

## Woman Participation in the Industrial Field

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**Abstract:** This work was carried out in a Higher Education Institution, analyzing the incursion of women in the industrial field, since the participation of women in the workplace a few years ago was not seen as appropriate for some roles, culturally it is learned from the childhood that women are inferior to men in terms of knowledge and physical strength, for this reason they have fought to give women recognition of their labor and political rights, in addition to giving them access to a dignified education. Clarifying that the recognition of such rights does not mean that there is equality between the genders. The way to measure this incursion of women in the industrial field is compared in the last ten years of the Institute, how many women start the Career of Industrial Engineering and how many have completed an academic load and graduates over the last years, it is also worth highlighting the importance of how the labor participation of women has grown during these ten years in administrative positions in the organization chart of the Institution, in addition to presenting an overview of the case of women who, despite being single mothers and studying, make a great effort to move forward a career in Engineering.

**Keywords:** Statistics, woman, industrial

### 1. RELEVANCE

Women education in Mexico had been reserved only for Spanish and creole girls. They lived confined to their house, but could attend a kind of private secular schools known as "amigas", or simply, "migas" where a woman, basically, taught them: religion, house tasks and to read only until the age of ten. After finishing this education, the girls were sent as maids to serve the Spanish Lords. [1]. As an example, we have the first school for poor Spanish girls, Girls' College ("Colegio de las Niñas") opened in 1548 in Mexico City. Later on, these schools were opened in other cities as in Guadalajara and Puebla. During the Viceroyship they were founded in the city of Valladolid (Morelia City now), Real City of Chiapas, Zacatecas, San Luis Potosí, Jalapa and Celaya, among others.

After the Mexican Independence, the country had to start a new way, focusing in consolidation as a free, autonomous country. During the XIX century a new phenomenon appeared: Industrialization. So, a need for new technologies training took place, substantially, changing some educational approach [2].

Education for women started to sprout at founding an industrial school for girls which allowed to detect diffusion and access ways to educate women for work [3].

In recent years, women incursion in labor and industrial life have, eventually, increased in a very positive, active manner, contributing to the economic, social and cultural development of our country. At the present time, women work as: head of family, workers and entrepreneurs, among other important positions.

Having man as the only house support taboo has been laid behind. Currently world economic situation has pushed women out from home in order to work and keep a better quality of life. Mostly, all jobs performed by women, were discriminatory or partial time ones. Certainly, these jobs were not, adequately, registered within global statistical sources such as population censuses. According to surveys carried out in Mexico, focused on labor active feminine population, and provided a percentage of 21% by 1979 of women force. Nowadays, it is of 39% [4]. Women have faced many labor challenges as obtaining better industrial benefits, openness to directive positions, flexibility and respect towards maternity rights at work, to mention only a few examples.

Other examples of women within the industrial context, is that they have achieved to have access to the educative system, their level of education has improved, and still continues to be better in order to face global challenges demanding more competitive workers each day. A small percentage of women work for their professional development, while most women work in industries due to economic needs [5]. Age active female labor in the 70's was around 20 or 24, while in the 80's and 90's this occurred after 25 in a very specific way, indicating that participation of women in the industrial field happened in the last decades [6].

Women incorporation to the labor force has brought economic independence, but also wages discrimination and men resistance in high positions where they have to be commanded by a woman.

Industrial participation of women at work reveals, to an outstanding extent, that women combine job and home responsibilities. Around 96% of Latin-American women say that they divide their time within professional and home maintenance. In Mexico, four out of ten economic active people are women.

## 2. AIMS AND OBJECTIVES

At getting into industry jobs, women broke old paradigms getting inside new realms, creating a new culture [7]. It is said that women double shifts, i.e., after working in the industry, they return home to continue working under their same old scenario, doing housework and raising children [5], what is an irrefutable truth is that man is no longer the only economic family support.

Objective of this study, carried out at Technological Institute of *San Juan del Río*, Industrial Engineering Course of Studies, was to, objectively observe women incursion within the industrial context from a schooling, working and housewife perspective in the last ten years.

### 2.1. Objectives

1. Analyze how many women enroll in the Industrial Engineering major, usually supposed to be exclusive for men, and how many of them finish their studies.
2. Measure women participation in leadership positions within Technological Institute of *San Juan del Río*'s organigram in the last ten years to denote women incursion into the working field.
3. Measure current equity and gender in the Industrial Engineering major for future student generations.

## 3. METHODS

Measuring used as method to obtain objectives in this study carried out at Technological Institute of *San Juan del Río* was thru frequency charts and histograms.

