

# Practical Mechanical Engineering: Women Involvement, Productivity and Authority

Okeudo, Paula Chisom

Department of Mechanical Engineering, Federal University of Technology Owerri, Imo State, Nigeria

---

**Abstract:** Amidst all engineering disciplines, mechanical engineering tends to be women abhorrent in West African countries. The presence of women in industries and technical workshops is so insignificant. From facts gathered from Mechanical Engineering workshops, through personal interviews and questionnaires, women are absent in 99% of these workshops and industries. The major causative factors being the use of crude tools and technology, poor and highly polluted environment as well as the labor-intensive nature of the jobs and the male-dominant associated mindset. This paper focuses on the stimulation and the effect of females in mechanical engineering, the encouragement of available female engineers to pursue excellence, productivity, research and deliberate involvement is greatly emphasized and the place for engineering bodies and establishment to proffer a solution to this menace. The methodology of improving the presence of innovative women into Mechanical Engineering as well as other STEM disciplines in West African Countries (using the eastern part of Nigeria as a case study) is outlined well.

**Keywords:** Mechanical engineering, Women, Women Involvement, Productivity, Authority, Industrial Reorientation.

---

## 1. INTRODUCTION

The underrepresentation of women in the field of mechanical engineering at the undergraduate level, graduate level and in the industries or rather engineering workforce is well known in the world as well as in West African countries. Women are barely present, this is not unconnected with the perception of the profession as being physically and mentally demanding. Thus even when degrees in mechanical engineering are offered nationwide-Federal University of Technology Owerri (FUTO), University of Nigeria Nsukka, Enugu State University, Anambra State University, to mention a few-female enrollment is not significant. Looking at the statistics of undergraduate enrollments in FUTO, where I am currently an undergraduate student, the male to female ratio is an average of about 50:1 and for years, there has not been any female post-graduate student. This discovery is alarming as it may not really be gender discrimination that causes female relative absence in the profession but could be non interest of females. This in extension rubs off in the industries and engineering practicing firms as female mechanical engineers will not be available. As a matter of fact, all the companies visited for the purpose of this survey had no female mechanical engineer, technologist, technician, or craftsman. All authority in terms of hierarchy were males.

### 1.1 What is Mechanical Engineering and who is a Mechanical Engineer?

According to American Society of Mechanical Engineers (ASME), Mechanical Engineering is the discipline that applies the principles of engineering, physics, and material science for the design, analysis, manufacturing and maintenance of mechanical systems. It is the branch of engineering that involves the design, production and operation of machinery.

**International Journal of Novel Research in Engineering and Science**

Vol. 4, Issue 1, pp: (44-54), Month: March 2017 - August 2017, Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)

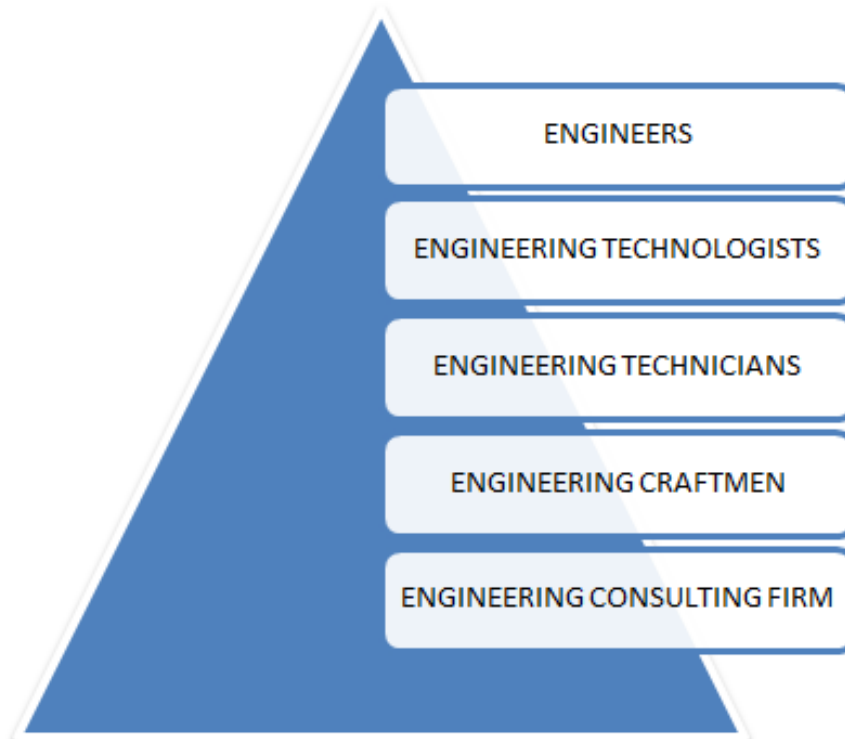
However, In Nigeria, A Mechanical Engineer is a graduate of a Mechanical engineering from a University, who has at least four years of experience and is registered with the council for the Regulation of Engineering in Nigeria (COREN).

