

Research Article

Women Engineers: Some Issues

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Traditionally engineering was perceived to be a profession only for men. Participation and contribution of women in this field used to be very less. Thus women represented a large untapped source of talent. However, of late, there has been a steady rise in the number of women entering and performing satisfactorily in the field of engineering and technology. This trend is more visible and vibrant in India. Still there are many women who are not either opting for this career or after entering, are not continuing. There are some issues which are acting as deterrent for the women. Present paper discusses this aspect. Basic difference between women and men are brought out. The strengths of women which are relevant to engineering domain are narrated. Problems faced by women pursuing engineering as career are analyzed. Then the remedial measures are proposed. The intention is to provide level playing field to women and encourage the prospective and deserving women to opt for engineering and make a successful career there in.

Keywords: Women Engineers; Equity Issues in Engineering Education and Employment ; Gender Discrimination

1. Introduction

Participation and contribution of women in the field of engineering was not much. Presently, there is rise in number of women engineers. However, still there are some concerns like many prospective and deserving women candidates are not opting for engineering. For those who have entered this field, there are problems of finding employment and continuing successfully in it with due career advancement. The reasons for these are of two type: internal and external. Internal reasons are due to the very attitude of the women whereas the external reasons are due to the society, religious beliefs, employers, etc.

Present paper discusses this aspect. Basic difference between women and men are brought out. Problems faced by women are analyzed and the remedial measures are proposed. Women need to be provided with a level playing field and encouragement to opt for engineering and make a successful career there in. Women and men are different from each other. Both have unique features and each one has both strengths and weaknesses.

1.1 Women

The way women differ from men is visible even at their childhood looking at the toys they play with like Barbie dolls proclaiming Math class is tough. Girls wear pink attire whereas it's blue for baby boys. Middle-school math teachers call on boys more than girls. High-school girls are urged to be cheerleaders or writers instead of scientists.

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Women prefer dealing with people as against things. Men prefer the opposite. Women, cognitively and hormonally, think and feel differently from men, and have different aptitudes. Women have been conditioned to want to focus on family and prefer a nurturing role. Women have better verbal skills than men. General perceptions about women are that they are soft, caring and emotional. They are concerned about others and are effective and natural caretakers. They are weak physically and are restricted in their world vision.

1.2 Men

Attributes of men are masculine, aggressive and competitive. They are fascinated by power and money. They long for owning, be it land, wealth or women. They move from problem to problem, facing them and trying to solve. This has made them stronger. Men have wider world vision and 'larger canvas' perspective as is evident from the way they are always after news paper/channel. General perceptions about men are that they are intellectual, rational and logical. They are workers. Make it Happen is natural for man. Men are comparatively less emotional.

1.3 Attitude

What man & woman are as what they are is due to their anatomy & attitude. Of these two aspects, it's the attitude which is a variable. Attitude is shaped and influenced by variety of aspects like:

- Culture; history; religion; biological; sociological reasons

- Over centuries women are conditioned with some attributes which has lead to that attitude becoming the reality like family care, soft behavior, etc
- Technology has a big impact on the attitude formation. Take for example the industrial revolution which has brought about a sea change in the attitude of both men and women
- Ambience in which the child is born and brought up matters much in shaping the attitude. Children in adventurous and entrepreneurial surroundings will have their attitude formed accordingly.
- Hence Emotional Quotient (EQ)/ Intelligence Quotient (IQ)/ Social Quotient (SQ) are different for men and women. This is to be born in mind while comparing them for recruitment of jobs or other opportunities.

1.4 Engineering

Engineering is about creativity, having a positive impact on society and teamwork. Engineering is the process of Make it Happen. And Make it Happen physically has been engineering traditionally. As engineering itself is changing in its shape and form, many women are finding their way in to engineering. Women have the following strengths which are relevant and suitable for engineering field:

- Competency in programming languages
- Natural capability of planning, coordination, inventory management and quality control. This is evident from the way women do Home Making . But somehow these capabilities of women are not amply exploited in engineering.
- Having a liking towards life science, women fit in aptly for the areas which combine life science and engineering like Bioengineering or Biotechnology.

2. Women engineers: present state

2.1 Engineering Education

In India, the participation of women in engineering was negligible till the early 1980s. It is only in the past 15 years that their enrolment has shown an increasing trend (Parikh & Sukhatme, 2004). Over 50 years from 1951 to 2001, there has been nearly a 50-fold increase in intake capacity. Growth in the last 3-4 years is because of the capacity created in information technology, computer science engineering and electronics.