### 3.1. Histogram

Statistical tool that allows visualizing two aspects of a data set besides showing the form in which data was distributed within its variation range.

Histogram is a graphic representation in bars form, from a data set or a variable distribution, where data is classified by its magnitude into certain number of groups or classes. Each class represented by a bar, which length is proportional to represented value frequency. Generally, horizontal axis is formed by a numerical scale to show data magnitude while the vertical axis represents frequencies. [8].

Histogram usually is obtained from a frequency chart:

- a) Data variation range is divided into certain number of intervals which covers all range.
- b) It is determined how many fall into the interval. It is recommendable to keep classes or intervals of 5 to 15. In order to decide a value among this range there are several criteria; for example, one of them says that the number of classes must be, approximately, equal to the square root of the number of data. Another criteria is known as Sturges rule, that is the number of classes equals  $1+3.3*\log_{10}$  (number of data).

### 3.2. Linear Regression

It is a statistical technique used to study the relationship among adaptable variables into a wide range of situations. In social research, regression analysis is used to predict a wide phenomenal range, from economic measurement to human behavior in different aspects.

In market study it can be used to determine in what kind of communication could be more effective to invest or to predict the number of sales of certain product. Regression analysis is used to explore and quantify the relationship of a variable called dependent (Y), and of one or several variables called independent ( $X_1, X_2, \dots, X_3$ ), as well as to develop a linear equation focusing predictive goals.

The straight line of the linear regression is defined as follows:

$$Y_i = B_0 + B_1 X_i \text{ Equa. (1)}$$

Where coefficients  $B_0$  and  $B_1$ , which define the straight line, are obtained. Coefficient  $B_1$ , is the gradient of the line. Coefficient  $B_0$  is the point where the straight line cuts the vertical axis. By knowing the values of these two coefficients, any person could reproduce the straight line and describe with it the existing relationship between both variables. So, even the origin of the straight line provides information on what could happen if, the observed data pattern is extrapolated downwards. By doing this, a forecast would have within a value range, going further from the ones covered by the available data.  $R^2$  coefficient determination, the correlation coefficient square, deals with a standardized measurement taking values between 0 and 1 (0 when variables are independent and 1 when between them there is a perfect relationship). This coefficient possess a very intuitive interpretation: it represents the profit range that can be obtained from predicting a variable based on knowledge got from the variables [8].

### 3.3. Professional Residence Definition

Professional residence is a curricula educational strategy which allows a student start a theoretical-practical, analytical, critical and professional project, having as purpose the solving of a specific social real and productive problem, in order to strengthen and apply his/her professional competences.

Professional Residence project can be performed individually, in teams or interdisciplinary: depending on requirements, conditions and characteristics of the company, organization or governmental office project. Professional Residence can be performed though integrating projects, under the scheme of dual education, among others [9].

These projects are carried out through local, regional, national or international; internal or external projects, in any of the following areas:

- Social, Productive Service and goods sectors;
- Innovation and technological development;
- Research;
- Design and/or Construction of Equipment;
- Technological Innovation Events participating in the National stage;
- Science or research summer;
- Projects proposed by the Academy, counting with Academic Department approval;
- Integrating Projects;
- Dual Education Projects; [9].

### 3.4. Surveys

A selection of questions proposed by the professional residence group was carried out. The coordinator of this investigation carefully evaluated, corrected and approved these questions.

Surveys were applied in a written and personal way, by visiting each one of the Industrial Engineering groups, both morning and evening turns, which maintained following characteristics:

- Structured surveys, i.e. questions were previously chosen as well as the order in which they were to be made.
- Open questions, where participants were asked to provide answers in their own words, providing more profound answers. Also asking why and how.
- Close questions, where participants were asked to choose one of the "yes" or "no" options, as applied.

Ethnographic methodology was chosen for the analysis and systematization of applied surveys, which allowed survey application be contrasted with an objective description from students' social interaction, through observation and rounds on field.

4. RESULTS

A case study from the 90's where women incorporated into higher education at the Technological Institute of San Juan del Río, especially in bachelor's degree, has grown in an accelerated way. In Figure 1, a bar diagram shows the percentage of women starting their Industrial Engineering Course of Studies since 2001, as it was thought this was a specialty exclusive for men.

