

Factors that influence the high percentage of women enrolled in engineering in the UAE and preparing for careers in the oil and gas industry

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ABSTRACT: The low percentage of women studying engineering around the world is well known. Despite many efforts, the number of women enrolled in engineering programmes in Western countries remains low. In the Middle-Eastern Gulf Cooperation Countries (GCC), a different picture emerges. There has been significant progress in the GCC over the past 10 years in women enrolling in STEM programmes, especially engineering. In the United Arab Emirates (UAE), the percentage of women enrolled in engineering programmes at ranked universities reached 44.5 percent in 2017. At the Petroleum Institute (PI) in Abu Dhabi, UAE, the percentage of female students surged in 2015-2016 to surpass that of male students. The aim of this study was to identify the factors that influenced the female students at the PI in their choice to enrol in an engineering programme, and to later pursue a career in the oil and gas industry. Also explored was their motivation, expectations and support they receive. Several factors emerge. These include government support, industry needs and the motivation of young women to serve their country.

Keywords: Women in engineering, gender gap, women in oil and gas industry

INTRODUCTION

While the percentages of women enrolled in engineering programmes in developed countries have stagnated in the low 20s for the past decades, in the Middle-Eastern Gulf Cooperation Countries (GCC) these percentages have been steadily rising over the past 10 years [1] and in some cases surpassing those of male students. In this study, an exploration was carried out of the motivations and expectations of Emirati women enrolled at the Petroleum Institute (PI) in Abu Dhabi, the United Arab Emirates (UAE), who opted to pursue engineering degrees, and who made the commitment to begin later their professional careers in the oil and gas industry.

Women in Engineering Programmes

The percentage of women enrolled in engineering programmes in the GCC has soared over the past 10 years. Meanwhile, in most Western countries, despite great efforts from governments, industries and academic institutions, women remain underrepresented in engineering education. Table 1 shows female enrolment in engineering at ranked universities in North America, Europe and GCC countries, in 2017 [2].

Table 1: Percentage of women enrolled in engineering programmes.

Country	Percentage of women enrolled in engineering programmes at ranked universities
US	23.0
Canada	20.4
UK	18.0
France	26.9
Germany	20.8
UAE	44.5
Qatar	44.0
Kuwait	69.9

Research shows that female engineering students perform as well as men; however, a higher percentage of female

students drop out of engineering and change majors than male students. The most commonly cited reason is that they believe they do not have the skills or they do not fit into engineering [3].

Women in Science Technology Engineering Mathematics (STEM) in the UAE

The UAE Vision 2021 calls for a strategy based on knowledge, innovation, research, science and technology. The large investments made by the government in renewable energy, high-tech manufacturing, biotechnology, pharmaceuticals, telecommunications equipment and aerospace will make the need for engineers and scientists soar in the next few years. The Abu Dhabi National Oil Company (ADNOC) plans to increase its oil output, requiring the recruitment of a large number of engineers every year. More than 95% of Emirati women who graduate from high school enrol in a higher education institution, as compared to 80% of males. Women perform even better than their male counterparts academically and are making strides in majors previously considered male-dominated; 46% of the country's graduates in STEM subjects are women. With a population of one million citizens and with women making up 71.6% of students in public universities and 50.1% in private ones, it is inconceivable that the ambitious goals the UAE set for itself could not be reached without their active involvement.

The Petroleum Institute (PI)

The PI is a research university sponsored by the ADNOC and its international partners (BP, Shell, Total and the Japan Oil Development Company). The PI offers BS, MS and PhD degrees in chemical engineering, electrical engineering, mechanical engineering, petroleum engineering and petroleum geosciences. Initially, the PI enrolled only male students and admitted its first cohort in autumn 2001. In 2006, the PI launched a female campus, and 104 female students joined the Institute. In 2016, 1,547 undergraduate and 650 graduate students were enrolled at the PI. All undergraduate students have signed an agreement to work for one of the companies of the ADNOC group for as long as they have attended and completed their degree at the PI.

At present, most of the 1,573 PI graduates are employed by the ADNOC group. Between 2006 and 2009, the number of female students rose steadily to reach a plateau of approximately 35% of the total undergraduate population. During this period, there was no housing available for female students on the PI campus, limiting access to students from the city of Abu Dhabi. Soon after dormitories for female students became available; in 2014, the numbers soared to eventually surpass those of male students, as illustrated in Figure 1.