Mechanical engineering plays a dominant role in enhancing safety, economic vitality, enjoyment and overall quality of life throughout the world. Mechanical engineers are concerned with the principles of force, energy and motion. The men and women who work as mechanical engineers are professionals with expert knowledge of the design and manufacture of mechanical systems and thermal devices and processes. Some examples of products and processes developed by mechanical engineers include engines and control systems for automobiles and aircraft, electric power generation plants, lifesaving medical devices and consumer products ranging from air conditioners to personal computers and athletic equipment. They also design the machines that mass-produce these products. Virtually every aspect of life is touched by mechanical engineering. If something moves or uses energy, a mechanical engineer was probably involved in its design or production. (www.asme.org/careers, 2015).

More so, it is well known that engineering began with mentorship and apprenticeship. Mechanical Engineering is not different. This has paved a way for certificates in craftsmanship and its' likes in Nigeria.

**1.2 What is Engineering Practice?**

The cadre of engineering personnel gives an overview of those that practice engineering.



Members of this cadre are trained both in a formal and informal way to add value to the engineering profession. Although the area of specialization of various personnel differs, but they all work together to achieve a common goal.

Engineering is not just about mechanizing or digitizing the world to make life less burdensome and nations more powerful. Engineering as a profession ought to improve the world for the common good. The professional education of engineers demands the acquisition of a body of specialized knowledge, problem-solving skills, and good judgment for the service of society. These three domains of engineering education are aimed at forming engineers who are intellectually trained, practically adept, and ethically responsible for their work. Every professional engineer, therefore, is called on not only to achieve a certain degree of intellectual and technical mastery, but also to acquire a practical wisdom that brings together the knowledge and skills in a way that best serves a particular purpose for the good of humanity. (Sheri. et al, 2010).

## International Journal of Novel Research in Engineering and Science

Vol. 4, Issue 1, pp: (44-54), Month: March 2017 - August 2017, Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)

### 1.3 Research Aim:

Mechanical engineering is a part of STEM, which stands for Science, Technology, Engineering and Mathematics. Being a part of the female minority fields, this research focuses on:

1. The factors that cause the under representation of women in the field (using the South-east of Nigeria as a case study).
2. Ways of influencing and encouraging females into the field.
3. Opportunity for women in a working environment where productivity and innovation is not judged by gender.
4. Securing a visible presence by women in engineering practice and research.

### 1.4 Research scope:

The general scope of this study is to typify the state of things in Mechanical engineering discipline and ways of improving it through:

- (a) Review of appropriate Literature.
- (b) Generation data by administering questionnaires and through interview.
- (c) Analysis of acquired data on the subject matter.
- (d) Proffering solutions and recommendation.

## 2. LITERATURE REVIEW

A number of methodological frameworks applied in gender and engineering research have indeed unpacked gender relations with a view to understanding women's constraints through investigations into gender access and negotiation during job interview.

As a matter of facts, there is an alarming absence or insignificant presence of paper or research work on practical mechanical engineering relating to women involvement in Nigeria and Africa at large.

Considering the Underrepresented Groups in STEM Majors and Fields globally, we see the need for diversity in the training of students, which include females as well as foreign students.

According to some previous works, gender and ethnic diversity are commonly identified as issues of concern within engineering. Representation of women and ethnic minorities has stagnated during the past decade. In the United States, Females were awarded only 18.4% of bachelor's degrees in 2011 (20.9% in 2002), and Black or African American students were awarded 4.2% of bachelor's degrees in engineering (5.4% in 2002). The urgency for investment in STEM education is underscored by recent trends in engineering enrollment. (Maria-Isabel, et al 2013).

This is also noticed locally in Africa as the number of females are barely increasing.

This past year, the Association of Professional Women Engineers of Nigeria (APWEN) sent representatives to the Nigerian government demanding that reforms be made in the job market to eliminate gender discrimination in the engineering industry. They argue that since they have the same training and must pass the same exams as their male counterparts, that it should be illegal for companies to refuse to hire women engineers. (Oghifo, 2005).

Discrimination during job offer and interview is not encouraging women competition and presence in mechanical engineering.

