PERSPECTIVES FOR AERONAUTICAL RESEARCH IN EUROPE

Perspectives for Aeronautical Research in Europe

2018 Report

CHAPTER 11

Increasing the Participation of Women in Aerospace

Final Version

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Chapter 11 – Increasing the Participation of Women in Aerospace

The factors that affect the professional career of women may not be too apparent in childhood (section 11.1) but may have effects in secondary school (section 11.2) and university (section 11.3). The employment opportunities for women (section 11.4) should offer the guarantees of equal treatment (section 11.5) and protection of maternity (section 11.6). The recognition of on the job achievements should include reasonable allowance for special circumstances (section 11.7) and acknowledge the benefits of complementary (section 11.8). The increased participation of women in the aerospace sector is not only a numerical enlargement of the workforce, but also a qualitative enhancement by additional and unique talent (section 11.9).

11.1 Family Influences in Childhood

The traditional attitudes of family and friends that 'girls play with dolls and boys play with cars' may already be influencing future career choices. Two real life examples illustrate the trend.

The first example concerns as distinguished lady professor at university, who became head of department of electrical engineering and well renowned for her work on speech acoustics. Her father had a larger Mecano collection, built up during his entire life. When he became too old to use it, he offered it to a nephew, rather than to his daughter. It did not occur him otherwise, although he was a good and dedicated father.

Another example concerns a very bright and mature 6-year-old girl. Her father had a collection of model cars which she freely used in her playtime. Her father also had a collection of real cars, where she travelled in a child seat in the rear bench. As soon as the car stopped, and the father left for some activity, she would sit next to her mother on the driver position and try to drive the car. The father offered her a driving simulator, with which she would drive the car from the rear child seat, imitating the use of controls of the real car by her father.

Once the father gave her a bigger car model and the mother objected: "why are you giving our daughter a car? She is a girl: you should give her a doll". Well the father had already given her many dolls, and this was the first car. If a boy wanted a doll what would be the reaction?

The Pre-Conceptions about the roles of activities of men and women arise at an early stage and should be countered for girls and boys as soon as possible (Key Topic 11.1).

KEY TOPIC T11.1 – COUNTERING PRE-CONCEPTIONS INDUCED BY SOCIETY ON GIRLS AND BOYS

Research on students' self-efficacy in math and science subjects shows a startling reality: girls and boys begin developing gender stereotypes and self-selecting out of these subjects as early as second grade. By the time girls reach high school, they make up only 25 percent of students pursuing science and engineering pathways. According to the U.S. Department of Education, in 2015 women earned fewer than 19 percent of bachelor's degrees in engineering.

Microsoft commissioned a research to understand better what causes girls and women to lose interest in STEM subjects and careers, as well as what strategies and interventions have the greatest potential to reverse this trend. Some of the main results are presented (Figures 11.1 – 11.7) as follows:

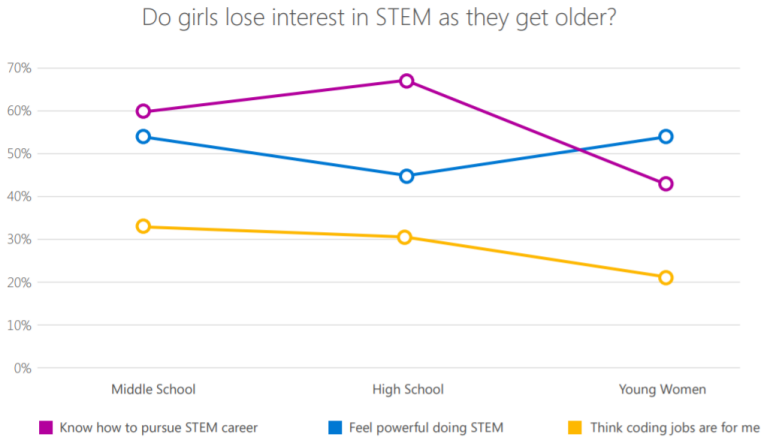

Figure 11.1 – Do girls lose interest in STEAM as they get older?

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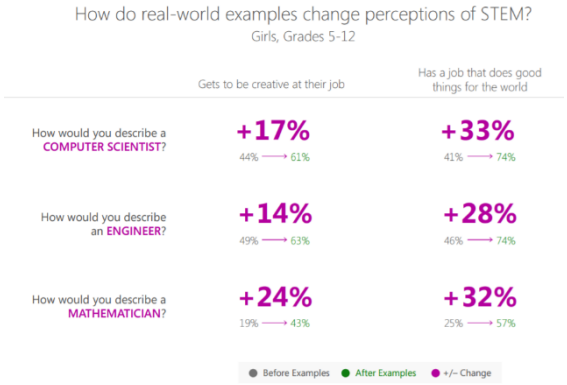

Figure 11.2 – How do real world examples change perceptions of STEM?

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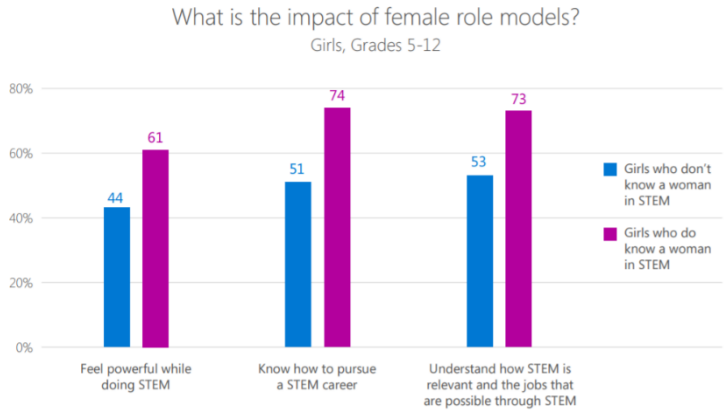

Figure 11.3 – What is the impact of female role model?

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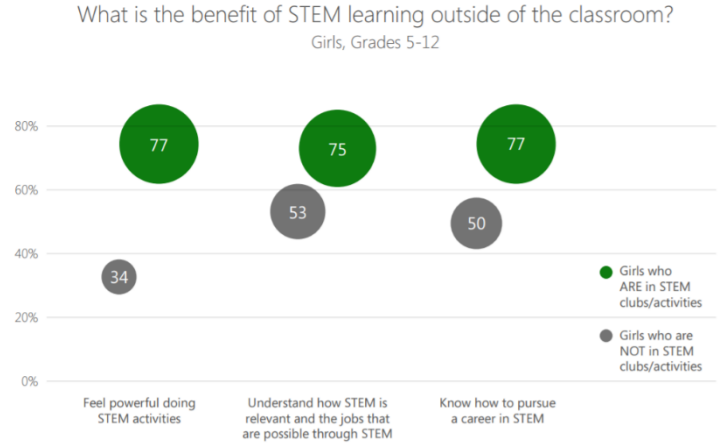

Figure 11.4 – What is the benefit of STEM learning outside of the classroom?

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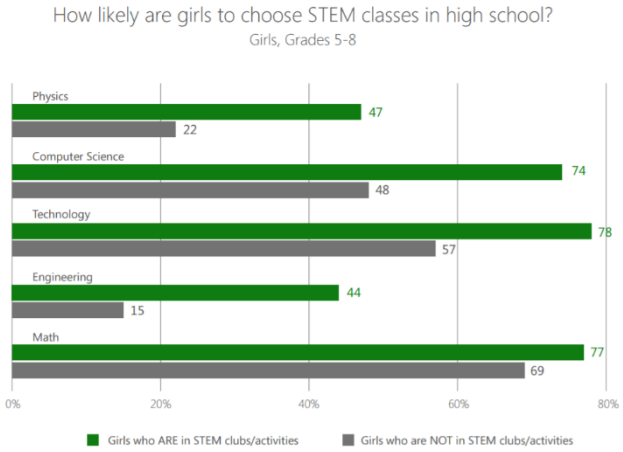

Figure 11.5 – How likely are girls to choose STEM classes in high school?

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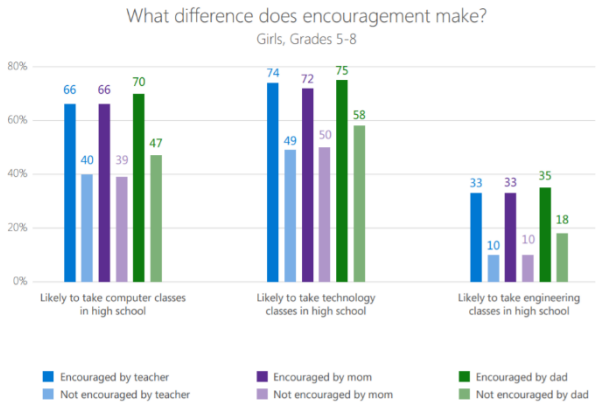

Figure 11.6 – What difference does encouragement make?

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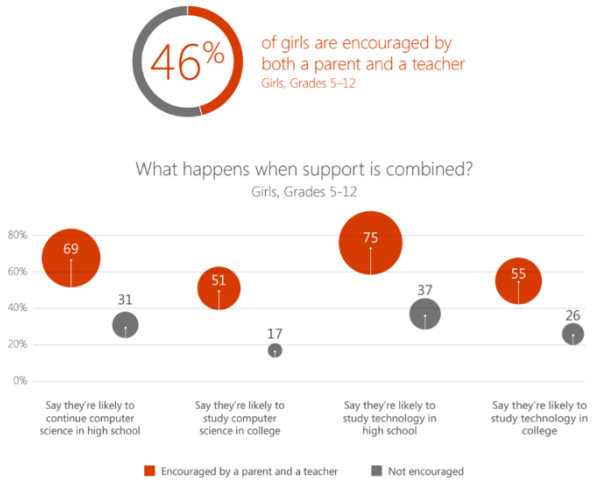

Figure 11.7 – What happens when support is combined?

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Attracting girls to STEM in Schools

Across the EU there are a wealth of communication campaigns and initiatives seeking to attract young people and women to take up jobs in different aspects of the transport sector. This corresponds to evidence of skills shortages and needs relating to an ageing workforce and other limitations on transportation jobs. There is also an assumption that some of the barriers to employment relate to a lack of or ineffective promotion of jobs and/or that there is a need to support and reinforce communication activities in this area.

