

## Women in engineering: a general perspective

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**ABSTRACT:** Engineering is a profession that has been known as male-oriented. In the last few years, a number of campaigns have been launched in academia and the industry to improve the ratio of female to male engineers. The main purpose of these campaigns is to promote more widely engineering to the community. In this article, the authors attempt to investigate the various prospects of women in engineering. Interviews have been conducted to more thoroughly understand the success and difficulties faced by women who try to progress in the engineering profession. Recommendations are made to improve the success of women in the engineering profession and also to widely promote engineering female students in the early stages of their careers

### INTRODUCTION

Engineering combines the art and science of production. It is a pragmatic activity that draws on imagination, judgement, integrity and intellectual discipline to apply science, mathematics and practical experience to design and operate useful objects and processes that meet the needs and expectations of people [1]. In particular, engineering is crucial in society because solutions to real world problems cannot always wait until the phenomena that influence them are completely understood using rigorous scientific methodologies [2]. Thus, engineers are required to find solutions even when aspects of the underlying science have not been resolved. Therefore, it should be noted that engineering education is an important issue for the developments of the future engineering industry [3-7].

As such, engineering courses offer students multiple resources for learning. However, it is not clear how much time students devote to these resources or how effective they are to master the course materials [8]. Employers attempt to shape employees' work identities through the organisation of work [9]. However, they are partly constrained by employee expectations related to education and training, the occupational structure and the labour market [10]. Employees, individually and collectively, also attempt to influence how their work is performed and hence play an active role in shaping their own work identities [11]. Work identities are, therefore, influenced by structural factors and the agency of employers and employees.

The engineering profession has been known as male-oriented and thus there are not many female engineers currently in the industry [10]. By saying that, it does not mean that women cannot survive in the industry nor are they unsuccessful. It is believed that women who can obtain a Bachelor of Engineering tend to be more creative and successful than their male

counterparts. However, the number of women working in the engineering profession is still very small. Typical reasons for this are family, health, commitment to travelling, lack of confidence in dealing with male engineers and the over-dominance of male engineers in the industry.

Various campaigns have been launched with some success to try attracting women to the engineering profession from the early stages of their careers by providing scholarships and promotion to give women more chances and opportunities in the profession. However, to be able to study the success and failure of promoting women in engineering, it is important to understand the practical view of female engineers and what they have encountered while working in the profession. To achieve that goal, conduction surveys is one of the most effective methods.

The objectives of this article are as follows:

- To thoroughly understand the success and failure of female engineers in the male-oriented profession;
- To promote engineering to women so that the profession becomes more popular;
- To give recommendations on how to attract more women to engineering.

Seven female engineers with more than three years of working experience were interviewed to investigate their positions in engineering professions. The following key areas were asked in the interviews:

- Role differences between male and female engineers;
- The promotion of women in engineering;
- The most challenging task;
- Success factors;
- Future plans;
- Remarks

## ROLE DIFFERENCES BETWEEN MALE AND FEMALE ENGINEERS

From the interviews, it has been found that engineering is a diversified profession that is challenging in nature. The profession involves detailed designing skills, site coordination, quality monitoring and meetings.

Part of the difference in ratio of women to men may be due to the traditional image of engineering, which is usually misleading. Many people think that engineering is only about building sites and is physically demanding. In fact, from one of the interviewees, this is not the case. Engineers these days are involved in all aspects of land, property and construction, as well as computer programming. Elements of an engineer's job include the following:

- Shape corporate development;
- Determine land use;
- Identify environmental issues;
- Monitor quality;
- Manage large scale building projects

Another identified role difference collected from the interviews is that working in the engineering industry usually means working long hours; this can be inconvenient for people with family responsibilities and may deter some women. According to an interviewee, this is the major factor that drives women away from the profession. Flexible working policies are not common in other professions; however, in engineering, male or female engineers still have a work culture of long hours that can sometimes be a major disadvantage for women as they cannot really commit to other activities and only engage in work.

There are also a limited number of women in comparison to men at senior management levels in the engineering profession, which leads to a lack of female role models to attract women into the industry. This is another major factor that simply indicates that there would be no bright future as a big female boss in the profession. Thus, the motivation level for women who are thinking of joining the profession is low.

Women are more likely to take a career break in order to start a family, which means that their career progression may be slower than that of their male counterparts. Unfortunately, this means that they are less likely to advance to a position where they gain experience in managing people and higher reasonability.

