusion from social networks. Further, such a negative environment results in reducing their satisfaction with their jobs and life. Two important sources of support are family- parents, in-laws and spouse and mentoring supervisor. These result in improving women’s engagement with work and their self-efficacy. Women also cope with different challenges they encounter by constantly being growth oriented- ready to learn new skills, new knowledge, by growing a thicker skin and accepting trade offs as a part of life.

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Annexure I

Semi-structured Interview schedule STUDY 1
(Focus Group discussions with engineering students)

1. How did you come to choose engineering as a field of study?

2. What experiences contributed to your decision to pursue your occupation?

3. How was your decision influenced by others?

4. Tell me one memorable story that would really help me understand how you came to choose what you study. (Explore for role models)

5. What are your long term career goals? (How does engineering help you fulfil these?)

6. How do people react to you when they learn you are pursuing engineering? What do they say?

(Family/Teachers/Peers/Culture) What sort of sociocultural messages did you get? (*messages about your career choice/your field of study. explore how peers behave*)

7. How would you describe your feelings and beliefs about engineering as you were pursuing it?

a. How did pursuing engineering make you feel?

b. What are your beliefs about what you do, or the area for which you were preparing yourself to have a career?

c. What are your emotional responses about your area of interest?

8. Why do you think that so few women pursue mathematical/ Engineering-related careers? What could be or should be done to alter that?

9. Considering your academic experiences if you could have done anything differently, what would that be?

Annexure II

Semi structured Interview questions for study 2

1. Do you have any questions before we start?

2. Could you briefly introduce yourself? Please include your current title, how many years you have been in this profession, and your specialty areas. (Profession of engineering)

3. Could you please describe your current occupation, role in the organization, responsibilities?

4. Please recount your career story over time.

5. How were your experiences that you could share with us?

- What were the challenges you faced and are still facing?
- What supported you in your career journey?

6. Let's talk about people's attitude towards women in the work place in engineering organizations.

- How many women are there in your organization? (Specific engineering departments)
- How do your peers/colleagues perceive/react to your presence? Can you share one such experience with us? (If both positive and negative then one of each and ask the designation/gender of the other person)
- How do you deal with it?

7. A general belief is that qualified women leave the field of engineering (don't pursue long term careers), in your opinion why do they do so?

8. Are there any dominant beliefs about engineering profession suitable for certain kinds of people? Is there a culture prevalent that reflects these beliefs? What experiences lead you to believe this?

9. Can you describe situations where you have encountered such stereotype and how you reacted?

Annexure III: Questionnaires for Study 3

Instruction: Think about your interactions with your co-workers over time and respond to the items given below based on those experiences, where 1 = strongly disagree and 5 = strongly agree.

Sr. no	Questions	1	2	3	4	5
1.	At work, I have heard negative comments about women's abilities as engineers.					
2.	At work, I find less is expected of me professionally (as an engineer) because of my gender					
3.	. I have been made to feel like I have to work harder than my male colleagues to be taken seriously					
4.	I have felt my gender will make it difficult for me to succeed in my profession.					
5.	I have been excluded from a discussion about engineering related tasks because of my gender.					
6.	I have received negative comments about my abilities as an engineer because of my gender					

7.	I have been passed over for a job because of my gender.					
8.	I have been passed over for a promotion because of my gender.					
9.	I have been denied a senior role because of my gender.					
10.	On using flexi-timing I have received comments about taking my work casually/easily					
11.	I have received comments that my promotion is because of my gender or as a diversity candidate.					
12.	I find my co-workers have difficulty accepting my authority /position because of my gender.					
13.	Despite my technical qualifications I have been pushed into non-technical roles.					

14.	. In my career I have been given roles that do not commiserate my qualifications					
15.	I have felt I need to highlight my work more to gain visibility.					
16.	I find my colleagues interrupt me while I speak in a meeting					
17.	I feel others listen to me when I try to speak					
18.	I believe, if women speak/give opinions they are judged in organizations.					
19.	In a meeting, while making a point I have felt being discounted by others					
20.	I feel my views have been valued in the organizations I have worked with.					
21.	At work, I feel I am offered help in doing my work because of my gender.					
22.	At work, my supervisor feels the need to protect me specially when I interact with external parties like vendors because of my gender					

23.	At work, I am accompanied by my co-workers to meetings with clients so that I am not alone as a woman.					
24.	. I have sometimes been asked not to do some parts of my job because my supervisor considered it difficult for me because of my gender.					
25.	I have experienced belittling by a co-worker because of my gender.					
26.	At work, I have been asked whether I even know how to do the work I am doing.					
27.	At work, I have received aggressive gestures from a co-worker.					
28.	At work, I have heard comments about women not being good with engineering related tasks					
29.	People make jokes about differential abilities, because of one's gender, in engineering.					