Directorate General for Mobility and Transport (DG MOVE) project identified 10 **specific communication practices and strategies** that can **promote transport jobs effectively** to **young people and women.** Among them, the most relevant concerning women attraction

in primary and secondary are "**Showcasing real people as role models" and "Going into schools, colleges and universities".**

1. "**Showcasing real people as role models" -** *Firstly, mirroring is an important aspect of targeting. This is where communications confirm, albeit on a subliminal level, that the communication is relevant because it reflects the targeted individual. This is highlighted by the significant use of women and young people to confirm that people with these profiles work in different transport sectors. In order to really influence young people on the prospects of jobs in transport, it is necessary to provide them with* ***concrete examples****, which show what it would be like for them. One of the ways to do this is to provide a platform for young people or women* ***doing the job*** *to tell others what it is about. For instance,* ***Women in Logistics (WIL), UK,*** *is a networking group, which focusses on three key activities: networking, mentoring and showcasing. WIL aims to provide a platform for women to be part of the wider debate about logistics issues. Three examples of showcasing are highlighted below.*
    - *At WIL networking events, women are given* ***opportunities to be at the front*** *to talk about their own experiences and to lead the debate on logistics issues.*
    - *WIL identifies other relevant events and debates and where there is an all-male panel speaking then WIL will make contact and offer help to the organisers so that they are able to put forward* ***a more diverse line up****.*
    - *WIL also runs an annual awards event, which showcases* ***very successful women****, putting them in a position where they can be role models for other women in the sector, who can see what can be achieved.*

   'Women in Motion', in Italy, was a Ferrovie project where they *selected 80 successful women under the age of 45, working in technical jobs to provide positive examples of young women working in the rail sector. These women visited girls in high schools, and told them their* ***personal story*** *and experiences, trying to* ***overcome the stereotype of girls and proposing the rail industry as a valid career option****. During these meetings, girls had the chance to establish a personal contact, to ask questions and to get more insights.*

2. **Going into schools, colleges and universities"- Secondly, as decisions on future career choices are typically made by young people in an education setting,** several organisations addressed this issue by generating opportunities for direct face-to-face contact in schools and colleges by:
    - *developing a plan of events in many schools – visiting one or two schools is not enough;*
    - *not relying on careers fairs – where it can be difficult to compete for attention;*
    - *working with careers advisors;*
    - *training* job coaches on company processes and taking them to schools;
    - *bringing apprentices to talk to school children;*
    - *offering work experience to school children;*
    - *helping schools* to develop employability skills training/curriculum.

Promoting an increase in the number of female recruits only addresses part of the problem, transport organisations need to:

- Support female **career progression**;
- **Recognise the contribution** of female employees; and
- Facilitate more **flexible working** for carers (male or female).

Finally, is crucial to mention that promotional efforts which engage young people on a face-to-face basis work well, particularly when they:

- Provide **opportunities to explain** what is involved in the range of jobs available;
- Help young people to understand the **fit** between their skills and transport job;
- Give young people opportunities to **meet others** who are employed in these jobs;
- Effective promotion must be **highly tailored to** correspond to what potential recruits' need.

Besides that, many of the individuals interviewed for this DGMove highlighted:

- What they saw as deficiencies in the **quality and availability of information on the transport sector in public life**;
- The **school curriculum does not necessarily equip young people with the skills** that are needed to be attractive and employable to employers, or enough understanding of what is involved in the wide range of roles available.

Teachers can adopt a growth mindset and explicitly teach female students that academic abilities are expandable and improvable to enhance girls' beliefs about their abilities. Middle school math and science teachers should establish a challenging curriculum focused on exploratory learning that engages female students in risk taking and problem solving to build their confidence in math and science. Girls who are more confident in their abilities to engage in math and science curriculum are more likely to pursue challenging courses in math and science in high school. Middle school math and science teachers should also provide female students with specific feedback on ways to improve their performance and nurture their spatial reasoning skills. This can be done by incorporating teaching and learning practices that build on a student's prior knowledge and help the student make connections. Finally, teachers should avoid any negative stereotypes when working with female students in math and science. They can avoid stereotypes by encouraging female students to enter science fairs, join math competitions or robotic teams, and choose activities that spark inquiry learning and interest in math and science. Additionally, teachers can engage female students in STEM experiences that become transformative, such as hands-on science activities, exploratory trips and field experiences, and positive interactions with female role models.

Attracting girls to STEM outside schools

WISE, campaign for gender balance in science, technology and engineering enables and energises people in business, industry and education to increase the participation, contribution and success of women in science, technology, engineering and mathematics (STEM). WISE members inspire girls to choose maths, physics and computing. WISE members attract, retain, develop and progress female talent in their companies. Our mission – gender parity in the UK's scientific, technology and engineering workforce – from classroom to boardroom.

11.2 Primary and Secondary Schools

In the past separate boys and girl schools tended to put greater influence on girls away from science and technology, even if the curricula were the same, because they induced different choices: majority humanities for girls and majority science for boys, with significant minorities otherwise.

The current practice of mixed primary and secondary schools means that there are similar opportunities for both boys and girls, as far as their choices are not too much influenced by educators, relatives and friends and these young people have their own inclinations and are willing to follow them, which may not be entirely straightforward.

One consequence of all this, sometimes imperceptible, conditioning from childhood is that girls who choose science and engineering tend to be more determined, and due to their strong motivation may achieve better results at university on average than boys.

The gender imbalance in general is either reflected in or a consequence of gender imbalance in education, with different choices according to gender (Key Topic T11.2).

KEY TOPIC T11.2 – GENDER IMBALANCE IN SOCIETY AND IN EDUCATION

Gender parity is an essential issue to understand whether and how economies and societies thrive. In addition, it has a great influence on the growth, competitiveness and future-readiness of economies and businesses worldwide.

According to the Global Gender Gap Report, in 2017, the average progress on closing the global gender gap stands at 68%, which means that an average gap of 32% remains to be closed worldwide in order to achieve universal gender parity.

Figure 11.8 shows the average gender gap that remains to be closed in each world region. At a global level, four regions have a remaining gender gap of less than 30%. Western Europe records a remaining gender gap of 25%, placing it ahead of North America, with a gap of 28%, Eastern Europe and Central Asia, with a gap of 29%, and Latin America and the Caribbean, with a gap of 30%. The East Asia and the Pacific region rank ahead of Sub-Saharan Africa, with a remaining gender gap of 31.7% and 32.4%, respectively, and South Asia, with a gap of 34%.

Finally, the last position corresponds to the Middle East and North Africa, with a gender gap of 40%, which means that it is the region with the higher gender gap to be closed.

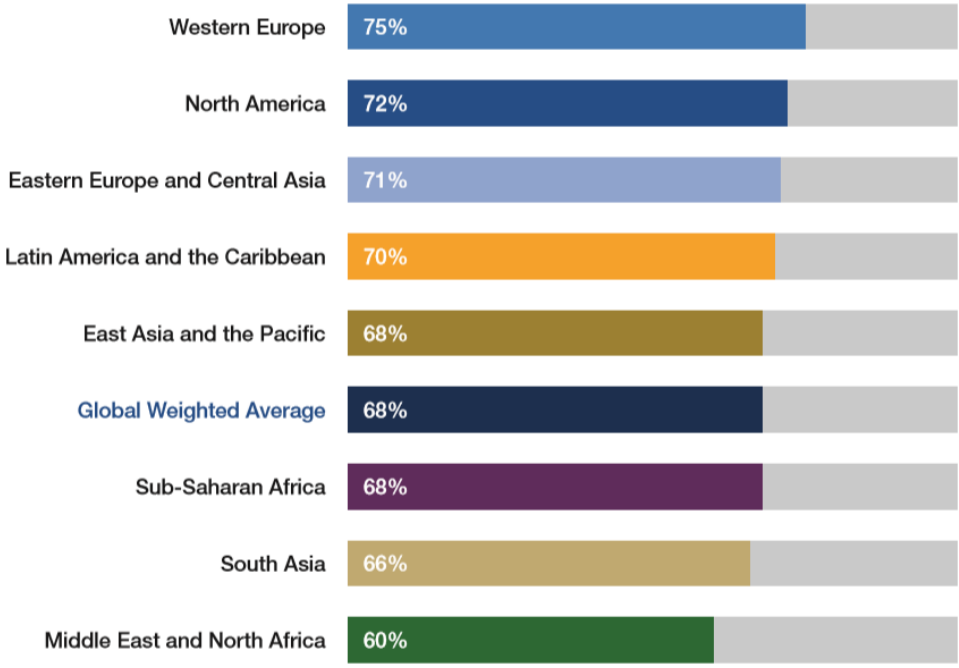

Figure 11.8 - Distance form gender parity 2017, by region
(Source: The Global Gender Gap Report, 2017)

Figure 11.9 shows the evolution of the global gender gap since 2006 by geographic region, considering that one means gender equality and zero means gender inequality. It highlights the local progress towards gender parity made over the past decade in regions such as Western Europe, South Asia, Sub-Saharan Africa, Latin America and the Caribbean. While all regions have recorded a narrower gender gap that they did 11 years ago, the figure nevertheless also reveals that more efforts will continue to be needed in all world regions to accelerate progress.