According to one of the interviewees, whatever men can do, women can do better. This attitude is believed to provide an advantage and that more women should employ this attitude to advance in the engineering profession. Most women who possess this attitude tend to be successful as engineers.

Another interviewee also believed that there are differences between men and women, but when it comes to work, these differences do not count. The point she wanted to make was that it is not about gender, it is about working attitude. Women tend to possess better attention to detail, and are more careful and patient than their male counterparts. By combining all of these skills together, women can theoretically overtake men in the engineering profession. However, the two major disadvantages outlined above hinder their progress in the profession.

## PROMOTION OF WOMEN IN ENGINEERING

The perception of engineering being male dominated probably does still persist to some extent today, although this is currently changing as people have been made more aware of the diversity and opportunities offered by the profession; for this reason, the interviewees did not consider why there should specifically be a need to attract more women to engineering.

According to another interviewee, although engineering is traditionally a male-oriented profession, there is no reason why more women should not enter the profession. The essential skills required are possessed by both genders and are similar to those in law and accountancy, both of which have a more equal ratio of women to men.

Undoubtedly, a major barrier exists for women to climb up the ladder as it used to be – and still is – a male-dominated industry, but there is no reason why women should not enter the profession. These days, engineers are involved in all aspects of civil, environmental, electronics, geotechnical, manufacturing, mining and construction. As the skills required by both genders are similar, the interviewee believed that when more female engineers enter the industry, the above-mentioned barrier will hopefully be removed.

Another interviewee acknowledged that there is not much gender discrimination in engineering. In fact, she found that many women hold high positions in the profession and are responsible for important projects that are also handled by male engineers. This may be because women are more cautious and thorough than men and they think in a more systematic manner. The interviewee also realised that there are also prerequisites for engineering work.

The fact that there are many successful female engineers in the engineering industry who are smart, confident, energetic and enthusiastic was also realised by one of the interviewees. Their successes in their careers will help attract more people to join the profession, as well as to promote it to the wider community.

## THE MOST CHALLENGING TASK

The majority of the interviewees noted that travelling is the most demanding tasks mentally and physically. A lot of women who are not in the profession usually believe that travelling and work cannot coexist. In the engineering profession, these two aspects do strongly exist. While travelling, engineers need to be well prepared as they will meet new challenges at their destination that they are not used to. As noted above, the engineering profession is already quite challenging for women, and the additional pressures from travelling, surviving and progressing in the profession make it even tougher. It should also be noted that travel makes it very difficult for women to commit to other activities, such as family, which is one of the major barriers for women to overcome.

According to one of the interviewees who works in a consultancy company, the most demanding element of her job is always trying to reach an equitable solution to problems that are acceptable to both clients and contractors. To be successful in this position, the interviewee had to possess skills like patience and care, which are usually lacking in male engineers. This is one of the aspects that facilitated the interviewee being promoted and was greatly endorsed by her boss.

According to another interviewee, frequent meetings with clients, contractors, financial advisors and auditors are also very challenging as these processes are very time consuming. In addition, it is very crucial to have a clear mind when answering queries from clients and all professional parties. The ability to reach an equitable solution to problems that are acceptable to clients is also the most demanding part. This job certainly requires an outgoing personality and a lot of commitment.

Apart from professional skills, effective communication skills and having a work commitment attitude are very critical to success in an engineering career, as noted one interviewee.

Apart from professional skills, communication skills, a sense of responsibility, integrity, persistence and dedication are also required according to one interviewee.

Another interviewee acknowledged that the eagerness to learn and an adaptability to change are very important. The market always acts unexpectedly with rising expectations from clients plus evolving policies and laws from market regulators. To keep abreast with the market, engineers have to learn unceasingly and be ready for changes.

#### SUCCESS FACTORS

Most interviewees noted the importance of keeping on learning and being equipped with more skills to cope with the changing market as the key factor to success in the engineering profession.

They also noted that it is important to learn from successful people. One of the interviewees has been fortunate to work with brilliant bosses and learnt from them a strong sense of responsibility, enthusiasm for continuous learning and initiatives to reach for excellence; these attributes helped guide her towards career success. The success factors in this case are hard work and persistency.