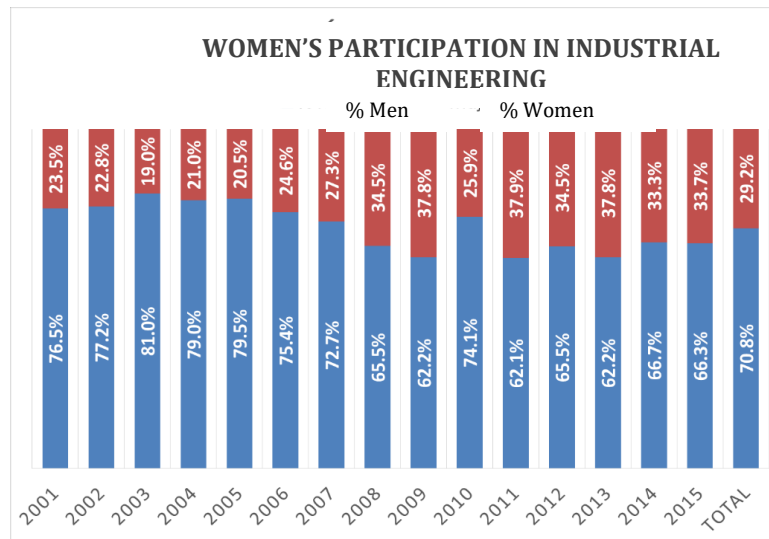


Fig1. Women's Participation in Industrial Engineering in the Technological Institute of San Juan del Río

As it can be observed in the bar chart, 23.5% of women participated in professional studies in 2001. By 2002 it decreased a little to 22.8%. By 2003 decreased to 19%. In 2004 it increased to 21%. By 2005 it reduces to 20.5%. In 2006 it increases to 24.6%. By 2007 it increases to 27.3%. In the year 2008 it increases to 34.5%. By 2009 it increases to 37.8%. In the year 2010 it reduces to 25.9%. In the year 2011 it increases to 37.9%. In 2012 it reduces to 34.5%. In the year 2013 it increases to 37.8%. In the year 2014 it decreases to 33.3%. Last year, 2015, it maintains in 33.7%.

It is important to stand out that, in relation to the proportion of women and men enrollment in education, women participation in the Technological Institute of San Juan del Río has increased in a total of 29.2% in accordance with 2001-2015 historical record of the Industrial Engineering Course of Studies Figure 2.

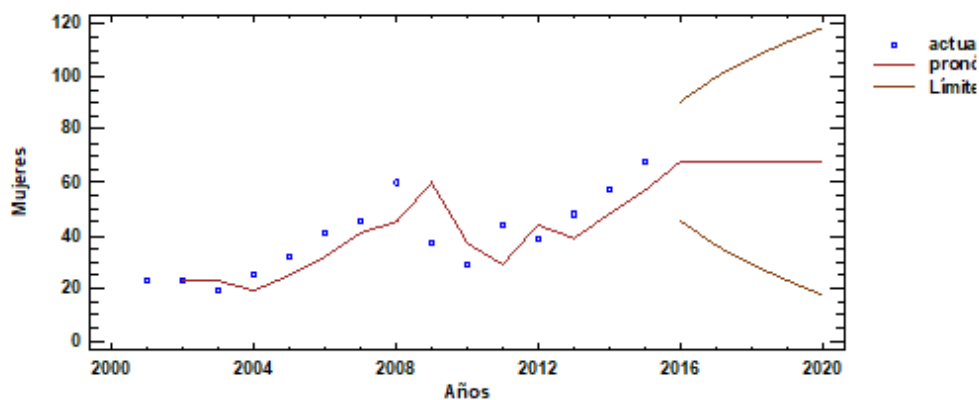
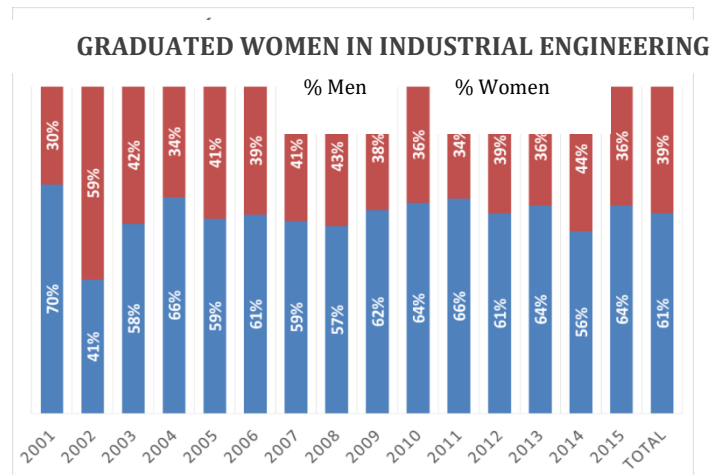


Fig2. The participation of women in the industrial context is shown, as women arriving to the Technological Institute of San Juan del Río

Figure 2, shows women enrollment forecast values in Industrial Engineering Course of Studies. There is a 95.0% confidence level over forecast prediction for periods of time beyond time series of the fifteen historical data shown at the beginning.