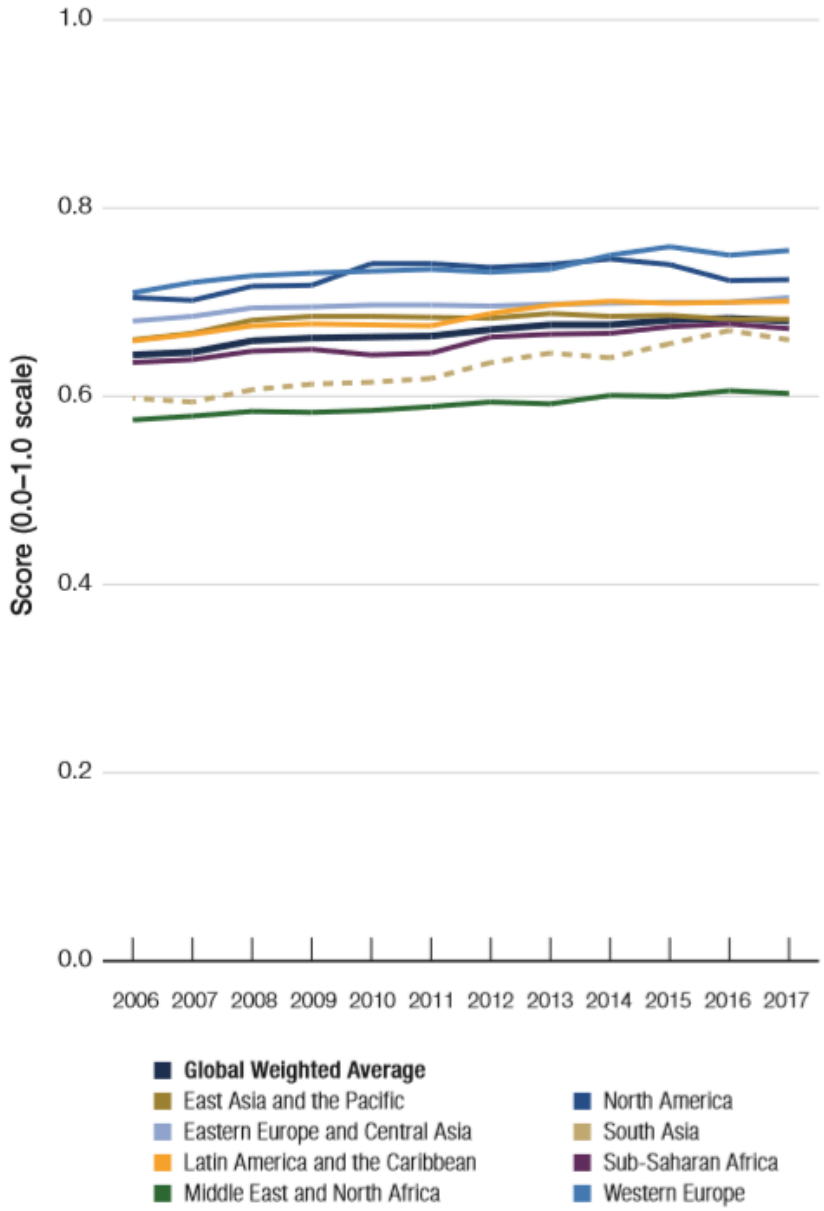

Figure 11.9 - Global gender gap index evolution, 2006-2017, by region
(Source: The Global Gender Gap Report, 2017)

According to the Global Gender Gap Report, if all things held equal, with current rates of progress, the overall global gender gap can be closed in 61 years in Western Europe, 62 years in South Asia, 79 years in Latin America and the Caribbean, 102 years in Sub-Saharan Africa, 128 years in Eastern Europe and Central Asia, 157 years in North America, 161 years in East Asia and the Pacific, and 168 years in the Middle East and North Africa.

These forecasts reflect the current state of progress and serve as a call to action to policymakers and other stakeholders to accelerate gender equality.

Once the global gender gap has been analysed, the objective of the following points is analysing this gender gap from the education perspective, both for global and European level.

2. Education

2.1 Global level

The world, taken as a whole, has achieved the target of gender parity at all levels except tertiary education. However, this is not true of all regions, country income groups or individual countries. Only 66% of countries have achieved gender parity in primary education, 45% in lower secondary and 25% in upper secondary. (Global education monitoring report gender review, 2018).

Between 2000 and 2015, the share of countries that achieved gender parity in primary education increased by 8 percentage points and in upper secondary education by 14 percentage points (Figure 11.10).

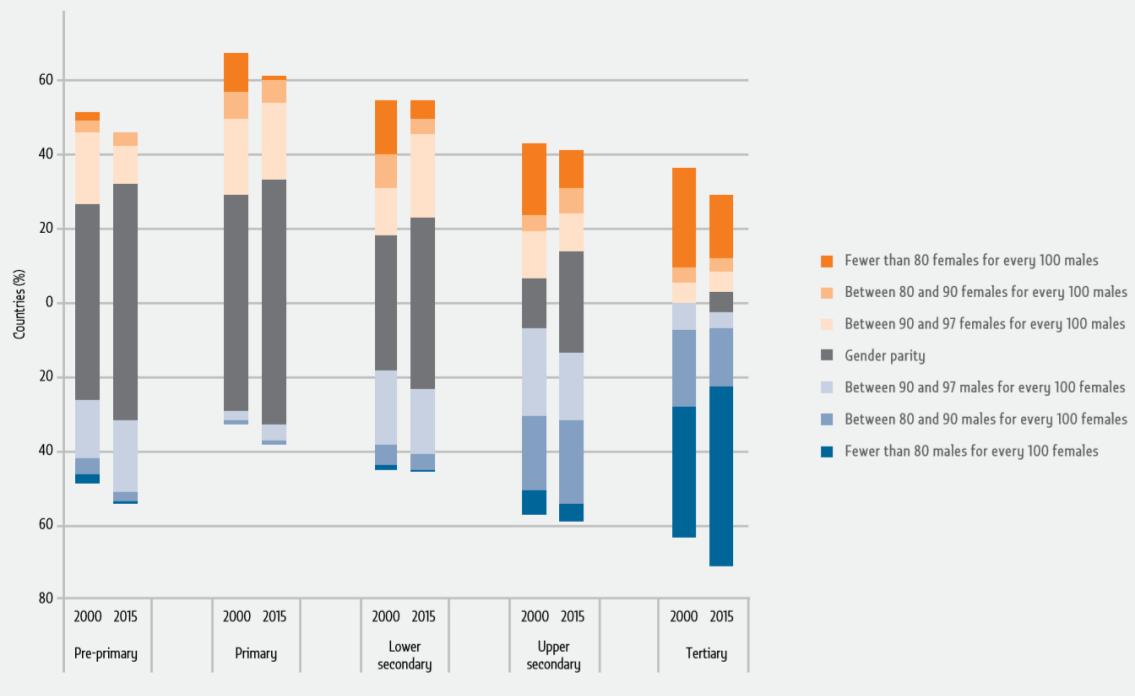

Figure 11.10 - Percentage of countries by level of gender parity index of gross enrolment ratio, by education level, 2000 and 2015
(Source: Global education monitoring report gender review, 2018)

As it can be seen from the previous figure 11.10, more countries have achieved gender parity, but disparities persist, especially at higher education levels.

On the other hand, the world is still a long way from ensuring that all children, adolescents and youth, of either gender, are enrolled in school. In 2015, there were 264 million primary and secondary age children and youth out of school. This includes some 61 million children of primary school age, 62 million adolescents of lower secondary school age and 141 million youth of upper secondary school. After a decline in the early 2000s, out-of-school rates have stagnated.

Gender disparities in out-of-school rate have narrowed substantially over the last 15 years. Globally, a gap exists only in primary education: 9,7% of primary school-age girls and 8,1% of boys are out of school. In lower and upper secondary education, there is parity overall, but disparities emerge at regional level.

In tertiary education, only 4% of countries have achieved parity, with the gender imbalance increasingly at the expense of males. Overall, there are more females than males in tertiary education in almost all regions. However, in many countries, although women outnumber men as graduates, they lag behind men in completing science, technology, engineering and mathematics (STEM degrees). That is, women are a majority of university graduates, but a minority of STEM graduates (Figure 11.11):

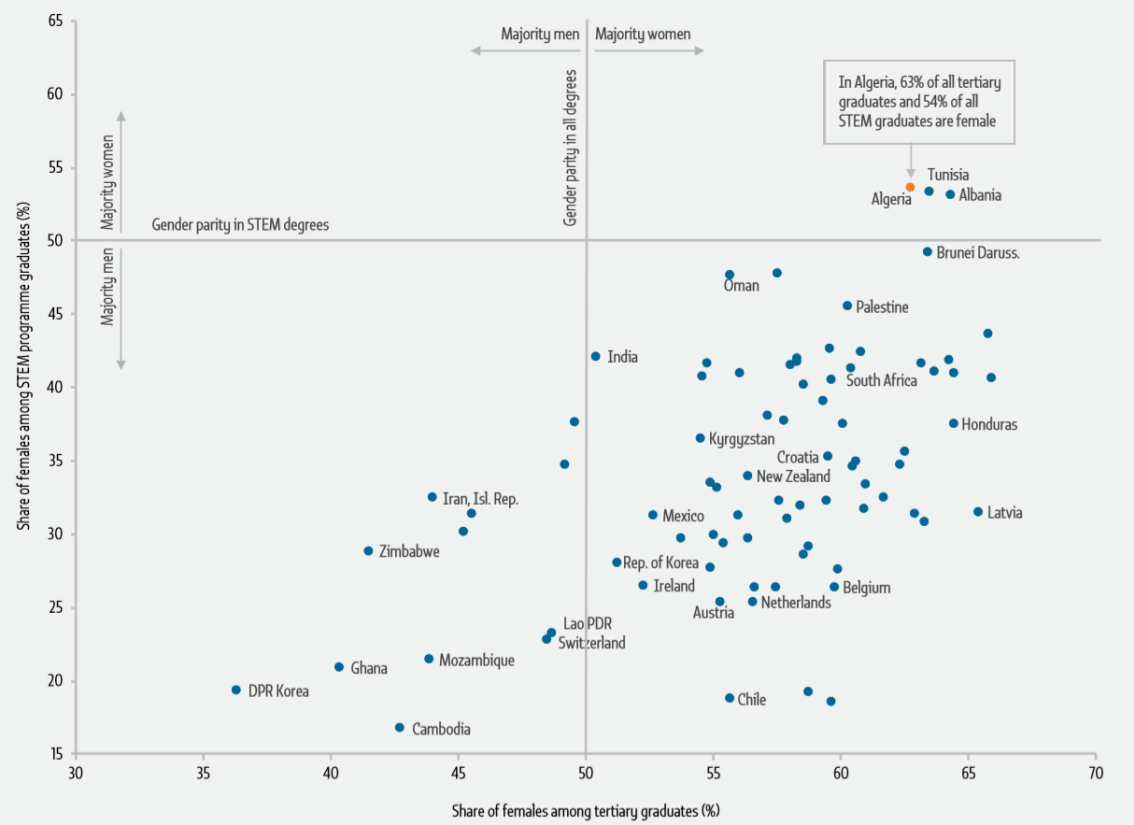

Figure 11.11 - Percentage of female graduates from science, technology, engineering and mathematics programmes and all tertiary programmes, 2015
(Source: Global education monitoring report gender review, 2018)

2.2 European level

Once it has been analysed the gender gap in education at a global level, in this section it is included several specific examples for the European Union related to gender parity in education.

2.2.1 Primary and secondary education

The number of students found in each of the earliest levels of education varies between the EU Member States. This reflects, to some degree, the demographic structure of each

population and also country-specific policies relating to the provision of primary and secondary education.