### 2.1 Engineering and Male Dominance:

A look at the different engineering fields all over the world and in Nigeria particularly reveal that the fields are dominated by men and the profession regarded as a male domain. As Walton (1986) reported, societies do not expect women to become scientists and those that do are seen to step "out of line". As a response to this restriction, women are under-represented in the fields and over-represented in what can be termed the service-sector. The jobs include teaching, nursing, sales and advertising. (Badekale 2003, p.15).

## International Journal of Novel Research in Engineering and Science

Vol. 4, Issue 1, pp: (44-54), Month: March 2017 - August 2017, Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)

Various researchers have tried to summarize the causes of males dominating the engineering disciplines and they are: the positive impact of role models and company policies on careers of women, biological sex differences (that is, their genetic makeup which enable males excel in Mathematics and other related courses). Though there are some truths with regards to the biological selection but many still think that it has more to do with psychological mindset “Newton (1981) wrote on the traditional image of engineering as being heavy, dirty and masculine, while a woman who would succeed in the field had to be tough, aggressive and masculine.” (Badekale 2003). It is observed that though there is increase in women enrollment since the shift of engineering from conventional machine tools to automated manufacturing process, much is still needed to improve the lot of women since there is a shift to computers, printed circuit boards and electronics. Furthermore, the roles of women and men have been changing because of women’s liberation and empowerment movements and changes in economic conditions, altering the division of labor and raising questions otherwise left unasked in the past.

### 2.2 Overview of Factors Serving as Barriers to Women’s Participation in Engineering:

“The lack of women in general, and the lack of women mentors makes it [engineering] a LONELY field for women to want to stay in. There is little to no RESPECT for women in male-dominated fields.” (Nadya et al, 2011, p.2).

Not only are people more likely to associate math and science with men than with women, people often hold negative opinions of women in “masculine” positions, like scientists or engineers. Research profiled in this report shows that people judge women to be less competent than men in “male” jobs unless they are clearly successful in their work. When a woman is clearly competent in a “masculine” job, she is considered to be less likable. Because both likability and competence are needed for success in the workplace, women in STEM fields can find themselves in a double bind. If women and men in science and engineering know that this bias exists, they can work to interrupt the unconscious thought processes that lead to it. It may also help women specifically to know that if they encounter social disapproval in their role as a computer scientist or physicist, it is likely not personal and there are ways to counteract it. (Hill, et al, 2010).

The causes of women’s low participation in engineering can be classified into three factors:

- i) The assumptions that society makes about males and females (their abilities, behaviors, roles, and aspirations).
- ii) The objectives and organization of the learning process.
- iii) The practice of engineering in the industries and other Institutions.

Women comprise more than 20% of engineering school graduates, but only 11% of practicing engineers are women. Project on Women Engineers’ Retention (POWER) was designed to understand factors related to women engineers’ career decisions. (Nadya et al 2011, p.5)

## 3. RESEARCH PROBLEMS

Looking into the engineering practicing firms and manufacturing industries, there is a shortage of skilled work force at all levels. This problem is pronounced due to the low rate of participation of women in engineering and technology. Nigeria’s manpower or human resource in this economic viable field is just limited to the males basically, which is affecting the nation socioeconomically. Studies have revealed that engineering training remains the higher education sector with the lowest female participation rate despite efforts to attract them. (Michel, UNESCO 1988). These studies also show that there are contradictions, which remain intolerable, thereby making engineering profession “a male quasi-monopoly” (Badekale, 2003).

### 3.1 Research Questions:

Answers were sought empirically to the following questions in the study:

- (a) What can be done to increase female involvement in mechanical engineering?
- (b) How does female mechanical engineering students experience their studies?
- (d) What factors hinder females from choosing mechanical engineering as their career line?
- (e) What steps can be taken by female mechanical engineers to improve this condition?

**International Journal of Novel Research in Engineering and Science**

Vol. 4, Issue 1, pp: (44-54), Month: March 2017 - August 2017, Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)

(f) What can be done by the government to sustain women empowerment and make this viable citizens economic and technology contributors?

**3.2 Methodology:**

To really get hold on valid verifiable facts, the population of study was randomly selected among indigenous industries and Nigerian Universities renowned in the engineering fields in the southeastern part of Nigeria and the gathered data was analyzed using percentile.

**3.2.1 Primary Data Collection:**

The primary data was adopted from questionnaires. It was also based on the virtual responses from interviews and personal observations.

**3.2.2 Secondary Data Collection:**

Secondary data for the study was adopted from online search, which provided an access to online books and some articles.