In Figure 3, women incursion within the industrial context will be shown. When women have reached this scholar stage, in the Technological Institute of San Juan del Río they have already finished their Professional Residence process.



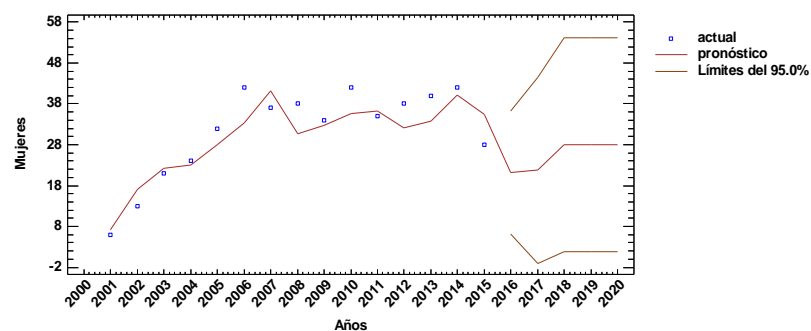
**Fig3.** Women terminal efficiency in Industrial Engineering major in the Technological Institute of San Juan del Río

*\*Note: The historical shown above is not in accordance with a generational cohort.*

As part of the professional residence process, students must be responsible to accomplish a professional job based on the competences acquired during their major studies.

It can be observed that 30% of women who entered to the Industrial Engineering Course of Studies in the year 2001 obtained the degree. In the year 2002 this increased to a 59%. In 2003 it reduced to a 42%. In the year 2004 it reduced to a 34%. In 2005 it increased to a 41%. In 2006 it decreased to 39%. In 2007 it increased to 41%. In 2008 it increased to 43%. In 2009 it decreased to 38%. In 2010 it decreased to 36%. In the year 2011 it decreased to 34%. In 2012 it increased to 39%. By 2013 it reduced to 36%. In 2014 it increased to 44%. And, in 2015 it decreased to 36%.

It is important to denote that, in relation to the proportion of women and men enrolment in regard to obtaining the industrial engineering degree in the Technological Institute of San Juan del Río, women contribution to this major has increased 39% in total in accordance with the 2001-2015 historical record Figure 4.



**Fig4.** Graduated women in Industrial Engineering forecast.

In Figure 4, it can be observed forecast values for women studying Industrial Engineering who can be able to graduate, prediction confidence level of 95.0% according to historical data.

In Table 1, a most clear Technological Institute of San Juan del Río’s female participation in working activities can be seen.

**Tab1.** Female participation in the Technological Institute of San Juan del Río activities.

No.	Department	Women in a chief leadership position periods		
1	Direction	2009-2014		
2	Academic Sub direction			
3	Administrative Services Sub direction			

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4	Planning Sub direction	2005-2008		
5	Professional Studies Division	2004-2006	2006-2008	2011-2012
6	Industrial Engineering	2014-2016		
7	System Engineering	2000-2004	2011-2016	
8	Economical – Administrative Sciences	2006-2009	2009-2014	
9	Electric and Electronical Engineering			
10	Basic Sciences			
11	Academic Development	2015-2016		
12	Scholar Services	2004-2013	2015-2016	
13	Information Center	2006-2015		
14	Planning, Programming and Budgeting	2006-2007	2007-2009	
15	Extra scholar Activities	2004-2007		
16	Communication and Diffusion	2007-2009	2012-2016	
17	Technological Management and Outreach	2012-2016		
18	PC Lab	1999-2011		
19	Financial Resources	2005-2007		
20	Material Resources			
21	Human Resources	2004-2007	2007-2010	2012-2016

In this table it can be stated that since the beginning of the Technological Institute of *San Juan del Río*, women inclusion as department chief leaders has been very important in a 76% from the twenty one leadership positions of the organization chart.