In the European Union, there were 28, 7 million students in primary education in 2015. The 49% of these students were women and the 51% were men, as is shown in Figure 11.12:

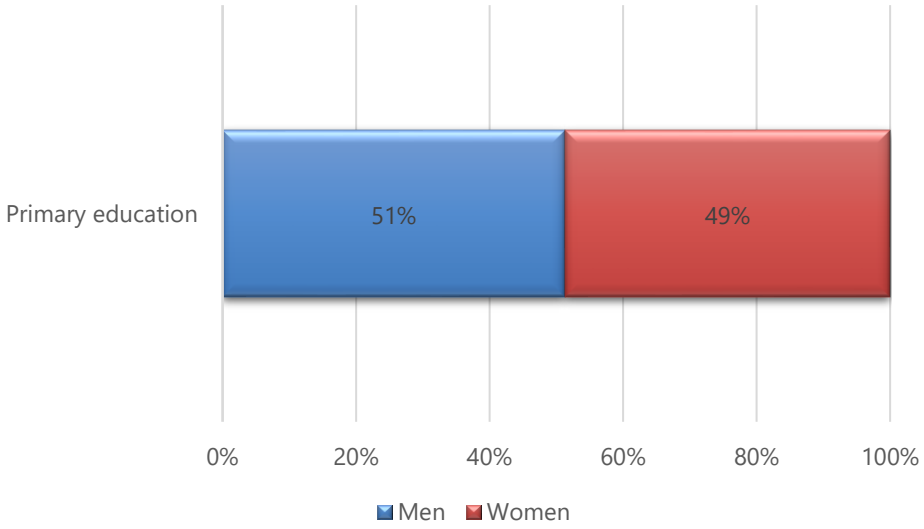

Figure 11.12 - Distribution of students by gender in primary education, 2015
(Source: Eurostat statistics)

Therefore, the gender distribution in primary education was balanced. In secondary education, an analysis of graduates from upper secondary (Figure 11.13) and post-secondary non-tertiary education (Figure 11.14) shows differences between the sexes. Generally, in upper secondary education, the gender distribution was relatively balanced while among post-secondary non-tertiary education graduates there was a fairly clear pattern of more female than male graduates.

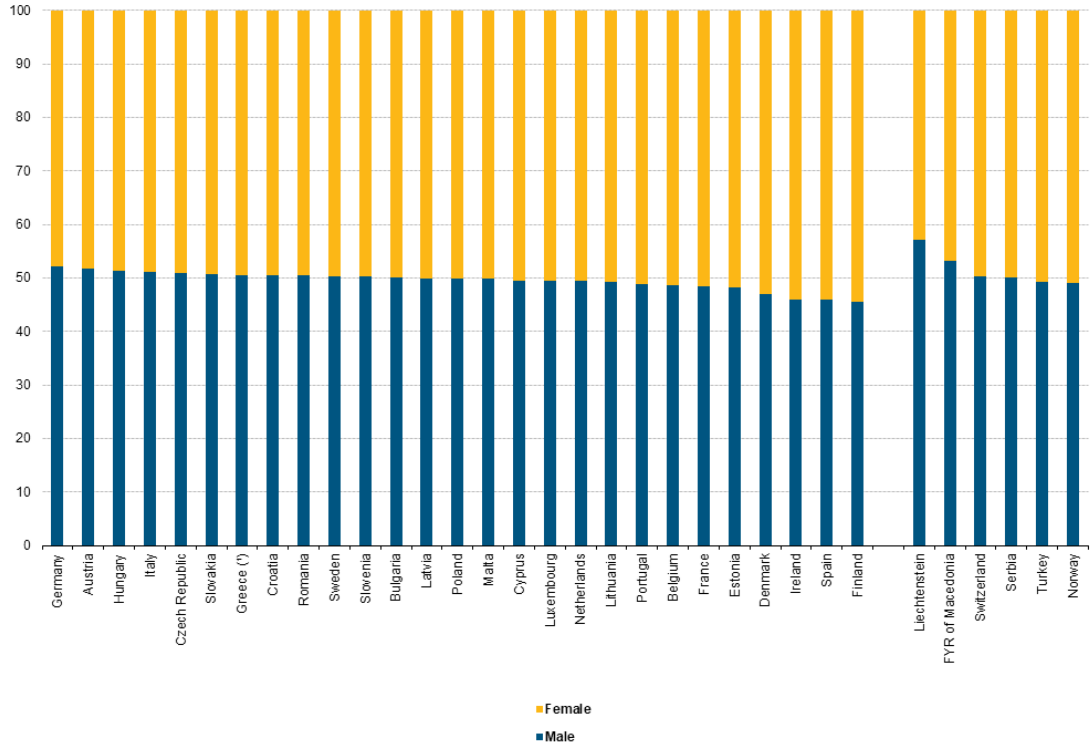

Figure 11.13 - Distribution of upper secondary education graduates by sex, 2015
(Source: Eurostat statistics)

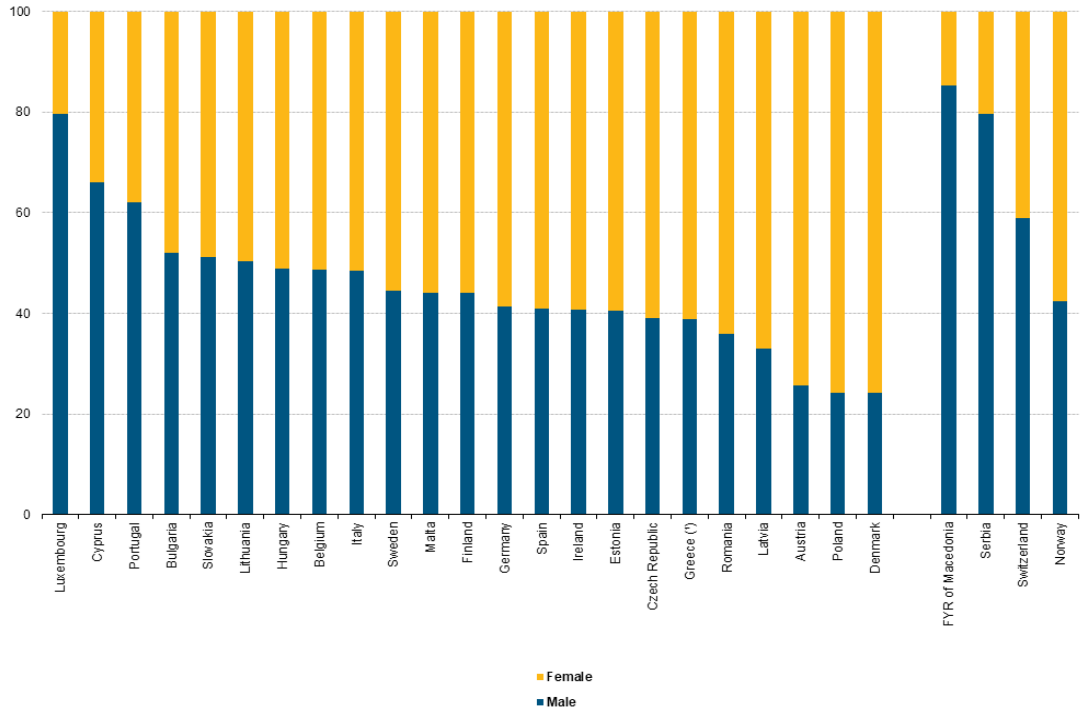

Figure 11.14 - Distribution of post-secondary non-tertiary education graduates by sex, 2015
(Source: Eurostat statistics)

2.2.2 Tertiary education

Tertiary education, which is provided by universities and other higher education institutions, is the level of education following secondary schooling. It plays an essential role in society, by fostering innovation, increasing economic development and growth.

In the European Union, there were 19,5 million tertiary education students in 2015, of which 46% were men and the 56% were women (Figure 11.15):

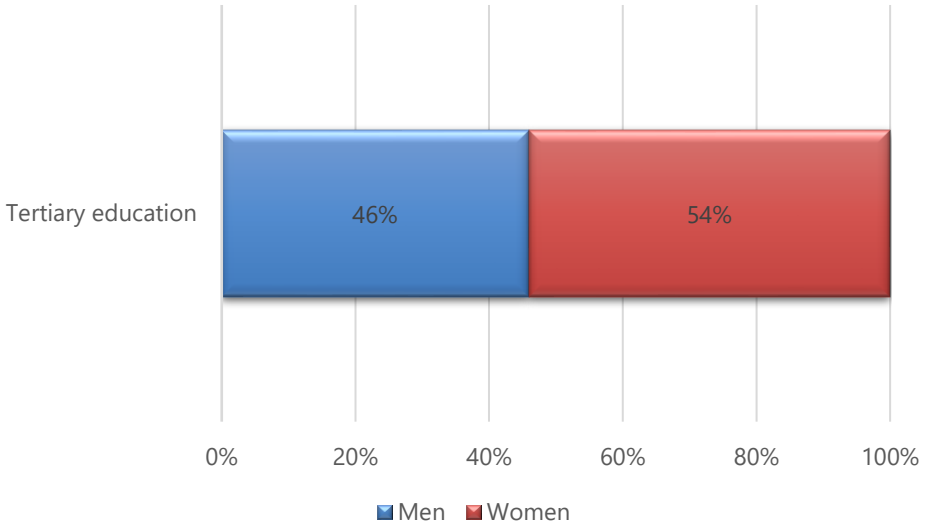

Figure 11.15 - Distribution of tertiary education students by sex, 2015
(Source: Eurostat statistics)

If it is analysed the different levels of the tertiary education, it is obtained that the share of women among tertiary students was slightly higher among those studying for master's degrees (57%), somewhat lower for those studying for Bachelor' degrees (53%) and following short-cycle courses (52%). For doctoral students, however, the majority (52%) of students were men (Figure 11.16):

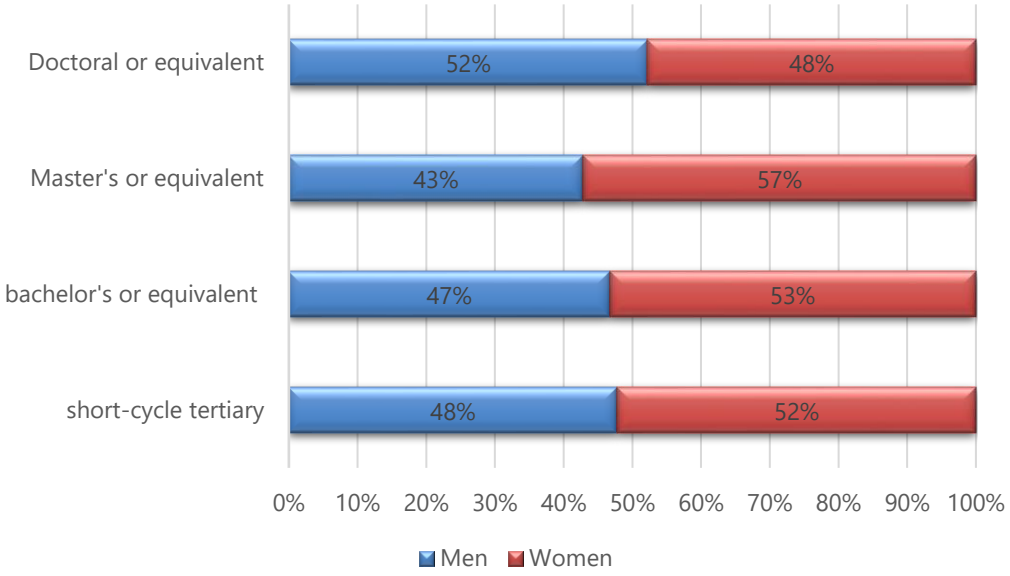

Figure 11.16 - Distribution of tertiary education students by level and sex, 2015 (Source: Eurostat)

On the other hand, different choices across study fields between women and men is a relevant characteristic of gender differences in education patterns in the European Union.