Engineering is a unique profession that requires a rare combination of skills, interests and abilities. One needs to be able to communicate with people at all levels and backgrounds, have effective negotiation skills, and be able to make presentations and write reports. In fact, all interviewees agreed that engineers on average spend about 80% of their time writing reports. Apart from that, a successful engineer also has to possess financial acumen and have an interest in engineering work. It is also acknowledged that a good sense of humour would greatly help one to be successful in his/her profession.

#### FUTURE PLAN

All interviewees noted that one needs to know more than just how talented one is. They also expressed their strong commitment to the profession as they have been progressing well since they joined the profession. However, there were doubts expressed that they could not fully commit to their work once they had families. A number of them were quite determined to choose engineering as their career. A small number of the interviewees expressed concerns whether they should progress in the profession in the next five years. However, the key thing is that all interviewees were fully committed to the profession and if they thought that they could no longer commit to the profession, then a career change was planned.

#### REMARKS

One of the interviewees considered the future to be bright – providing that women engage more in self-learning and are able to grasp opportunities. She believed that there are still many opportunities. Women need to be prepared to work hard to become qualified. Two other important remarks for younger female engineers. She also noted that there may be opportunities to work all over the world, which is on the one hand quite challenging, but on the other hand, quite exciting.

Another interviewee noted that engineering is a rewarding profession. If one is prepared to work hard to become fully qualified, then she can have many rewards. Entry to the profession these days is usually by degree, followed by on-the-job training and professional examinations. The rewards can be considerable and there are opportunities to work all over the world. No day is typical and most jobs in engineering give opportunities to get out of the office and try out different practical aspects that are usually not tested while at university. Her major remark for younger female engineers is that boredom does not exist in the engineering profession.

Most of the interviewees agreed that there should be more fora or meetings to promote the engineering profession to female students at the tertiary education level, such as the National Association of Women in Construction (NAWIC).

#### RECOMMENDATIONS

From the conducted interviews, a number of key points can be identified to improve the success of women in the engineering profession. These are as follows:

- Travel;
- Family commitment;
- Lack of a formal association to promote the engineering profession to women;
- Life-long learning;
- Multidisciplinary skills;
- Doubt and concerns for future career plans;
- Over commitment to work;
- Challenging tasks.

The key factors that have been considered as positive contributions to attract women to the engineering profession is that it:

- Is exciting and challenging;
- Offers opportunities;
- Provides understanding;
- Is rewarding.

From the above factors, it is clear that there are some major barriers that should be removed in order to improve the number of women in the engineering profession. The following recommendations are given based on the conducted interviews and experience:

- To help women become more successful in the profession by devising special tasks and plans that are more suitable like report writing, consultancy and negotiations. Travel can also be used as a motivation factor;
- To give more opportunities to women to be promoted and rewarded. In other words, reward and promote women.

who have been working in the profession for more than five years;

- To regularly organise meetings, fora, plans and projects to widely promote engineering to the community, not just to attract women;
- To improve the motivation and confidence levels of women in the engineering profession by assigning more senior roles to able women. An unbiased promotion scheme is thus crucial;
- To devise effective planning for women with heavy family commitments, especially during maternity;
- To make engineering more exciting to women, it should always be ensured that engineering is a not always male-oriented by giving talks and organising promotional campaigns;
- To devise career plans for female engineers so that they are more determined and committed to the profession.

## CONCLUSION

In this article, the authors show attracting women to the engineering profession is a challenging task. Seven female engineers have been interviewed and their views on the profession are used to identify how to improve the career aspects of women in engineering. The six main key areas in the female engineering profession are investigated using interviews:

- Role differences between male and female engineers;
- Promotion of women in engineering;
- The most challenging task;
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It has been shown that the number of women in the profession is generally small. The major barrier that hinders the progress of women in the engineering profession is family commitment. Travel, challenges and career doubts are also major factors that lower the number of women joining the profession. Effective recommendations and solutions to the above factors are given in this article in which special plans for women who have heavy family commitments are crucial to keep them in the profession. It should also be noted that travelling has also been considered as a positive contribution to attract women to the profession even though some of the interviewees acknowledged this to be quite challenging. By saying that, effective planning is required.

Overall, the progress of attracting more women in engineering has been initiated in recent years with some success, but the number of women working in the profession is still low. It is believed that with effective planning and careful consideration, the number of women working in the profession will increase; this will bring benefits to the community, the profession and improve the strength of the economy.

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