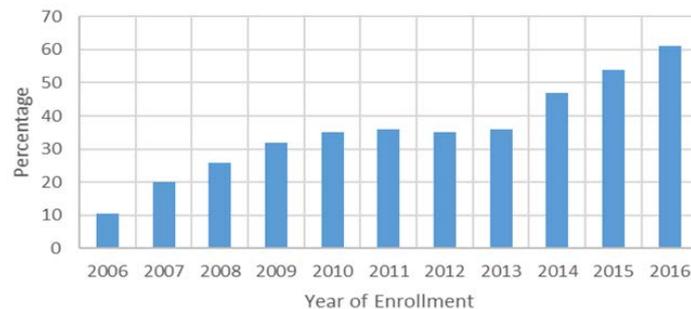


Figure 1: Percentage of female students enrolled at the Petroleum Institute.

At the PI, the percentage of women in engineering is higher than 60 percent; the class of 2020 will have 63% female students. Harsh working conditions, a less than convenient work schedule, living arrangements and family obligations make the oil and gas industry one of the least attractive industries for women. They account for less than 8% of the global workforce in the oil and gas industry [4].

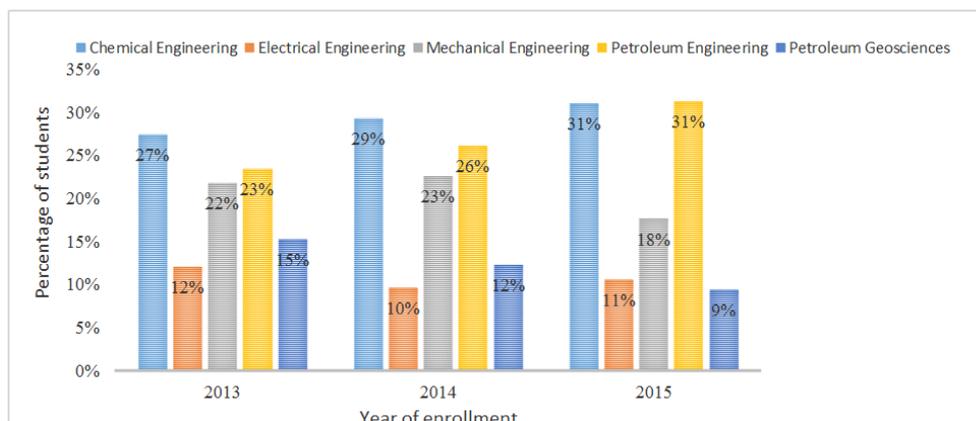


Figure 2: PI undergraduate female students by major.

A lower percentage occupy engineering positions and only 11% of board positions in the top 100 oil and gas companies are occupied by women [5]. Despite this, Figure 2 shows that the largest increases in female student enrolment at the PI occurred in the Departments of Chemical and Petroleum Engineering; a clear indication of the commitment of these students to the oil and gas industry.

Furthermore, the female students' academic performance measured by the grade point average (GPA) at graduation was very similar to that of the male students, as illustrated in Figure 3.

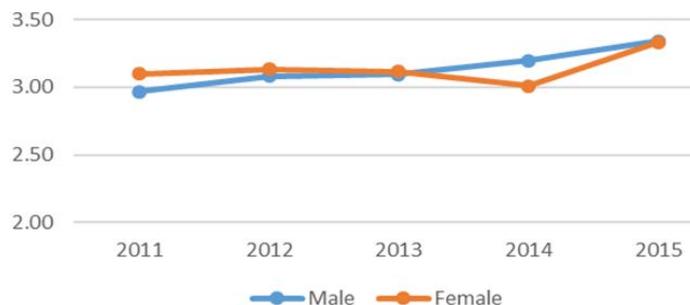


Figure 3: PI students GPA at graduation.

CONTRIBUTING FACTORS

A study conducted at the University of Massachusetts, Amherst, identified five factors that motivated women to pursue a degree in engineering [6]. These included internal factors, such as strong mathematics and science self-efficacy, and external factors, such as encouragement from family members and friends. In another study, women cited *doing something to contribute to society* as one of the main reasons they chose engineering as a major, while men cited *the prospect of earning a high income* as the main reason [7].

The aim of this study was to identify the factors that influenced the female students at the PI in their choice to enrol in an engineering programme, and to later pursue a career in the oil and gas industry. In an effort to better understand the female students' perceptions, motivation and expectations in studying engineering, and later pursuing a career in the oil and gas industry, a survey was conducted.

Methodology

A survey titled *Interest in engineering* was conducted to gather information related to the students' beliefs about their career choice, as well as to collect background information. The survey was formatted mostly as a multiple choice bubble sheet that can be read and further analysed by a special computer program utilising optical mark reader technology (Remark Office OMR). Further analysis of the results was done using Microsoft Excel statistical analysis functions to find correlations among the sample groups and the questionnaire items.