Most preferred branches are Computer Science Engg, Electronics, Electrical, Chemical, Biotechnology, Biomedical and Civil engineering in that order of preference. Table 1(Wikipedia, 2013) indicates the percentage (10 to 20%) of undergraduate women in engineering in the developed countries. Indian situation on this count is depicted through the specific case (Table 2) of an engineering college: SDM College of Engg & Technology, Dharwad (SDMCET, 2013). It can be observed that over years, the number of women graduates is increasing. It's also evident that the main branches of

engineering which account for large number of women are Electronics & Communication (E&C), Computer Science Engineering (CSE), Information Science Engineering (ISE), Electrical & Electronics (E&E) and Chemical Engineering.

Table 1. % of undergraduate women in Engineering

Country	% women to men	year
Australia	14.1%	2004
Canada	18.5%	2004
United Kingdom	9.5%	2005-06
United States	19.3%	2005-06

Table 2.SDMCET: UG Student Profile

	2008		2009		2010		2011	
	Male	Female	Male	Female	Male	Female	Male	Female
E&C	98	22	86	34	87	34	79	46
CSE	79	41	72	45	72	48	79	47
ISE	37	24	33	27	33	26	21	42
E&E	44	16	44	15	52	8	48	15
Civil	51	9	76	10	73	16	77	16
Chem	23	18	20	14	16	8	16	12
Mech	121	3	119	1	119	0	125	1
Total	#	133	#	146	#	141	#	179

2.1 Engineering Employment

In US, 11% of the engineering workforce in 2003 were women whereas 9.6% of engineers in Australia are women. In India, Technical Educational Institutions (TEIs) provide the largest avenue for employment which is about 21% of the total woman employment. Employment in the large-scale private sector industry is 18.4 %. On the whole, the percentage of women engineers works out to be 6.1 %. Details of the situation in a technical educational institute are brought out with the specific case of faculty profile at SDMCET and presented in Table 3 (SDMCET, 2013). It can be observed that women engineering faculty strength, in total, is considerable being in the range of 25% and above. Their number is high in the departments like electronics, computers, etc. Interestingly in some cases, they are more in number than men! This is the indication of the trend that's going to pickup for the years to come.

2.2 Nature Of Job

The preferred areas for employment by women are (Parikh & Sukhatme, 2004) Teaching, Computer, Design, R and D, Project planning, Maintenance and troubleshooting, Production, Construction/Erection/ Commissioning,

Consultancy and Management in that order. Women have started becoming remarkable engineers. An interesting and increasing trend observed in Bangalore, the heaven of computer engineers, is that many companies have started choosing women to head a team of techies (DNA, 2013). Many are moving up to higher positions like Chief Executive Officer, Professor, etc. However the percentage of women engineers who successfully move up the ladder is small as depicted in Fig. 1 (Wendy & Stephen, 2012). It presents the case of career growth of faculty in academic domain and clearly indicates that the number of women engineering faculty members is quite considerable at the Assistant Professor level which is the entry level. The number decreases remarkably and is very small at the highest level i.e., in the cadre of full professor.

Table 3. SDMCET: Faculty Profile

	2009		2010		2011		2012		2013	
	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Male	Fem
E&C	13	13	14	12	10	12	15	12	16	13
CSE	17	10	18	10	18	5	19	8	21	7
ISE	4	9	4	9	4	7	6	7	5	7
E&E	13	1	14	1	13	--	14	2	15	2
Civil	14	1	16	1	12	1	15	6	18	5
Chem	4	4	4	3	6	2	5	2	6	2
Mech	30	--	30	--	27	--	32	--	34	--
Total	95	38	100	36	90	27	106	37	115	36

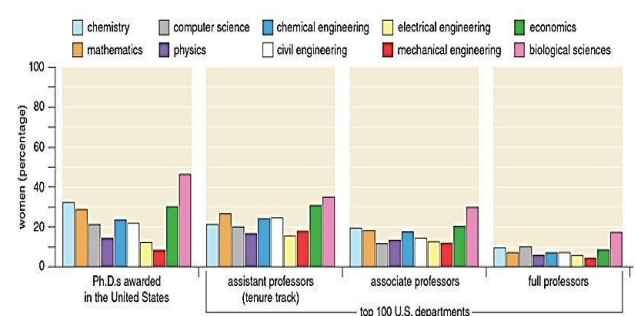


Figure 1. Typical Scenario of Academic Career Progress in USA

3. Challenges for Woman Engineers

3.1 Entry to Engineering

Though there has been growth in the number of woman engineers, still many potential and deserving women are not entering engineering. There exist many reasons for this happening and need to be understood. Some of these are given below:

- Many parents perceive the expenditure on the education of their wards as investment. From that angle, the expenditure on girls' education is perceived to be of no use as the girls will not remain in their parents' home after marriage.