**4. RESULTS AND FINDINGS**

Despite so many limitations in gathering data for this research, some statistics were gotten and analyzed below.

**4.1 Statistics Generated:**

To really get down to the objectives of this study, data for this research work have been gathered from various sources such as previous research documents, questionnaires, and personal interviews.

**4.1.1 Statistics from Questionnaires:**

From Table 1 to 3, Questionnaires revealed that the participation of females in Mechanical engineering based organizations and Universities is insignificant. The Organizations that had females did not involve them in their working process, since most of them are not trained in engineering profession. Their females were the secretaries and cashiers. In addition, those females who studied Mechanical Engineering were the consultants or Workshop supervisors. Engr. Dr. G.O Osueke, Managing Partner of Goocon Associates Inc., pointed out that if fieldwork is reduced for the female engineers and they are allowed to function as consultants, then, they can function effectively in the field of mechanical engineering even during marriage and childbirth.

African society is still very biased toward female Mechanical Engineers. This is because the rate of illiteracy and skill acquisition through apprenticeship is still high. In the opinion of Mr.A.C. Oparaugo, Head Of Dept., Wood Work, Federal Ministry of Industries," There is nothing like remedying the situation of the limited involvement of women in Mechanical Engineering, Females cannot be involved in highly skilled jobs such as Welding, Carpentry, Machining etc." .

Few respondents were positive. Mrs. C. Uzoamaka (Workshop Supervisor of Zotel Autoworld LTD) opined that enlightening females about the field and its benefits is a way of subsiding its male dominance. Mr. Mbanu M.N (Head of Metal Department-IDC, Federal Ministry of Industries) stated that the Government should establish skill acquisition centers for the females as a way of encouraging them. Mr. Alex Ephraim (Director of Ephraim and Joeanna Akwivu Auto Shop) declared that Women Empowerment should be a top Priority in the Country. Mrs. Okoro P.N, Principal R&D Officer of Scientific Equipment Development Institute, Enugu (SEDI-E), Department of Electrical Research and Development stated that ‘Women should be exposed to practical training and they should be allowed and challenged to bring out what is in them’. Engr. Nwajiobi, Principal Engineer, Department of Mechanical Maintenance (SEDI-E) narrated that the situation can be remedied by education and counselling.

**Table1: Data gotten from Industries through questionnaires.**

Name Of Organization.	Year of Establishment	Job Description	Working Process	Working Environment	Number of Employees	
Zotel Automated Ltd, Port-Harcourt Road, Imo State.	2011	Diagnosis, servicing and repairs of Automobiles using modern equipment	Highly Mechanized	Barely Polluted	Male 10	Female 3

International Journal of Novel Research in Engineering and Science

Vol. 4, Issue 1, pp: (44-54), Month: March 2017 - August 2017, Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)

Ephraim and Joeana Akwiwu Auto Shop, Orji, Imo State	2011	Diagnosis, servicing and repairs of Automobiles using modern equipment	Highly Mechanized	Not Polluted	Male 5	Female 0
#Goocon Associates Inc.(Main Garage, FCT, Abuja)	1986	Maintenance, Consultancy and Mechanical Engineering servicing	Moderately Mechanized	Barely Polluted	Male 6	Female 2
Federal Ministry Of Industries-Industrial Development Center(I.D.C) Owerri,Imo state.{Metal Laboratory}	1963	Welding, Use of machine tools such as Lathes, borers etc. and other manual techniques to manufacture components.	Moderately Mechanized.	Averagely Polluted	Male 3	Female 0
Federal Ministry Of Industries-IDC(Wood Work department)	1963	Carpentry, Upholstery, Cabinet work, furniture work etc.	Manual	Not Polluted	Male 5	Female 0
*Imo State college of Advanced Professional Studies (ICAPS)-Welding Department	2012	Manufactures components through Welding and other joining procedures	Moderately Mechanized	Not Polluted	Male 10	Female 0
Scientific Equipment Development Institute Enugu(SEDI-E) {Machine Shop Department}	1982	Manufacture of indigenous equipment.	Moderately Mechanized	Averagely Polluted	Male 31	Female 0
(SEDI-E) { Advanced Manufacturing Section}	1982	Manufacture of indigenous equipment using CNC Machines	Highly Mechanized	Not Polluted	Male 15	Female 1
SEDI (Mechanical Maintenance Department)	1982	Maintenance of workshop machines and servicing.	Moderately Mechanized.	Not Polluted	Male 15	Female 0