Section A of the survey covered basic demographic data related to age, gender, nationality, high school, current academic level, engineering major and current GPA. Section B was labelled *Career choices* and included multiple choice questions covering why they chose to enrol at the PI, and pursue a career in the oil and gas industry; where they would be interested in working; who encouraged them; and if there are any engineers in the family. The last section of the survey was titled *Beliefs about Engineering* and was basically a five-point Likert questionnaire ranging from *strongly agree* to *strongly disagree* with 10 statements.

The section collected data to show whether the participants agree or disagree that they want to be engineers and that their families want them to be engineers. It also checked their agreement levels with the notions that the PI will prepare them well for their career, that the oil and gas industry offers the same opportunities for female employees as it does for male employees, that women can reach top management positions within the oil and gas industry, and that they will be able to raise a family and pursue a successful career in the oil and gas industry at the same time. The section also gathered data to see if they felt supported by their families, instructional teams and friends to pursue a career in the oil and gas industry, and if they were planning on pursuing a graduate degree afterwards.

Demographic Data

The number of PI students who participated by filling out the survey was 106, where 35% of the participants were male students, and 65% were female students. The majority of the sample (almost 90%) were UAE nationals. These students were all enrolled in the four freshman or sophomore courses offered by the General Studies Department. These courses cover the following topics: introduction to engineering, introduction to engineering in the petroleum industry, engineering design 1 and engineering design 2. About 60% of the participants were sophomore (second year) students aged between 19 and 20 years. Finally, only 11% of the participants reported a GPA of 2.0 or less.

RESULTS AND DISCUSSION

Both male and female responses were analysed and significant differences found, but the main emphasis in this study was on the responses provided by the female students. The survey results shed some light on three main points. These cover the reasons why they joined the PI, the location where they prefer to work and their perception of whether women receive equal opportunities in the field.

Career Choices

In the section of the survey called *Career choices*, 37% of the female sample indicated they chose to enrol at the PI, because of their interest in science and engineering, followed by 31% seeking a promising career with Abu Dhabi National Oil Company. Family encouragement came next at 21% of their responses. Male students showed a similar pattern. In Table 2 is a summary of the finding related to the question *Why I chose to enrol at the PI?*

Table 2: Percentage of women enrolled in engineering programmes at ranked universities.

Question: I chose to enrol at the PI because	Female	Male
My family encouraged me to	21%	29%
My interest in science and engineering	37%	30%
A promising career with the ADNOC group	31%	32%
Do not know	6%	5%
Other	5%	4%

The next item gathered data about the people who encourage the participants to seek a career in engineering when they are not sure about their career choice. Parents were reported to provide the most encouragement, as they were mentioned 75% of the time. The last item in this section checked whether there were any engineers in the family. None of the participants' mothers are engineers, while 20% listed the father as an engineer. Other male family members were 58%, while other female members were 33%; and 9% declared there were no engineers in their families.

Reason for Joining the Oil and Gas Industry

The next item posed a question regarding the reason for joining the oil and gas industry, and the choices provided were: high salaries; social status; the opportunity to serve my country; or other reasons. The top reason for female students was *servicing my country*, as reported by almost half of the female respondents. It was followed by *high salaries* and *social status*. By contrast, the male students reported *high salaries* as the top reason, while *servicing my country* was reported by only 24% of the males compared to double that percentage reported by their female counterparts.

The correlation between the two group responses regarding the reasons for joining the oil and gas industry showed the weakest among all survey items standing at 0.82, which is still a positive correlation. Presented in Figure 4 is the finding to the question: *Reason for joining the oil and gas industry* and the difference between male students' and female students' responses.

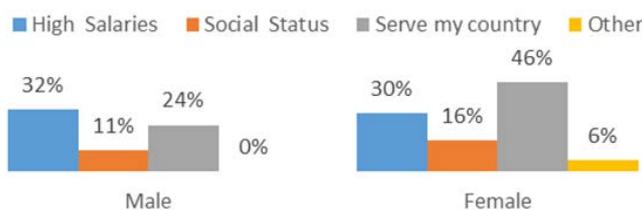


Figure 4: Reason for joining the oil and gas industry (some participants did not respond).