Across the European Union, almost one third (32%) of all students in tertiary education were studying social sciences, journalism, information, business, administration or law in 2015. There were considerably more females than male students studying social sciences, with women accounting for 57% of all students with this field of education (Figure 11.17). The second most common field of education was engineering, manufacturing and construction-related studies which accounted for 15% of all tertiary education students. In this field, almost three quarters (74%) of all students were male. The third largest field of study was health and welfare, with a 13% share of all tertiary education students. In this field, women accounted for close to three quarters (72%) of the total number of tertiary students. Among the remaining fields of education shown in Figure 11.17, the highest share of female students was recorded for those studying education (where 77% of all students were women), while women accounted for almost two thirds (64%) of all students studying arts and humanities. By contrast, within natural sciences, mathematics, statistics an information and communication technologies the share of men in the total number of tertiary students was 61%.

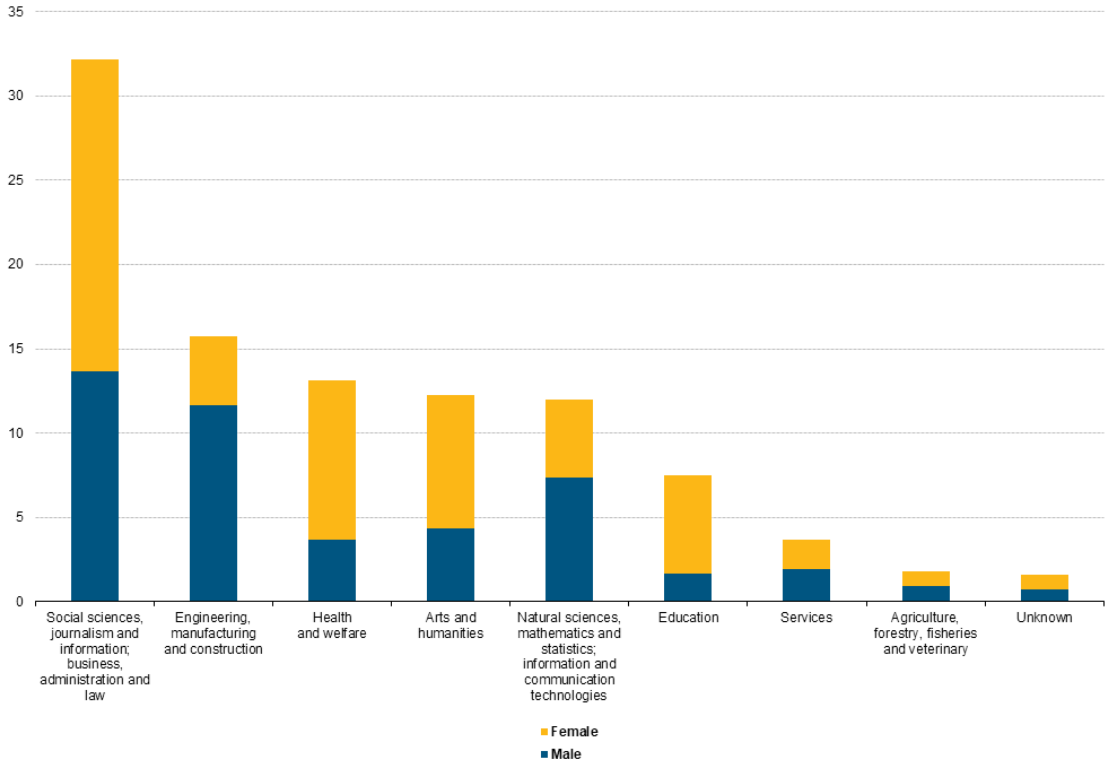

Figure 11.17 - Distribution of tertiary education students by field and sex, European Union, 2015 (Source: Eurostat)

Therefore, taken as a base the results showed in the figure 11.17, it is concluded that science, technology, engineering and mathematics fields of study are much more prevalent among men, whereas social sciences, health and humanities are much more common among women.

2.2.3 Teaching staff

Analysing the number of teachers (Figure 11.18) in primary and secondary education, there is a clear dominance of female over male teachers. In 2015, 2, 2 million persons worked as primary school teachers in the European Union. Women were predominant, accounting for 85%. In addition, there were an estimated 1.9 million lower secondary teachers in the European Union in 2015 and a slightly lower number (1.6 million) of upper secondary teachers. Within lower secondary education in 2015, men accounted for 32 % of all teachers, while in upper secondary education men accounted for 40 %, 8 percentage points more. In relation to teaching staff in tertiary education, there were 1,4 million people teaching in tertiary education in the European Union in 2015, of which the 58% were men and the 42% were women.

Therefore, in contrast to the teaching staff in primary and secondary education, where women were the majority, in tertiary education the majority of teaching staff were men.

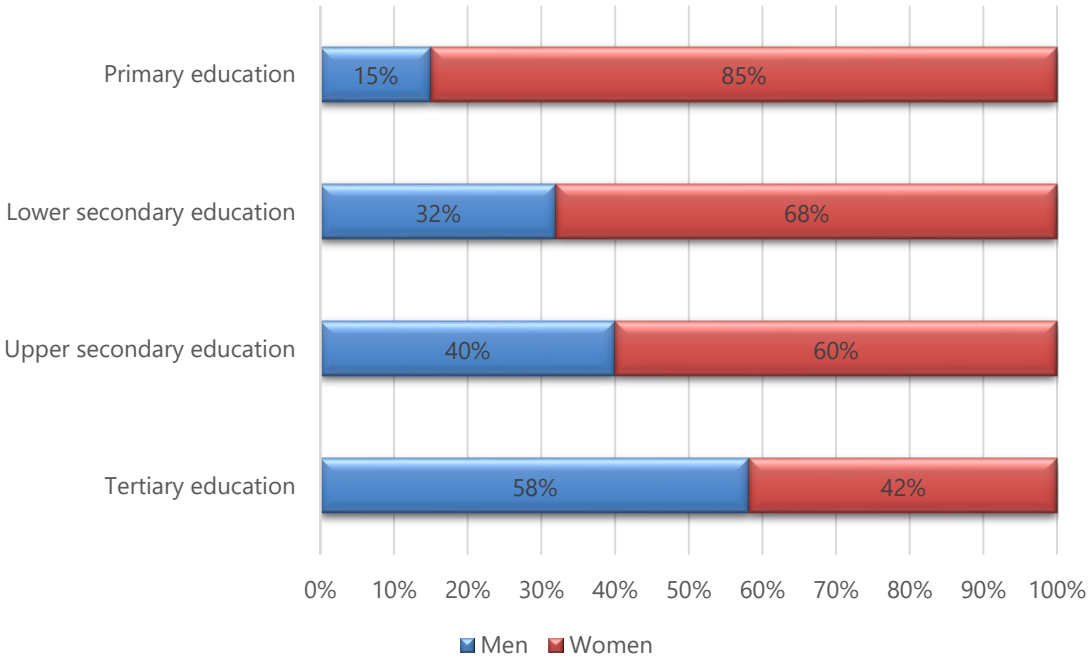

Figure 11.18 - Distribution of teaching staff by gender, 2015
(Source: Eurostat)

11.3 Choice of University Degrees

For a long time, most women who choose engineering at university opted for Chemical Engineering, where in many cases the majority of students were girls; in contrast few girls chose other branches of engineering like civil or mechanical engineering. The anecdotal explanation that chemical engineering is closer to cooking carries no substance and is just one more form of biased judgement.

The real explanation may be that in former times a lady civil engineer might feel uncomfortable among uneducated construction workers, and a lady mechanical engineer might not be at ease in a factory shop fall full of rough workers, although some could brave the situation successfully. A better prospect for women inclined towards science would be to work in a chemical laboratory or medical profession less distributed by the pre-conceptions and discriminations of society.

The situation has improved significantly in both respects. More branches of engineering put more emphasis on office and laboratory work, like engineering design and informatics. The attitudes of society have improved with regard to gender equality and respectful treatment, though mot to the extent of overcoming all barriers.

Nevertheless, the progress is noticeable in some aerospace engineering degrees: from 10% women 30 years ago, to 20% women15 years ago to 30% women now. It is a slow progress,

on the scale of one step by generation; 30% is already a not too small minority showing how much more room for improvement still remains.

Although girls perform as well or better than boys in STEM subjects several external factors influence their choices in other directions (Key Topic T11.3)

KEY TOPIC T11.3 – PERFORMANCE AND CHOICES OF WOMEN CONCERNING STEM

1. Choice of STEM Subjects

The National Centre for Universities and Business offer an excellent infographic poster, (Figure 11.19) Talent2030 Dashboard, which shows progress to their targets for women in engineering. In 2017, one of their targets was met: 50% of Physics GCSE students were girls.