\* Data gotten from observation. #Company not in the South-East of Nigeria

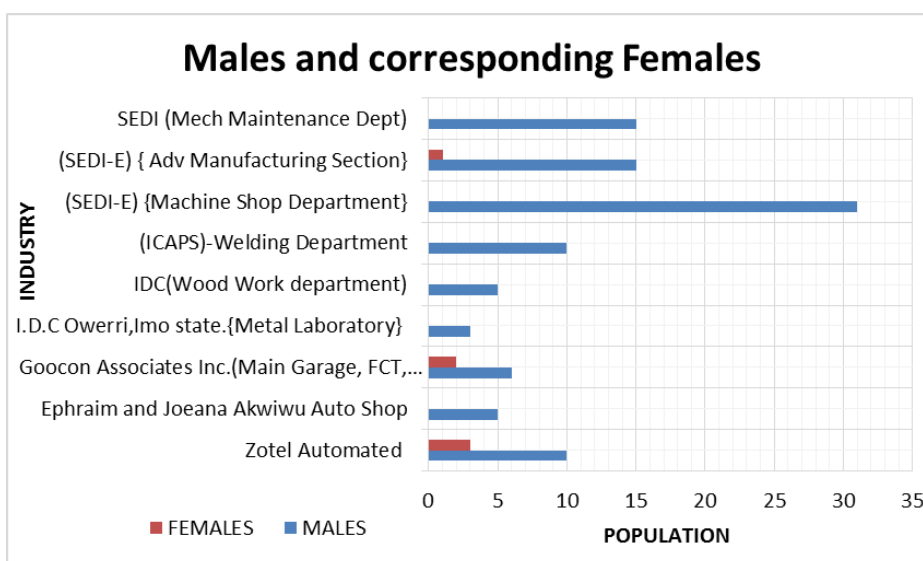


Chart 1: Visual representation of data from questionnaires

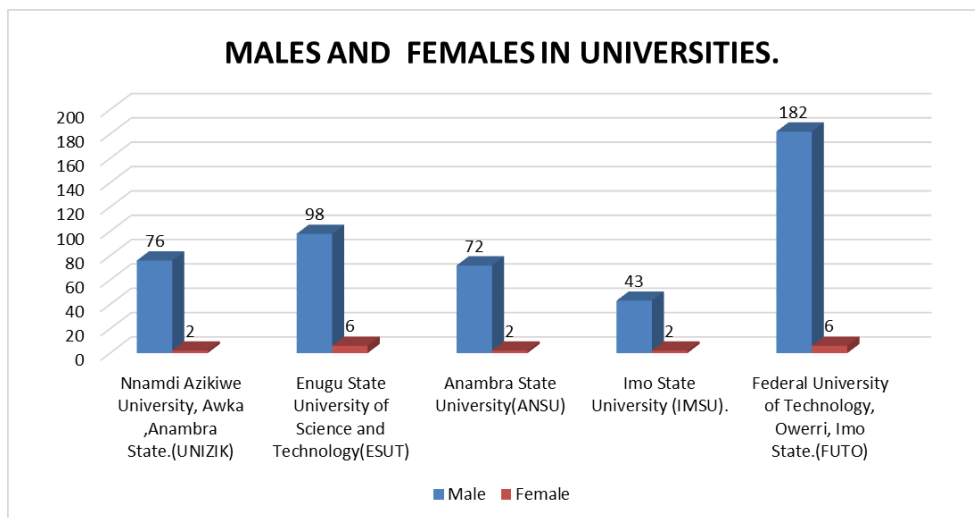
**International Journal of Novel Research in Engineering and Science**

Vol. 4, Issue 1, pp: (44-54), Month: March 2017 - August 2017, Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)

**TABLE 2: 2014/2015 Academic year of Final year Classes in different Institutions.**

Name of University	Female	%Female	Male	%Male
Nnamdi Azikiwe University, Awka ,Anambra State.(UNIZIK)	2	2.56	76	97.4
Enugu State University of Science and Technology(ESUT)	6	5.77	98	94.2
Anambra State University(ANSU)	2	2.7	72	97.29
Imo State University (IMSU).	2	4.44	43	95.96
Federal University of Technology, Owerri, Imo State.(FUTO)	6	3.2	182	96.8