To carry on the equity and gender study, a total population of 938 Industrial Engineering students (men and women) was taken; from which a representative sample of 450 students was taken, distributed as follows Table 2:

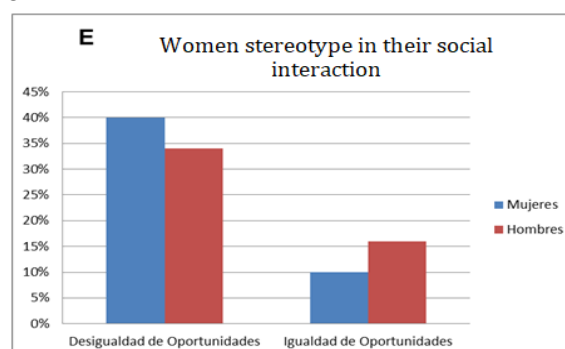
**Tab2.** Population distribution

Population	Sample	
938	100	Men - Morningturn
	100	Women - Morningturn
	100	Men - Eveningturn
	100	Women - Eveningturn
	25	Men – Teamwork
	25	Women – Teamwork
	450	Total Sample

Analyzed population age range is from 18 to 26; students pertain to mid-class [5], and inhabit in San Juan del Río downtown or nearby neighborhoods of the municipality, as well as from *Polotitlan*, Mexico State of Mexico or from the Hidalgo State.

Gender equity, refers to impartiality and justice at applying benefits and responsibilities distribution among women and men. The concept recognizes that women and men have different needs and are granted of different power and that these differences must be taken into account in order to correct unbalance between genders [10].

It is important to, culturally, recognize that each group or society make their own world view or ways to see the world, so, all persons have a particular conception of gender based on their own culture; in this case, from family [11]. Its strength relies in being part of their own history, traditions and values that are reproduced at interacting with other social circles; school, friends, family, sport clubs, recreational spaces, etc., Figure 5.

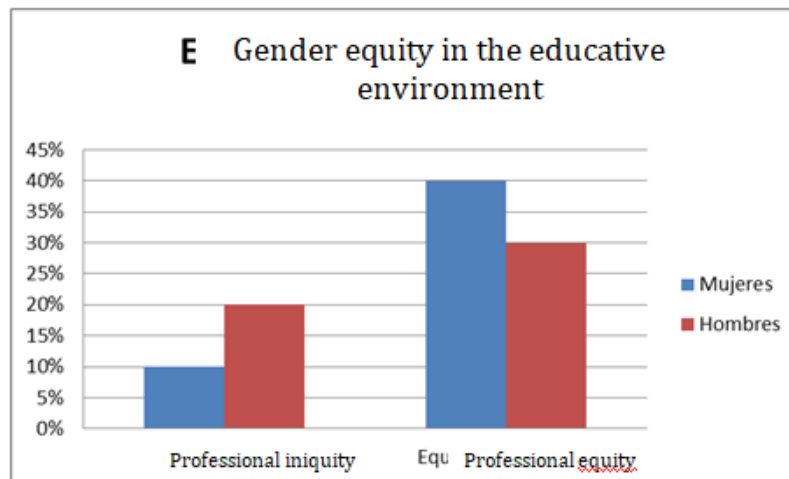


**Fig5.** Industrial Engineering major's women social interaction from the Technological Institute of San Juan del Río

From an anthropological analysis, results show that parents and social circles close to current Industrial Engineering student generations still have the stereotype that women does not have the same rights as men; having less professional development opportunities or even parents do not accept their daughters receiving education for self-improvement (in a 74%), while a minority (26%) show a gender sociocultural role change openness.

Indeed, it is important to emphasize that, women in Industrial Engineering face, day by day, challenges in their incursion to the industrial field. Also, through their behavior and decision making, they go breaking old paradigms, which lead them to reinvent themselves, creating new realities.

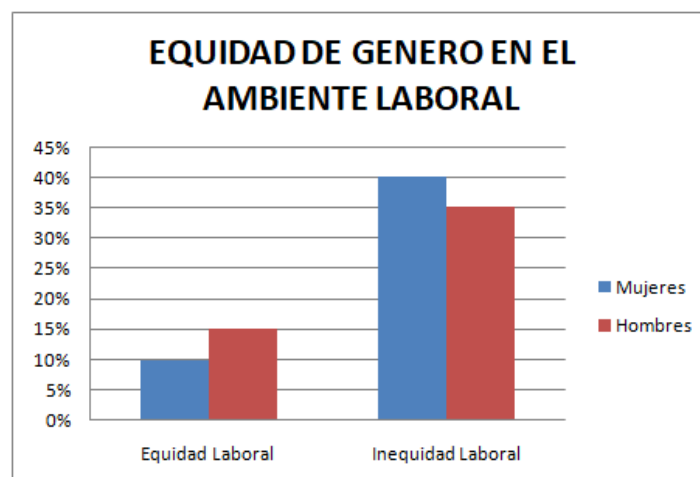
Self-esteem is a dimension of self-identity marked by social conditions under which a human being grows. Specifically, men and women self-esteem is affected if discrimination Figure 6, rejection or disqualification is continuously experimented [11].