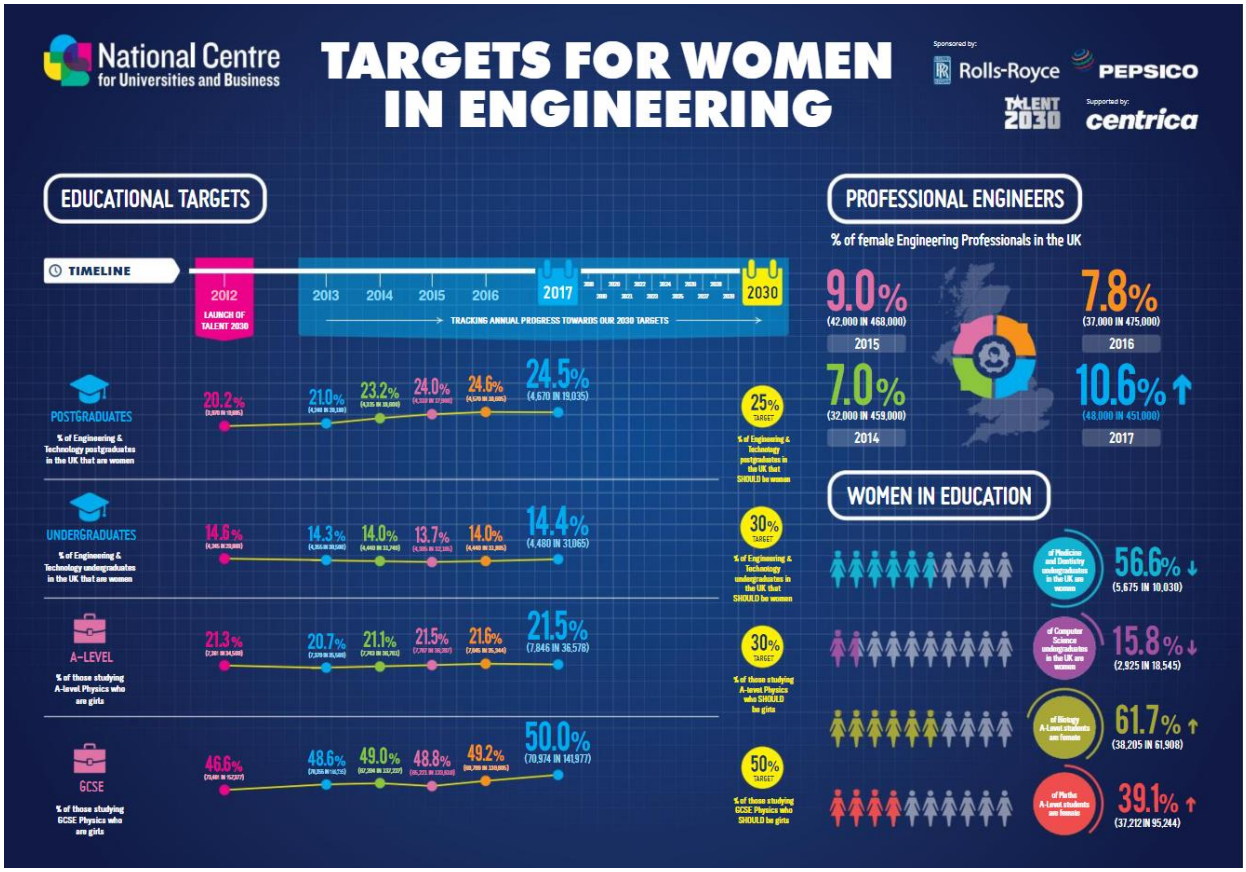

Figure 11.19 - Women in STEM subjects in the UK

In 2016, the proportion of women in full-time engineering faculty posts in Canada was 14.9 percent, a 1.5 percent rise since 2012.

The number of women graduating in a core STEM subject has continued to grow for another year (Figure 11.20). These women are talented individuals qualified to take up the exciting opportunities available in STEM and help address the persistent skills gaps across the UK. However, due to more rapid growth in the number of men graduating in these subject areas the percentage of graduates who are women has dropped from 25% to 24%.

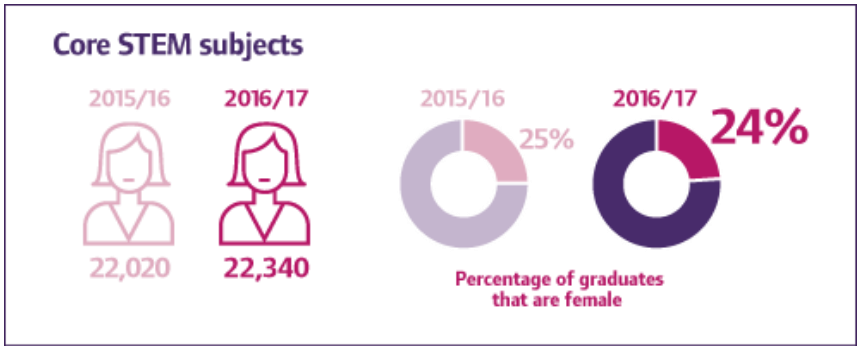

Figure 11.20 - Evolution of women in STEM subjects

Whilst WISE are encouraged by the growth in women pursuing core STEM education at all levels, they are still severely underrepresented in areas such as engineering and computing.

We would encourage universities to engage more women to apply by reviewing their marketing materials, entry requirements and offering taster days to women before they apply – actions which have had a marked impact in the apprenticeship sphere. WISE can support universities to tackle this challenge. Additionally, universities should consider training their outreach officers in People Like Me to help them engage effectively with local schools and prospective students.

Women graduating in core STEM subjects

Encouragingly for the third year in a row, the growth rate in the number of women graduates in physical science (Figure 11.21) has exceed that of men. Women now represent 41% of graduates in physical sciences, perhaps a sign that concerted efforts to encourage girls to consider studying physics may be starting to reap the rewards.

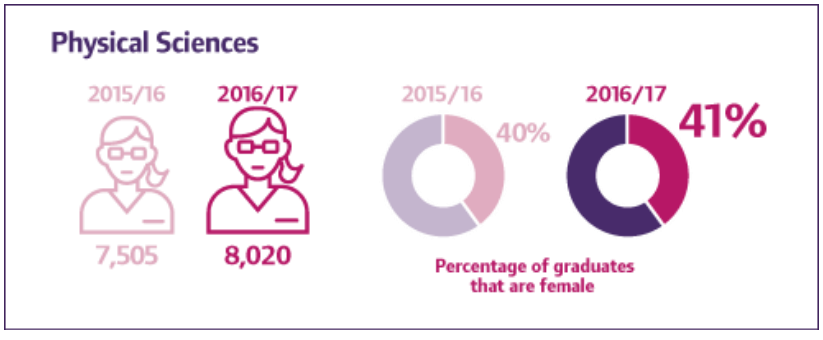

Figure 11.21 - Women in physical science

In mathematical sciences, the number of women graduates has remained static at 39 % since 2015/16 (Figure 11.22):

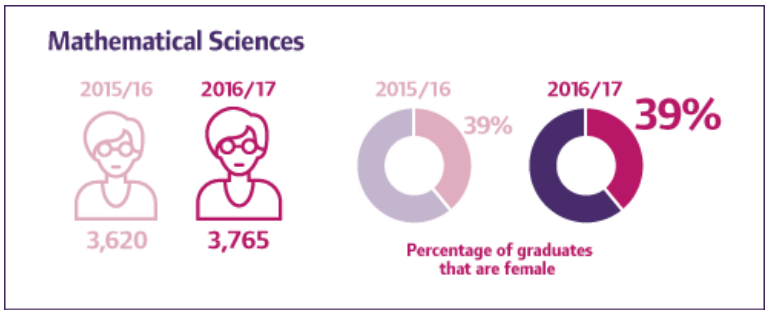

Figure 11.22 - Women in mathematical sciences

However, in computer science the growth in the number of female graduates is well behind the growth in the number of male graduates (3.1% vs 9% respectively). This year women represent just 15% of computing graduates, down from 16% last year (Figure 11.23):

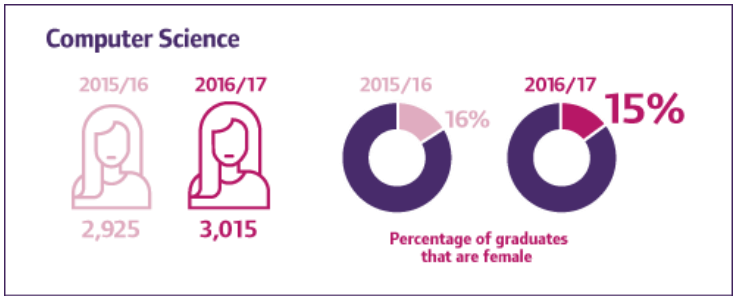

Figure 11.23 - Women in computer science

The picture is similarly disappointing in engineering where for the third year in a row, women represent just 14% of graduates (Figure 11.24):

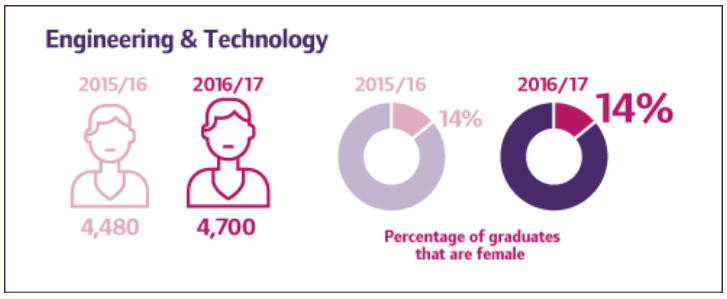

Figure 11.24 - Women in Engineering and Technology

The only core STEM area where the number of women graduates has decreased is Architecture, Building and Planning subjects where the women now represent just 27% of graduates compared to 35% in 2015/16 (Figure 11.25):

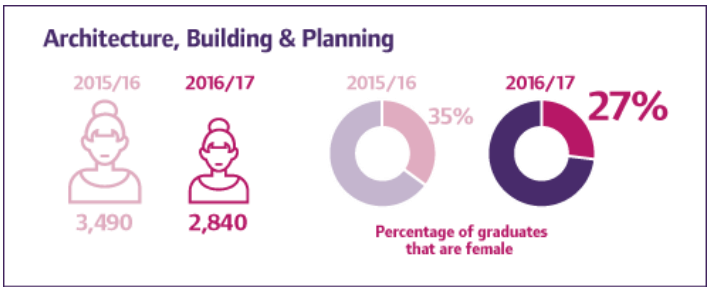

Figure 11.25 - Women in architecture, building and planning

Despite the continued growth in most core STEM areas, they still lag behind other STEM degrees on gender balance (Figure 11.26):