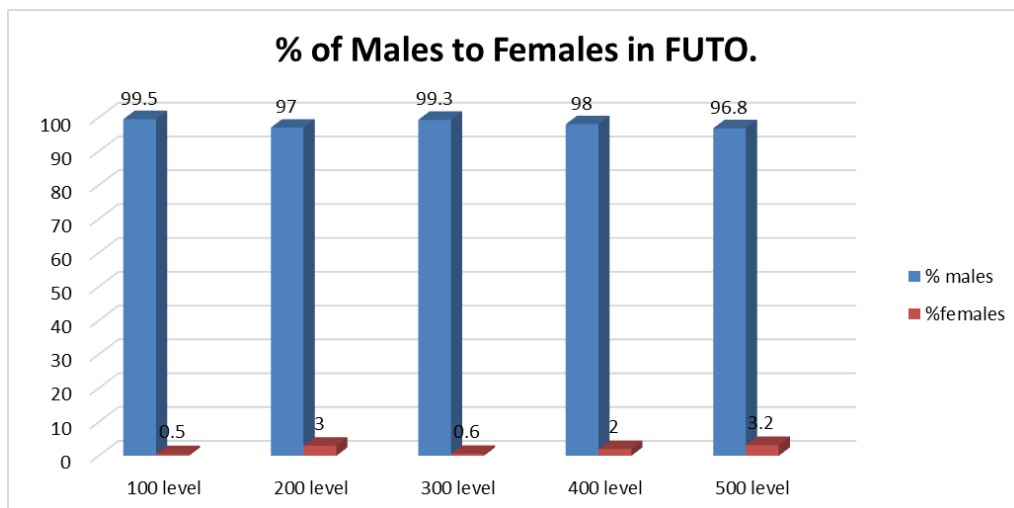
Source: Corresponding Students in the Institutions.



**Chart 2: Visual Representation of Universities Population.**

**TABLE 3: Statistics from Federal University of Technology for 2014/2015 Academic year**

Academic Level	Number of males	Number of females	% males	%females
100 level	195	1	99.5	0.5
200 level	191	6	97	3.0
300 level	154	1	99.3	0.6
400 level	147	3	98	2.0
500 level	182	6	96.8	3.2



**Chart 3: Graphical Representation of Students in FUTO.**

**International Journal of Novel Research in Engineering and Science**

 Vol. 4, Issue 1, pp: (44-54), Month: March 2017 - August 2017, Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)
**4.1.2: Statistics from other Research Documents:**
**➤ Participation of Women in Mechanical Engineering.**
**Table 3: Academic Staff by Sex in Engineering and Technology, Anambra State University of Science and Technology, 1983 - 1990**

Year	M	F	% F
1983/84	47	5	10.0
1984/85	N/A	N/A	N/A
1985/86	41	0	0
1986/87	41	0	0
1987/88	53	1	2.0
1988/89	N/A	N/A	N/A
1989/90	N/A	N/A	N/A

**Table 4: Academic Staff by Sex in Engineering and Technology, University of Nigeria, Nsukka, 1983 - 1990**

Year	M	F	Total % F
1983/84	66	0	0
1984/85	65	0	0
1985/86	62	0	0
1986/87	51	0	0
1987/88	50	0	0
1988/89	N/A	N/A	N/A
1989/90	N/A	N/A	N/A

N/A = Not Available. Source: NUC (1983 - 1990).

Mechanical Engineering practice in the 1980's and 1990's is much still in the same situation as today. In FUTO, there is just one female lecturer which has not been in the Institution for years and in UNIZIK, there is only one female lecturer, who is a graduate assistant. Female Mechanical engineering Lecturers are the rarest in the tertiary lecturing profession.

**4.1.3. Statistics from Interview:**

After interviewing Mechanical Engineering students from Federal Universities, State Universities, Polytechnics and Private Tertiary Institutions, the maximum number of females in an undergraduate level did not exceed 10 among about 160-200 males (between 0%-5%). Some Undergraduate levels had no female and some others had just one female. Federal University of Technology, Owerri (F.U.T.O) has just one female lecturer in mechanical engineering that is studying overseas and has not been around for years. Very little has actually improved in this field in relation to other engineering courses or other courses under STEM since the 1980s.

**4.2 Women Involvement in Mechanical Engineering:**

The African society being still biased towards women involvement in this field, as most people think that it will make the women think that they are equal with the men and it will rule out women role as home builders.

From the questionnaires, some head of organizations said there was no place for women in the Mechanical engineering because most of the industries operate with crude tools, or rather, are manual based industries. Therefore, they concluded there was no place for women in the field. Engr. David Matthew, Chief Chemical Engineer, Head of Advanced Manufacturing section, SEDI-E, confirmed that there are very few female mechanical engineers, fewer vacancies are competed for and to some extent there is implicit preference for male engineers.