**Fig6.** Gender equity in the educational environment for women in industrial Engineering Course of Studies at Technological Institute of San Juan del Río.

Within the scholar environment 70% of the students say that the fact of women dedicating to a men's exclusive profession does not affect them, because we all have the same abilities and on behalf of their effort and dedication they can aspire to directive positions; while 30% consider that being a woman do affect, because women can't do jobs that are considered hard (physically), by discrimination and disqualification attitudes.

The Technological Institute of San Juan del Río, efforts to promote an opportunity equity impartial environment which foments gender equity. In such a way, 96% of Industrial Engineering students mentioned never had been discriminated by the opposite gender and in contrast they consider that there's equity between men and women, while only 4% argue to have suffered discrimination on teamwork or operating some type of machinery Figure 7.



**Fig7.** Gender equity in the labor environment for women in Industrial Engineering Course of Technological Institute of San Juan del Río

However, working environment scenery changes for women as 75% of students considered that, regarding work, there is not gender equity arguing that there are "macho" chiefs who consider women weak and with poor capabilities to perform intellectual jobs, even more, they think that women must work at home. Another 25% think that there is equity at work due to the existence of laws protecting women and to equal job opportunities.

It makes evident that there are disadvantages coming from men supremacy and to women subordination roles in society. This represents harm to female identity, more over when considering it from a natural point of view.

### 5. CONCLUSION

Undoubtedly, education has been an important fact for women to come out from homes, where for centuries they were socially confined to, especially high-class women, because humble women have always had to work on a multitasks service basis in order to survive.

Little by little, woman has been opening spaces, and education has been an important foundation allowing her to generate new activities for industrialization purposes. Allowing her to share with man some, non for women, tasks, besides performing other ones that were traditionally exclusive for men.

Need forced and helped woman to access a different life style. Propelling her to search for better life levels through education, even though forcing her to leave her house and family when education institutions were out of her reach, favoring her independence.

It is concluded that women enrollment in the Industrial Engineering Course of Studies increased to up to 29% from 2001 to 2015. Furthermore, broadcasting that women enrollment in the Industrial Course of Studies for the next five years will be: For 2016 of 90 maximum and 45 as minimum. By 2020 maximum could be of 118 and a minimum of 17 women. Speaking of terminal efficiency, that is when students graduate, forecast is: In 2016 a maximum of 36 and a minimum of six women would graduate. By 2020 it can be foreseen a maximum of 54 women graduating and a minimum of two. From these statistics it is observed well-educated women incursion within the industry in the last years.

In terms of chief leadership occupied by women Technological Institute of *San Juan del Río*, it can be seen importance of women participation being good for the Institute performance, since its foundation up to recent years in which women have achieved a remarkable 76% of professional women.

Women incursion within labor and industrial life has, eventually, increased in a very active way during the last years. However, comparing to men, it makes it evident discrimination still existing towards women regarding personal development. This makes women to move between tradition and modernity, with some limited powers and rights, besides deficit and social gaps. [12].

Nowadays, current Industrial Engineering generations find themselves within social transition that, many times, means in congruency. On the social side, it is promoting new thinking tendencies showing openness and gender equity, equal opportunities and empowerment. But, at the same time, and opposite to this social advancement or social evolution, in practice still is perceived discrimination conducts and thinking ways damaging women self-esteem through rejection or disqualification.

The Technological Institute of *San Juan del Río* efforts to promote an opportunity equity impartial environment which foments gender equity. This is perceived by students, turning into a reflection space, where a thought change may be generated for further generations.

The working aspect, where female Industrial Engineering students develop, means to them all kind of social challenges, among them, breaking with old paradigms, disqualification and inequity marks that will reflect in their educational and professional aspirations.

One of the most important challenges that Technological Institute of *San Juan del Río's* female students must face is to empower themselves in an integral way, including their educational, working and familiar fields. In such a way that, every woman will be a promoter of her own sense of life, development and vital enrichment. This will lead them to generate interaction spaces, where there would exist a men and women coexistence without supremacy or oppression.



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