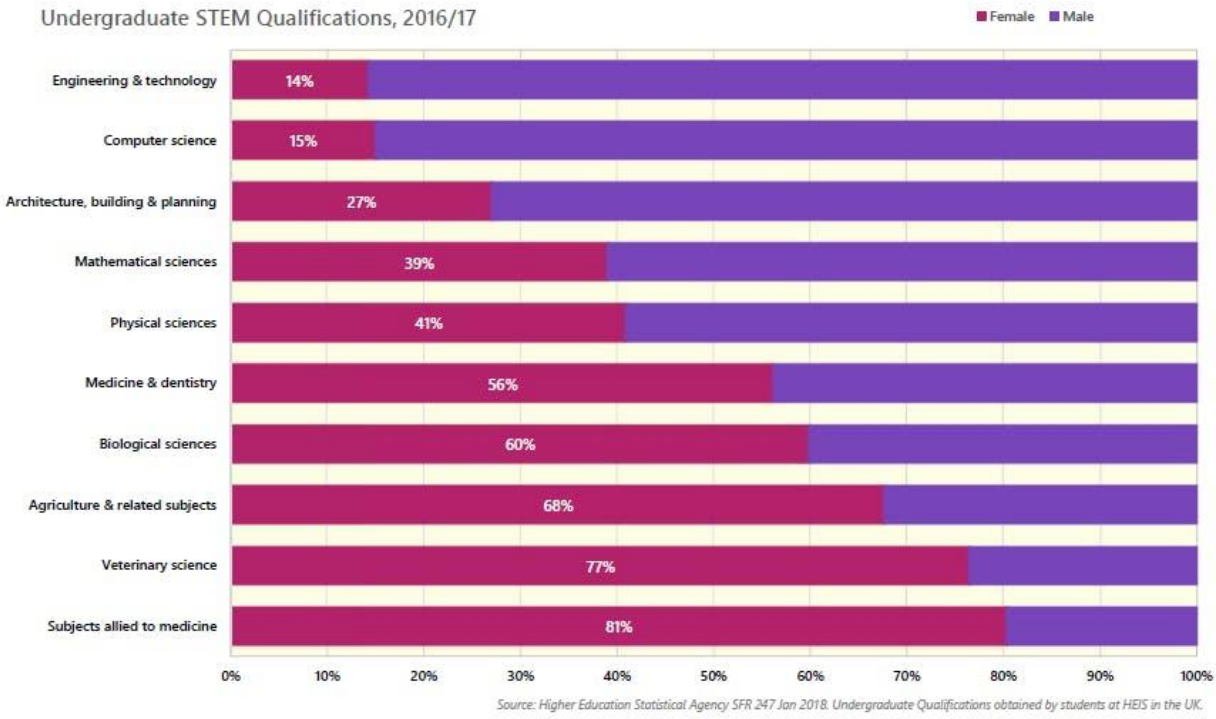

Figure 11.26 - Women in STEM areas

2. Why not choose STEM?

A study of 1,327 Swedish secondary school students explored why more boys are attracted to STEM subjects at university and more girls are attracted to subjects in the Heed (health, elementary education and domestic) spheres.

This difference was partially explained by "social belongingness": teenagers felt they would fit in better in subjects that had more of their own gender. But another important factor was "self-efficacy": the belief that one can succeed in a domain. We tend to approach domains where we feel we are competent and avoid those in which we do not. Boys and girls both had high

self-efficacy in the Heed subjects, but boys chose not to pursue them. The researchers suggest that this may reflect the low social value and rewards associated with careers in these spheres.

In contrast, girls on average had much lower self-efficacy ratings in Stem, despite outperforming boys across school subjects. Even in one of the most gender-neutral countries in the world and despite the evidence of their own marks, girls still seem to be succumbing to the stereotype that girls aren't as capable in these subjects.

3. University environment influence on women persistence in STEM fields and careers

Women in engineering majors enter college with the same levels of interest and intent to persist in the major as male peers, yet fewer women complete undergraduate degrees in STEM fields and persist into related careers (National Science Board 2016).

Overall, research shows **that women who have positive experiences in STEM majors via supportive faculty members and peers, research experiences, or participation in engineering organizations are more likely to continue taking STEM classes, complete degrees and continue on to post baccalaureate STEM careers** in comparison to those who do not (Beyer 2014; Gayles and Ampaw 2016; Hughes 2010; Kezar and Holcombe 2017; Litzler and Young 2012; Marra et al. 2009; Neumann et al. 2016; Ro 2011).

Many women in science and engineering report experiences with discrimination and bias that make it difficult to persist and succeed in their majors. Women in science and engineering have a long history of feeling **marginalized, isolated, and subject to stereotype** threats within their majors, a feeling that tends to grow over time (Marra et al. 2009; Neumann et al. 2016). **Favouritism and differential treatment** also detract from positive experiences that increase persistence and academic success for women, as male and female **faculty in science and engineering have been found to favour and be more responsive to male students in comparison to females** (Milkman et al. 2015; Moss-Racusin et al. 2012). Further, reports of bias in the form of **sexual harassment from classmates and faculty** are all too common for undergraduate women in science and engineering (Morris and Daniel 2008). **Differential treatment and bias towards women in science and engineering** also have negative underlying consequences for women's perceptions of their own abilities**.** More recent work suggests that **women underestimate their performance on engineering tasks compared to men** (Woodcock and Bairaktarova 2015).

Additional research has shown that **unwelcoming environments contribute to decreased self-confidence, self-efficacy, the tendency behave in self-limiting ways that negatively impact overall success and persistence for women in science and computing** (Haines et al. 2001; Morris and Daniel 2008), with **gender discrimination related to lower academic performance** (Beyer 2008).

4. How to attract women to choose STEM subjects at university?

To attract more girls to study Stem subjects at university and enter Stem careers, we need to tackle the stereotypes they are exposed to and we need to do this early. One way to encourage girls is to use appropriate role models. As part of a campaign to coincide with International Women's Day, **Speakezee, a platform that connects academics with non-academic audiences, is working with the Institute of Physics and the Girls' School Association to send young female graduate Stem students into schools to talk to and inspire young teenage girls to consider pursuing Stem topics at A-level.** Professor Brian Cox may be the popular face of physics for mass viewing audiences in the UK, but young girls need individuals they are more likely to relate to if they are to be persuaded not to abandon their Stem potential.

11.4 Employment Opportunities in Academia and Industry

Women tend to perform at least as well or better than men on average in university studies and has a relative percentage more proceed to a research and academic career. The underrepresentation of women in academic positions may be a question of time due to the slow promotion in university positions, or an indication that university after all is not so gender equal, or a combination of both.

Concerning employment in government agencies and services there are areas where women are more numerous, but that is mostly the exception, with a still bigger imbalance in industry, which some corporations try to reduce. To attract women industry and services should offer the same incentives as for men plus the assurances of equal treatment.

It may happen that the advertisement for positions in not even, and implicitly stresses factors that are not gender neutral, even when trying to encourage women to apply. It is not only the selection process that needs to be fair, it is also the mechanisms to access potential candidates and the offers that are made to them appeal equally to both genders.

The aviation sector has both jobs requiring STEM skills as well as not (Key Topic T11.4).

KEY TOPIC T11.4 – JOBS IN THE AVIATION SECTOR

1. Women in STEM and Engineering Jobs

The National Centre for Universities and Business offer an excellent infographic poster, Talent 2030 Dashboard, which shows % of female engineering professionals in the UK (Figure 11.27 and 11.28).

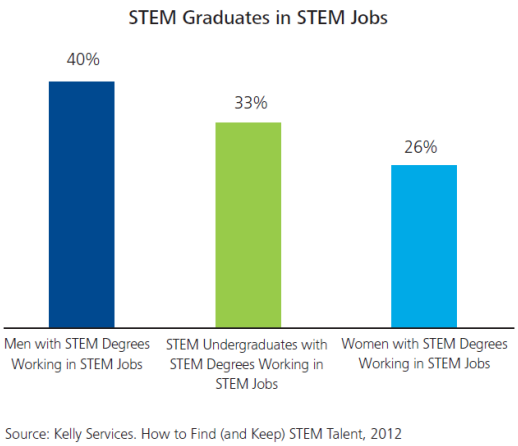

Figure 11.27 - Graduates in STEM

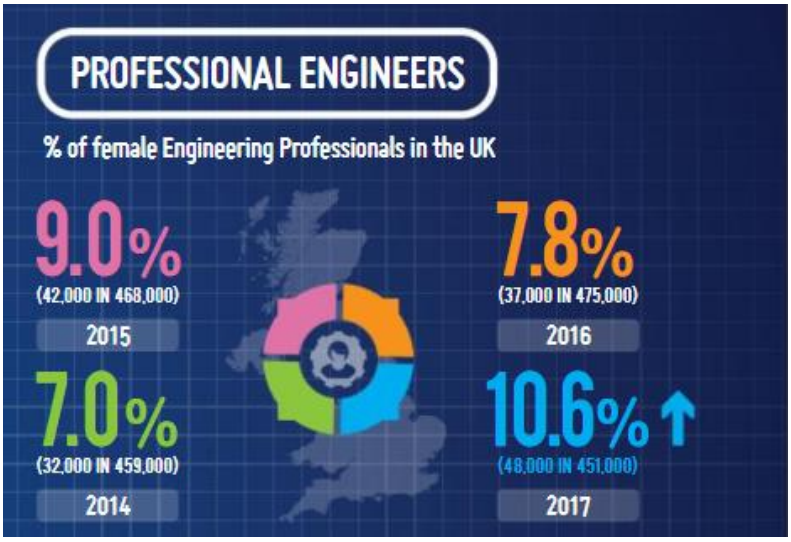

Figure 11.28 - Women graduate in STEM

2. Recruitment

Among 10 good practices identified by **DG Move 2 of them are useful concerning employment opportunities for women.**

1. Working with Men to engage Women

In the face of skills shortages and recruitment gaps many transport companies are having to take a hard look at the profile of their workforce and recognise the low and limited representation of women. This study highlighted how successful recruitment strategies recognise the importance of men in any plan to empower women and increase and improve recruitment. Men are part of the solution. Several organisations identified the importance of working with existing male workers to better understand the focus of recruitment promotion. Men can provide insights into the challenges of the work and how best to overcome them. They can engage and support the planned communication actions. It is important not to alienate existing workers, which could happen if they are not consulted or engaged in efforts to recruit more women. In many cases, there is a basic need to make changes to the culture at work so that it is a place where women

want to work. This means that men need to recognise the contribution of women and that going forward the company needs women to remain strong.

2. Providing opportunities to experience the job

It is difficult for young people to understand the diverse range of roles available across different transport sectors. The evidence suggests that it is difficult to change minds and behaviours unless people are given opportunities for some form of direct engagement.