**4.2.1 How Female Engineering Students Experience their Study:**

According to (Badekale, 2003, P.44). Female engineering students were asked to discuss their experiences in the course. Their responses included the following positive remarks:



## International Journal of Novel Research in Engineering and Science

Vol. 4, Issue 1, pp: (44-54), Month: March 2017 - August 2017, Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)

- All engineering requires is a lot of hard work. There are no pleasant experiences. It has been interesting and enlightening. Now I know the meaning of major stress -when a guy offers you his seat and helps you get something when there is a rush. Very superficial with little or no practical experience. It is an interesting course, but involves a lot of studying.
- The males try to help the girls when it comes to some heavy machine experiment. I do not feel inferior to male students because I know that I am better off than some of them academically.
- Engineering has been a great challenge to me being a female. It has made me aware of my abilities, challenging and interesting.
- A little trying, but interesting and worthwhile. The favor I have over the males in terms of decisions.
- It is an interesting course because it sharpens one's intellect.
- Lack of adequate number of female students bothers me a lot.
- The course is okay, but the faculty lacks practical facilities relevant to present day developments.
- Tedious and time consuming.
- We have almost no practical training. I cannot thus say that I will be a good engineer.
- The male students treat ladies with respect.

They however had negative experiences. These include:

- Lousy remarks made by male students, acts of indecency towards them, portraying of the male ego.
- Attempts to reduce the female students to mere playthings.

### 5. DISCUSSION, RECOMMENDATIONS AND CONCLUSIONS

According to AAUW the following steps will create an enabling environment for female students in engineering disciplines:

- Make performance standards and expectations clear in STEM courses.
- Teach professors about stereotype threat and the benefits of a growth mindset.
- Emphasize real-life applications in early STEM courses. Support faculty work-life balance.
- Policies that effectively support work-life balance such as stop-tenure-clock policies and on-site, high-quality child care are especially important to female faculty satisfaction.
- Take proactive steps to support women in STEM majors. Sponsor seminars, lunches, and social events to help integrate women into the department. Ensure that no student clique dominates or becomes the ideal way of "being" in a STEM major.
- Support faculty work-life balance.
- Counteracting Bias against women—both implicit and explicit—still exists in science and engineering. Even individuals who actively reject gender stereotypes often hold unconscious biases about women in scientific and engineering fields. Women in "male" jobs like engineering can also face overt discrimination.

#### 5.1 Discussion:

The results of this study have averred that female participation in engineering, particularly mechanical engineering, has been very poor in Nigeria and in West Africa (extrapolating results) due to many factors and conditions.

#### 5.2 Recommendation:

Due to the constant minute participation of women in mechanical engineering, conceiving a program like WiME can really change the normal trend.

## International Journal of Novel Research in Engineering and Science

Vol. 4, Issue 1, pp: (44-54), Month: March 2017 - August 2017, Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)

WiME strives to provide a uniquely welcoming and encouraging environment that fosters academic, professional, and social opportunities for women in Mechanical Engineering (WiME) at Iowa State University'. The department continues to be committed to the long-term success of the WiME program. Launched in mid-2008, the WiME program is a department-level effort to increase the participation of women in the mechanical engineering program at Iowa State University. The rationale was to create a sustainable student-driven, faculty-mediated effort to recruit and retain women and enhance their overall satisfaction and experience in the department. In the short time since its launch, the WiME program has become quite popular and the data suggest that various aspects of the program have positive impact on the number of women students. Students have commented on the value of the social activities in increasing their overall satisfaction of the learning experience for women students. (Sriram, 2012).

Government organizations such as the Department of Education, NASA, and the National Science Foundation could provide incentives (e.g., grants) to universities to promote women on their faculties and in their administrations and to develop woman-friendly engineering curricula. Companies can encourage the creation of women's organizations that can provide "places and spaces" for women's voices to be heard. The JPL Advisory Council for Women, established in 1980, has provided not only a voice for women but for all employees, resulting, for example, in the establishment of a child care center. (Donna, 1999).

These recommendations if implemented will enhance the present situation in mechanical engineering.

- ✓ The working environment should be made conducive enough for female participation.
- ✓ Opportunities for formal and informal mentoring such as work place forum should be provided for female mechanical engineering students and graduates by their national bodies since the importance of having role models and mentors to one's professional growth and progress cannot be overemphasized.
- ✓ The government should invest in providing substantial training and professional development for females in mechanical engineering in order to enhance their practical involvement and productivity.
- ✓ Women already in the field of mechanical engineering should deliberately get involved in research work in order to boost their authority and knowledge as a means of women empowerment and mentorship.
- ✓ Adequate awareness should be available at the secondary school level in order to enlighten the young female minds about the possibility of their involvement and the benefits associated with this field.
- ✓ Mechanical engineering based industries should upgrade their working tools to modern machines that use pneumatic actuators, hydraulic drives, electrical motors etc. To ensure stress reduction and high efficiency of production to increase its female-friendliness.
- ✓ The achievements of females in the field of mechanical engineering should be made available to the public, as a means of motivating and inspiring 'would be' female engineers.
- ✓ Engineering practicing firms should easily acquire funds and Loans, in order to upgrade their working conditions and environments.
- ✓ Women bodies should start up quality and practical campaigns to this effect.