The findings here match those in the study carried out by The Economist magazine, where data suggested that women are driven more by an aspiration to be of service to the greater good, and seek opportunities to help their society [7]. More than four-fifths of female respondents chose to study a STEM-related subject, because they wanted to give back to the UAE, while almost two-thirds felt that society respects people who work in a science-related field, such as an engineer. They state that Emiratis are highly patriotic and understand their country's development depends on their acquisition of relevant skills. Additionally, a study concluded that high income is a key attraction, as over four-fifths of their respondents believed that studying STEM will secure high salaries [7]. The findings are, therefore, consistent with prior research.

Location Where they Prefer to Work

Respondents were then asked about the location where they prefer to work. The three options provided were: in an office; in the field; or no preference. The results showed that 36% of the female respondents indicated they prefer

the field jobs, while only 22% of the male students opted for the field. Shown in Figure 5 are the findings in the *Work location* question of the survey.

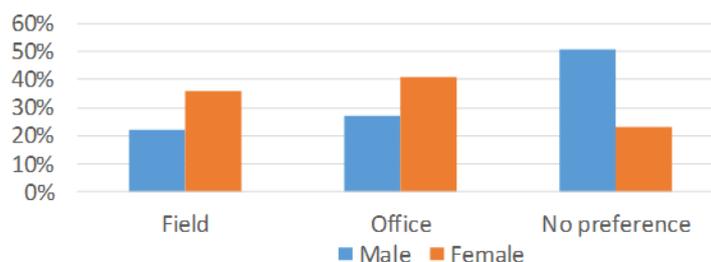


Figure 5: Work location preference.

The female responses were not as expected. This is based on the general public perception that a job in the oil field in such a hot climate is not as attractive as an office job. Additionally, most of the country's industrial facilities are far outside the cities and female engineers are usually compelled to drive back and forth from the worksite because proper facilities for women to stay overnight are lacking. This sometimes leads to female engineers getting much less onsite experience than their male colleagues. When women engineers arrive in the field, they can face other difficulties, such as the lack of adequate safety gear for women onsite. Despite all of this, the results showed that 36% of the female respondents indicated they prefer field jobs, while only 22% of the male students opted for this. This seems consistent with other studies that state Emirati women are driven by a desire to give back to their country [8].

Beliefs about Engineering

The final section of the survey was titled *Beliefs about engineering* and a five-point Likert scale questionnaire was adopted, with ten statements ranging from *strongly agree* to *strongly disagree*, regarding their beliefs. Participants mostly agreed with all 10 statements, with the exception of the following: *I believe that the oil and gas industry offers the same opportunities for female employees as for male employees*. Only 50% of the participants agreed with this statement, while the rest either disagreed or selected *neutral* as their response. This statement received the highest disagreement level among all questionnaire items. The other statements received a disagreement level of 0% to 3%, while the statement about equal opportunities for female employees in the oil and gas industry received 14% disagreement. The statements concerning *Beliefs about engineering* and the results of the questionnaire are shown in Table 3.

Table 3: Beliefs about engineering.

Statement	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)	No response (%)
<i>I want to be an engineer.</i>	67	17	7	1	0	8
<i>My family wants me to be an engineer.</i>	29	41	19	0	0	11
<i>I believe that the PI will prepare me well for my career.</i>	55	30	2	3	0	10
<i>I believe that the oil and gas industry offers the same opportunities for female as for male employees.</i>	20	30	23	14	0	13
<i>I believe that women can reach top management positions within the oil and gas industry.</i>	54	19	12	3	1	11
<i>I believe that I will be able to raise a family and pursue a successful career in the oil and gas at the same time.</i>	43	26	14	0	1	16
<i>I plan on pursuing a graduate degree after graduation from the PI.</i>	41	35	9	1	0	14
<i>I feel supported by my family to pursue a career in the oil and gas industry.</i>	42	25	13	0	0	20

<i>I feel supported by my friends to pursue a career in the oil and gas industry.</i>	39	36	12	3	0	10
<i>I feel supported by the faculty/staff at the PI to pursue a career in the oil and gas industry.</i>	32	42	10	0	0	16

Figure 6 shows responses to the survey statement: I believe that the oil and gas industry offers the same opportunities for female employees as for male employees. It shows similar disagreement regarding equal opportunities from both male and female respondents.