- Many girls themselves shun away from engineering as it's not a glamorous profession! More young females today aspire to be WAG's (Wives And Girlfriends of celebrities) than engineers.
- Females have a natural preference to other fields such as medicine, biology, law and veterinary science, rather than engineering.
- Due to lack of proper and ample exposure, women have inaccurate perception of the engineering workplace (DNA, 2013). Hence do not opt for engineering.

3.2 Employment

After engineering education, many women do not continue in this domain due to different reasons mentioned below.

First entry: Finding the first job after graduation is a major hurdle for women (Parikh & Sukhatme, 2004). They find difficulties in being called for campus interviews. Many firms require references (contacts) to get a job which is lacking typically in the case of rural women engineers.

Attitude: Women's own attitude is the main deterrent. The jobs require determination to succeed, resilience, and personal belief. Women still need to develop these traits. They have to overcome the syndrome what others think of me? playing an important role in all their decisions. Women engineers do not and cannot join male colleagues in informal groups and there is a certain amount of self-exclusion.

Gender discrimination: Women face gender discrimination at various stages of professional life. There is difference in the way women and men are perceived in terms of expertise or competency in the workplace. Regarding many tasks, still there exist assumption that only men can do it!! This leads to devaluing of women's work styles and biased assessment of their efforts, resulting in unequal pay and promotion. Women are either isolated or relegated to 'female' roles of note-taker, organizer or manager (Jenny Marder, 2012). Women have to do better than men to get equal professional recognition. The problem for women in male-dominated fields is lack of right role model in the office and lack of right female mentors. There are many occasions of subtle discrimination or work conditions in which men talk in a way that women find disrespectful.

Work Ambience: With the opening up of economy, the whole globe has become common market place. Engineers are to work in different countries. Women find it difficult to manage with the cultural differences between countries. In several cases, work ambiances are hostile like high temperature/ more noise/ more muscle power required (valve control) etc (Kaitlin, 1994). Even the minimum facilities like chairs & tables will not be properly available. All these push the women off the engineering domain.

Practical Training: Women get less or no chance for practical training. Due to this, they feel less comfortable in engineering than men. They lack the professional role confidence that male engineers seem to acquire easily.

Women find that there is too large a gap between the idea of being an engineer and the practice of it. Woman engineer teachers also face this problem with respect to some subjects and are not able to teach effectively such subjects due the lack of their own exposure to industries or real time systems.

Employers: When it comes to married women, some employers seem to be biased. They feel women, after marriage, will leave office without finishing the job or that she is disinterested. Women face embarrassing questions like - what will you do when you get married? They have to really work hard to convince others that they are the same persons with same efficiency and sincerity even though now they are married. General perception is that women engineers cannot work beyond office hours and on weekends, hence women employment is an economic burden.

Distance: Major problem for women is that of travelling long distances. Many women miss job opportunities just because the interviews are far away. Women cannot take up jobs involving travel. There is reluctance of family towards letting them stay alone. Married women necessarily look for a job in the vicinity of the place of their stay, at least in the same city.

Motherhood & Family: Normally childless women are paid, promoted and rewarded equivalently to their male peers. It is when woman engineers choose to be mothers that their real problems start (Wendy & Stephen, 2012). Family-formation goals extinguish time bound aspirations. Children completely change the landscape for women. Women's optimal fertility is between ages 18 and 31. She must deal with pregnancy, childbirth and child care while simultaneously caring for job. This reality is too daunting for some women, and they either leave the job/performance linked approach or give up on having children. The stresses faced when raising young families drive women out of careers for which they are trained and in which they would be as successful as men were they to make the choice not to have children. Stay-at-home male partners devoted to child care are rare!! Women face the perpetual challenge - How to reconcile family life with an engineering career? Hours spent or percentage of one's life energy devoted for job demand will be less for woman engineers (Jeanna Bryner, 2007). For women, it's not single-minded pursuit of academic goals!! Practical management of career breaks will be difficult.

4. Remedy For Problems

4.1 Approach To Increase The Number Of Women In The Engineering Field

Women need to be given guidance on course selection in early stage. Engineering should be accorded the status of Popular culture so that the women are attracted easily. The parents, teachers and counselors have to recognize engineering as an appropriate and legitimate career choice for women.