Numerous opportunities exist for creative solutions to the problem of insufficient numbers of women engineers in the workforce. They include taking a hard look at how engineering is done in the modern world and adapting educational strategies to the new situations, paying attention to what works to educate women and applying those principles to engineering schools, and inducing or persuading private and public organizations and universities to become more woman-friendly.(Donna, 1999).

### 5.3 Summary and Conclusions:

This study has attempted to generate data on the rate of participation of women in engineering. The data presented has shown that:

- Women in engineering often experience prejudices and antagonisms from their male bosses, colleagues and subordinates.

## International Journal of Novel Research in Engineering and Science

Vol. 4, Issue 1, pp: (44-54), Month: March 2017 - August 2017, Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)

- Societal beliefs has had a negative effect on the possibility of females choosing mechanical engineering as their career line. Bias, often unconscious, limits women's progress in scientific and engineering fields.
- Poor working environment and crude tools has also discouraged females from active participation in the field.
- Female engineering students lack role models in form of female university lecturers and practitioners.

It is therefore true that women are underrepresented in the field of mechanical engineering at all levels-education, employment and executive positions. Consequently, there should be ways of stimulating young females into the field of Mechanical engineering, which I suggest further research work should focus on. Therefore, this research paper also suggests the deliberate involvement of women engineering practitioners in research and innovative work at national as well as international level to heighten their authority and visible presence in Mechanical engineering.

### REFERENCES

- [1] Armour, Margaret-Ann (1985). "Women into Science Engineering and Technology: Strategies for Change at the University of Alberta" in contribution to the Third GASAT Conference.
- [2] ASME (2000). An Evolving Profession, ASME International, Retrieved on August, 2015, from <http://www.asme.org/careers>.
- [3] Badekale A.J (2003) Working\_paper\_series\_37.Women and Engineering in Nigeria: Towards Improved Policy Initiatives and Increased Female Participation African Technology Policy Studies Network, Nairobi, Kenya. Retrieved from: [http://www.atpsnet.org/Files/working\\_paper\\_series\\_37.pdf](http://www.atpsnet.org/Files/working_paper_series_37.pdf)
- [4] Bailyn Lotte (1987) "Experiencing Technical Work: A Comparison of Male and Female Engineers." Human Relations, Vol. 40 pp. 229-312.
- [5] Catherine Hill, Ph.D. Christianne C. Andresse St. Rose, Ed.D. Why So Few? Women in Science, Technology, Engineering, and Mathematics. Published by AAUW Washington, DC 20036.
- [6] D-E Communications - Critical Issues Series Women in Engineering & Related Fields – Diversity Analysis of Students Earning Bachelor's Degrees. Retrieved from [www.dedicatedengineers.org](http://www.dedicatedengineers.org).
- [7] Donna Shirley (1991). Women in Engineering: Focus on Success. Volume 29, Number 2. Retrieved on September, 2015.
- [8] Maria-Isabel C. Ph.D., Factors influencing students' choice of engineering major. University of New Haven et al, 21-23, June, 2013, 120<sup>th</sup> ASEE Annual Conference & Exposition
- [9] Lisa Frehill, Ph.D., Abby Javurek-Humig, and Cecily Jeser-Cannavale. Women in Engineering: A Review of the 2005 Literature. Retrieved on August, 2015 from [www.swe.org](http://www.swe.org).
- [10] Nadya A. L. Ph.D. and Romila S., Ph.D. (2011). Stemming The Tide: Why Women Leave Engineering.
- [11] Sheri Sheppard, Anne Colby, Kelly Macatangay and William Sullivan. What is Engineering Practice? Retrieved on September, 2015.
- [12] Sriram S. (Prof.), Theodore J. Ph.D., Baskar G. S. Ph.D. and Shankar S., Women in Mechanical Engineering: A Departmental Effort to Improve Recruitment, Retention, and Engagement of Women Students. American Society for Engineering Education, (2012).
- [13] Vetter, Betty M. (1996) "Myths and Realities of Women's Progress in the Sciences, Mathematics and Engineering" in Davis et al.