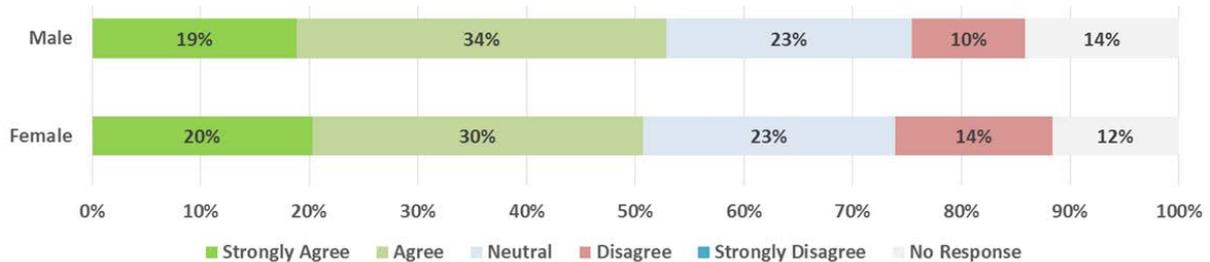


Figure 6: Perception of equal opportunities by gender.

The other statements received a disagreement level of 0% to 3%, while the statement about equal opportunities for female employees in the oil and gas industry received 14% disagreement. This finding matches the study carried out by The Economist magazine, where about 66% of their participants saw cultural issues as an obstacle to women in science and engineering [8].

More than two-thirds of respondents with work experience in science and engineering felt that engineering-related fields are a better fit for men. More than two-fifths of their participants identified gender as being an obstacle [8]. This consistency is a reason to believe that the general perception is that there is still room for improvement when it comes to providing equal opportunities in the field of oil and gas industry.

CONCLUSIONS

Despite the low percentages of women studying engineering around the world, the Middle-Eastern GCC countries in general and the United Arab Emirates in particular, reveal a totally different picture. There has been a substantial increase in the number of women enrolling in STEM programmes, particularly engineering. This is not unique to the UAE. According to International Gas Union (IGU-UNESCO), women make up about 60% of the engineering students at universities in the Gulf region [9]. This study has shown there are several factors contributing to the current increase in the percentage of women in engineering in the UAE. It is evidently a combination of factors, such as the vision of the government and the motivation of the young women to serve their community, and make their families proud.

The case presented in this paper deals mainly with one university, but it is not unique. Other publications seem to support the findings of this case study [8]. The female students' performance, motivation, expectations, and career choices seem to be quite similar throughout the GCC region. The findings shed some light on the reasons why so many of them choose to pursue a career in the oil and gas industry. A major outcome of this surge of enrolment coupled with the motivation and drive of the participants is that women will certainly reach top management positions within the oil and gas industry in the region.

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BIOGRAPHIES



Sami Ainane holds a BS degree in mechanical engineering from Joseph Fourier University, Grenoble, France, an MS and a PhD in mechanical engineering from the University of Maryland. He is at present serving as a UAE-Stanford Innovation and Entrepreneurship Programme Ambassador. Dr Ainane is currently an Associate Professor in the Mechanical Engineering Department at Khalifa University of Science and Technology (KUST) in Abu Dhabi, UAE. He served as Director of Undergraduate Studies in the A. James Clark School of Engineering at the University of Maryland from 1998 to 2009. In 2009, he joined the Petroleum Institute in Abu Dhabi, UAE, where he served as Associate Professor in Mechanical Engineering, Chair of the Department of General Studies and Dean of Student Affairs. Dr Ainane's research interests include erosion-corrosion, CFD and engineering education.



Ali Bouabid holds a DEST (BSc) and an engineering degree (MSc) in mechanical engineering from the Conservatoire National des Arts et Métiers of Paris, France, and an MSc and a PhD in systems engineering from the University of Virginia. Dr Bouabid is an Assistant Professor in the Industrial and Systems Engineering Department at Khalifa University of Science and Technology (KUST) in Abu Dhabi, UAE. Prior to his appointment at KUST, Dr Bouabid was an Associate Professor and Engineering Programme Co-ordinator at Piedmont Virginia Community College in Charlottesville, VA, USA, from 2006 to 2014. His research interests are related to sustainability of water supply, sanitation and energy systems in developing countries, and engineering education. Before his academic career, Dr Bouabid worked in industry in France and in Morocco (engineering and manufacturing) for more than 15 years.



Wael El-Sokkary earned his MA in instructional systems development (ISD), with a concentration on the design, development and assessment of bilingual education programmes, from the University of Maryland, Baltimore County (UMBC) in Maryland, USA, in 2003. He received K-12 certification from the State of Maryland in the same year. His undergraduate degree was also in education, majoring in English literature and linguistics from Ain Shams University, Egypt, in 1992. Wael El-Sokkary taught English and educational methodology at UMBC and later moved to Prince George's County Public Schools. He relocated from the USA to the UAE in 2006, to join the Petroleum Institute as an English lecturer. The Petroleum Institute became part of Khalifa University of Science and Technology in 2017. His research interests include engineering education and applied linguistics.