30.	I feel my work is scrutinized to stricter standards of quality because of my gender.					
31.	. Based on my experience, I feel women engineers are given similar roles and responsibilities as male engineers.					
32.	I believe I have got lesser opportunities to work on important projects because of my gender					
33.	. I feel throughout my career the salary I have drawn is influenced by my gender.					
34.	How supportive are family members or would be in helping you deal with work related problems.					
35.	How supportive are family members or would be in helping you cope with work demands.					
36.	. I have had a supervisor(s) who cared about my opinion.					

37.	. I have had a supervisor(s) who really cared about my wellbeing					
38.	. I have had a supervisor(s) who strongly considered my opinions.					
39.	I have had a supervisor(s) who showed very little concern for me.					
40.	. My Personal life suffers because of my job.					
41.	. I neglect personal needs because of my job					
42.	I put personal life on hold for my job					
43.	I struggle to juggle work and non-work commitments					
44.	. I am unhappy with the amount of time for non-work activities.					
45.	. My personal life drains me of energy for work					

46.	. My work suffers because of my personal life					
47.	. It is hard to work because of my personal matters					
48.	My past success gives me confidence for new challenges					
49.	I am optimistic about my ability to create positive outcomes					
50.	I feel pride in my achievements					
51.	When I make plans, I'm certain I can make them work					
52.	I feel that I have accomplished things in my life.					
53.	I can handle difficult situations					
54.	I have close and secure relationships.					
55.	I am able to shape my current environment and future destiny					
56.	I clearly see the purposeful meaning of my life.					
57.	When I evaluate my past experiences I can see successful adaptation					

58.	I like challenges					
59.	In difficult periods I have a tendency to find something good that helps me thrive.					
60.	I do not let negative forces around me affect my performance.					
61.	By working hard, I can nearly always achieve my goals					
62.	I generally persist in a given task until success is achieved					
63.	I have secure social relationships which help me frequently.					
64.	When I find a difficult situation, I can usually find my way out of it.					
65.	I can handle unpleasant feelings					
66.	Having to cope with stress makes me stronger.					
67.	I believe I can get through difficult times.					

68.	It does not take me long to recover from a stressful event					
69.	I usually come through difficult times with little trouble.					
70.	I can control my negative emotions during hard times					
71.	I am capable of engaging the support of others.					
72.	If I'm working on a difficult task, I know when to ask other people for help.					
73.	I am sure good things will happen in the future					
74.	I have enough experience where I have successfully dealt with stressful situations					
75.	I think I have a bright future.					
76.	I know how to accomplish my future goals.					
77.	I am satisfied with the success I have achieved in my career					

78.	. I am satisfied with the progress I have made towards meeting my overall career goals					
79.	. I am satisfied with the progress I have made towards meeting my goals for income					
80.	I am satisfied with the progress I have made towards meeting my goals for advancement					
81.	I am satisfied with the progress I have made towards meeting my goals for the development of new skills.					
82.	I will probably look for a new job in the next year.					
83.	I often think about quitting					
84.	At my work, I feel bursting with energy					
85.	I am enthusiastic about my job					
86.	I am immersed in my work					
87.	In most ways my life is close to my ideal.					

88.	The conditions of my life are excellent					
89.	I am satisfied with my life.					
90.	So far I have gotten the important things I want in life.					
91.	If I could live my life over, I would change almost nothing.					
92.	Have you had a mentor (one or more) in your career?					
93.	I share personal problems with my mentor					
94.	I socialize with my mentor outside of work					
95.	I exchange confidences with my mentor					

96.	I consider my mentor to be friend					
97.	My mentor takes a personal interest in my career					
98.	My mentor has placed me in important assignments					
99.	My mentor gives me special coaching on the job					
100.	My mentor advises me about promotional opportunities					
101.	My mentor helps me in my professional goals					
102.	My mentor has devoted special time and consideration to my career					
103.	My mentor shares valuable information with me					
104.	I try to model my behaviour after my mentor					
105.	I admire my mentor's ability to teach others					

106.	I respect my mentor's knowledge of the engineering profession					
107.	I have found the formal mentoring program effective					
108.	I have frequent communication with the assigned mentor					
109.	I prefer a female mentor/ a male one/ either.					
110.	I consider female managers/ mentors are more critical towards their junior female employees					