4.2 Remedy for problems faced by woman engineers

Individual Level: Women need proper mentorship. Discipline, punctuality, hard work and obedience are stated to be the qualities of women engineers and the same need to be nurtured to make their best use in career building also. Women have to overcome the feeling of insecurity. Self appraisal and corresponding corrections are to be a continuous process. They should not try to be seen as being the woman on the team, but rather as simply a fellow contributor who is judged on competencies and results. They have to develop better language and speak up & express with confidence. Should learn to say No. Blames are to be accepted with positive mind and are not to be taken personally.

There are also benefits of being female! Men like women and are remembered easily. They are better networkers and good at exploiting the underground economy. Their two traits, empathy and diplomacy are highly useful in collaborative efforts.

Employers: Justice to women is to be ensured at government levels through statutes like Equal Opportunity Legislation. The employing companies are to be directed to adopt a comprehensive and reinforced ethics policy to ensure that there is no discrimination. This is to be conveyed to the women folk emphatically by different mass media approaches like mentioning in the advertisements that the company is an equal opportunity employer. There should be a stated mission to meet the career aspirations of all their employees, irrespective of gender. The employers have to avoid penalizing older or non-traditional woman applicants for jobs.

Female engineers are not to be judged by their appearance, but on their ability. It is only in the last 50 years that it has been acceptable for women in business to wear trousers. The cosmetic gender differences are slowly being aligned and higher-ups are less likely to be detracted by outward appearance. Gender bias is to be avoided in the process of selection of engineering staff. A woman member is to be incorporated in the selection committee.

Parental leaves are to be provided for primary caregivers of either gender. Also tenure clocks may be stopped for them during family formation. Length of time allocated for work on grants may be extended to accommodate childrearing. Workloads may be reduced for parents of newborns. Together employment and transfer needs to be practiced for working pair (husband and wife). Physical facilities like Rest Room, Accommodation, Child care facilities, Emergency backup are to be provided at work place. If possible and feasible, employers should explore changing/relaxing quality standards/requirements/perception to give scope to women engineers. The developments in computer and communication technology can be exploited to offer special provisions for women, such as flexi-time slots, option of working from home, part-time job option etc.

Awareness Programmes: This is necessary to sensitise all the people involved to ensure justice to woman engineers. Employers are to be trained regarding the welfare of women employees. Right care to be taken during interviews and examinations for jobs. Compulsory apprenticeship for experience is to be implemented.

Awareness programs are to be conducted for women engineers regarding their rights, adequate representation for women, etc. Prizes and awards are to be instituted as a motivator to women engineers.

Society: It's high time that our society as a whole does critical thinking on continuing to 'groom' women for perpetual child bearing and housekeeping. Introspection is required as to how the society compensates the women for that sacrifice made. In the challenging career of women engineers, their family also has to provide all the support and cooperation.

General: In their own interest, women engineers should opt for collective approach like forming their Association, bringing out women specific magazines, eg.: Society of Woman Engineers; Women Engineer Magazine. They can focus more on computer science engineering and engineering teaching. Such a specialisation and the type of job suit women engineers the best. Entrepreneurship is the most versatile avenue for women engineers as it gives them freedom, flexibility as well as economic strength. Hence they should explore the possibility of becoming entrepreneurs. Incidentally and luckily, engineering culture is also changing - - no more big machines with monster look. Automation is becoming a part of all the processes, making the mechanical tasks simple. These are inviting developments for the women engineers. Fathers have a big role to play as they are the critical decision makers regarding the life course of the women .

Surveys apart, we all can easily appreciate the reality around. Women engineers should accept the reality and act accordingly. Instead of hogging on equal opportunities everywhere as a single point agenda and continuous comparison with men , the women should women should cultivate the positive mindset of give & take respect by acknowledging mutual uniqueness. That makes life more relaxed and worth living.

5. Conclusion

Traditionally engineering was perceived to be a profession only for men. Participation and contribution of women in this field used to be very less. Thus women represented a

large untapped source of talent. However of late there has been a steady rise in the number of women entering and performing satisfactorily in the field of engineering and technology. This trend is more visible and vibrant in India. Still there are many women who are not either opting for this career or after entering, are not continuing. There are some issues acting as deterrent for the women. Present paper has discussed this aspect. Basic difference between woman and man have been brought out. Problems faced by women pursuing engineering as career were analyzed. Then the remedial measures were proposed. The strengths of women which are relevant to engineering domain were narrated. The intention has been to provide level playing field to women and encourage the prospective and deserving women to opt for engineering and make a successful there in.

Positive changes are happening. It's just a matter of time that women will get their due share. It's evolutionary process - requires give & take on both sides. Martin Luther King, Jr. opined: Excellence is the best antidote for racism. The same is true for chauvinism, be it male or female. So let's all strive and be excellent! This is possible with the firm resolve that I will make it.

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