'#Nolimitsforwomen', Lufthansa, Germany

As part of its #Nolimitsforwomen week, Lufthansa provided an opportunity for women to apply for a career day with the company. The winner could choose from a wide range of professions mostly in operative areas that are typically male-dominated. Logistics, aircraft maintenance, or the air-traffic control centre; there are many possibilities. In addition to offering a look behind the scenes, the biggest German airline will provide travel to Lufthansa headquarters as well as accommodation in Frankfurt for the lucky winner.

*Agreed with the summary of Barbara Link, a manager at General Electric, about **effective recruitment approaches**, which centre around six elements:*

1. *The recruiters are engineers, scientists, and managers of engineers and scientists, not the Human Resources Division representatives.*
2. *Employees chosen as corporate recruiters are those who exhibit strong interpersonal skills, who "care and go the extra mile."*
3. *Recruitment occurs at a targeted group of universities.*
4. *The company maintains a corporate presence on each campus, interacting with faculty, students, and staff.*
5. *Entry-level recruits rotate through a series of technical and management assignments to learn about program opportunities.*
6. *Co-op programs enable the company to evaluate potential employees while they pursue projects that support the work of the GE laboratories.*

Additional linkages with universities have been developed by many companies to identify prospective employees.

3. Employment opportunities in industry that don't need STEM

When we talk about careers in aerospace most people instantly think of pilots and engineering jobs. However, airlines rely on many individuals to perform their job in order to keep them in business. They include baggage handlers, ticket agents, avionics technicians and others. Women should be also aware of this and work should be done in order to attract them to these jobs too.

In fact, air transport services accounts for a variety of employment types (Figure 11.29):

Figure 11.29 - Direct Job by Employment Type
(Source: Economic Impact of European Airports, InterVISTAS)

For instance, to be a cabin crew member there's no necessity to follow STEM education. Some airlines don't even request for a university course and just ask for high school education, as the case of Qatar Airways presented below (Figure 11.30):

Current Opportunities

QR17579 - Cabin Crew Recruitment Event Kiev | 23rd June 2018 | Qatar Airways | Doha

Organisation:	Qatar Airways	**Job Function:**	Cabin Crew
Division:	Cabin Services (Division)	**Employment Type:**	Full Time - Permanent
City:	Middle East | Qatar | Doha	**Last date of application:**	23-Jun-2018

About You:

To be part of this winning team, you need to meet the following requirements:

- Minimum age of 21 years
- Minimum arm reach of 212 cms on tip toes
- Minimum high school education with fluency in written and spoken English
- Excellent health and fitness
- Willingness to relocate to Doha, Qatar
- Outgoing personality with good interpersonal skills and the ability to work with a multinational team.

Figure 11.30 – Recruitment file from Qatar Airways

Jobs related to ground handling service do not also require STEM education, some professions are:

- Scale Assistance Traffic Technician;
- Baggage Handling;
- Passenger Handling;
- Aircraft Marshaller;
- Ramp Handling;
- Fuel and oil handling services;
- Airport Security;
- Flight dispatcher.

11.5 On-the-Job Treatment and Preventing Abuse

The professional activities are not immune from the problems that affect society in general and must address them to reduce their effects rather than become an excuse of refuge from inappropriate behaviour.

Companies usually take seriously, up to and including grounds for dismissal, two types of inappropriate action, and they should add a third.

An employed that proves to be professionally incompetent and causes disservice to customers or harms the reputation of the company can be rightly dismissed. Similarly, an employee that misuses company resources or fails to carry out important duties may face consequences. Using the workplace an opportunity for gender abuse, whichever way, should have a similar sanction to incompetence or dishonesty, because all three are improper forms of conduct.

In most institutions, including large ones, individual rights are not equally applied. A successful top executive may have much more reward than all others that contributed to the result; a failed worker may be dismissed whereas a failed top executive may have a generous retirement offer that cannot be refused. Countering gender abuse may face similar difficulties, especially if the culprit is up and the victim down the hierarchical ladder; this should be countered by putting more responsibility on those who have more power and should be more ethical in its use.

The issues of women on the job treatment need to be considered very seriously in order to have access to this major half of the workforce (Key Topic T11.5).

KEY TOPIC T11.5 – INTEGRATION OF WOMEN IN THE AEROSPACE SECTOR

Concerning on-the-job treatment and preventing abuse, there 3 main factors to take into consideration:

1. Women Mentoring Programs;
2. Women job satisfaction determinants;
3. Women Networking.

1. Mentoring

One way that organisations can improve the recruitment and retention of women in the aviation and aerospace industry is by offering support to their female professionals through ***mentoring****. Evidence shows that the assistance of a mentor is important for women at all stages in their careers (Ehrich, 2008; Singh et al., 2002; Vinnicombe and Singh, 2002; 2003), but especially in terms of* ***career advancement*** *(Durbin and Tomlinson, 2010; 2014; Lineham and Walsh, 1999; Ragins, 1999). Mentoring also acts as a channel for the* ***exchange of tacit knowledge and information that is often linked with promotion opportunities*** *(Durbin, 2010; Swap et al., 2001). Mentoring is of particular significance for women as it may help them to* ***break through the 'glass ceiling'*** *(Lineham and Walsh, 1999; Ragins, 1999). Mentoring also* ***increases women's visibility within organisations*** *(Hersby et al., 2009) and contributes to* ***raising aspirations and levels of self-confidence*** *(Institute of Leadership and Management, 2011).*

However, mentors are harder to come by for women, especially in male-dominated industries (Durbin, 2010; Durbin and Tomlinson, 2014).

***Alta** is an Economic and Social Research Council (ESRC) co-funded project to design a mentoring scheme for women in the aviation and aerospace industry. The project was based on a knowledge-exchange partnership between the **University of West of England**, the **Royal Aeronautical Society** (RaeS), the **Royal Air Force** (RAF) and **Airbus**. These partner organisations recognised the critical role that women play in their industry and through a **formal mentoring programme, wanted to support their female professionals and encourage more into leadership roles**. Aligned with the project Alta is a mentoring scheme, providing **one-to-one mentoring from successful women, and a network** that's dedicated to ensuring that talented women reach their full career potential, for the benefit not only of individuals but also our industry as a whole.*

Alta positive aspects:

- *When we asked women what they were specifically looking for from alta, they told us that they were looking for **advice** on careers and behaviours, **access to female role models**, matching with a mentor who could clearly meet their needs, being able to choose a mentor, **clear structure and guidance** on mentoring, the choice **about how to meet (i.e. face to face or via social media)** and involvement in a **mentoring community and attendance at alta networking events**.*
- *The **'woman to woman'** aspect of alta was appealing to most women as they felt other women could help to show them the way, share common experiences and establish woman to woman trust. They also felt that alta could ultimately help more women into managerial and leadership roles.*
- *The project offered **the potential to build a network** of support for women in aviation and aerospace that will lead to an increase in the numbers of women working (and progressing) within what is a vital business sector within the UK economy as a whole.*

2. Attention to women's job satisfaction determinants

On job treatment should consider women's determinants for job satisfaction (Table 11.1) and design their jobs ensuring these factors. For instance, in 2015, independence on work, be part of a larger team, valorisation of work by the supervisor, flex time and job stability were pointed as crucial to women workforce in aviation.

Women
Independence in my work
Part of a larger team; supervisor values my contribution; flex time
Job stability

Source: Aviation Week 2015 Workforce Study

Table 11.1 – Some determinants for job satisfaction of women

3. Networking

Establishing networks of women to share experiences and promote opportunities are perceived to be an important element of improving working conditions (DGMove, 2016)

There are several organizations aiming to help women through networking opportunities:

1. **Women in Aviation International** is a non-profit organization dedicated to the encouragement and advancement of women in all aviation career fields and interests. Women in Aviation International provides: education resources, scholarships, outreach programs, annual Conference and Job Fair, girls In Aviation Day (girls ages 8-17) and girl Scout Aviation Patch.
2. Women in Aerospace (WIA) is dedicated to expanding women's opportunities for leadership and increasing their visibility in the aerospace community. Networking is one of the many significant benefits of joining Women in Aerospace. Comprised of individuals from an array of disciplines and technical experiences, WIA members are given a number of opportunities to meet equally driven colleagues at events held throughout the year. http://www.womeninaerospace.org/about/mission.html
3. **Women in Aerospace Europe (WIE) -** *Being a part of our ever-growing network means benefiting from our programmes and special member offers, as well as connecting with like-minded professionals through our local communities. http://wia-europe.org/*
4. **The Royal Aeronautical Society's Women in Aviation & Aerospace Committee (WAAC)** *was established in 2009 to encourage more young women to consider aviation and aerospace as a worthwhile and exciting career. It also exists to provide support for women already working in all sectors of aviation and aerospace.*
5. **The International Aviation Women Association (IAWA)** *is an international organization for women who hold positions of impact in the aviation and aerospace industry. Founded in 1988, IAWA brings together women of achievement and promotes their advancement throughout the world. Women are assuming greater and more visible roles within the industry. Through annual global conferences, regional receptions and connects, IAWA provides a forum to share views on matters of importance to the industry, as well as to women in general. Women should have five years' leadership experience in*

aviation or aerospace to apply for IAWA membership. However, our conference is open to all women in our industry. https://iawa.org/

One best practice identified by DGMove project (2016):

- ***SNCF Au féminin (Réseau de Femmes), France -*** *The SNCF works with Ambassadors/Role Models through its 'Réseau de Femmes'. Launched on 26 January 2012, the network has been chaired since September 2016 by Francesca Aceto. This network is dedicated to employees who want to strengthen the role of women in the company and enhance their place in society. SNCF Au féminin is both a 'physical' network, with regular meetings in Paris or in regions, to know and conduct collective reflections (Think tank), and a "virtual" network thanks to the extranet site open to women executives of the group. Space of exchange, information and animation, this extranet site is the daily link of SNCF Au féminin throughout the territory. SNCF Au Féminin has a Charter detailing commitment of the company and the network to promote the inclusion of women in transport professions.*

4. In sum

Create a culture that:

- *has zero-tolerance for incivility and undermining;*
- *recognizes employees' contributions and cares about their well-being, and;*
- *respects employees' work-life obligations and responsibilities.*

Create systems and policies that:

- *Invest in skills-based training and overall professional development;*
- *Provide transparent paths with clear, fair criteria for mobility and advancement;*
- *Provide opportunities for formal and informal mentoring;*
- *Provide other networking opportunities, and;*
- *Offer a variety of options to manage multiple life responsibilities, without any career penalties.*

Implement role-level changes:

- *Communicate clear work goals and relevance of tasks to the corporate objectives;*
- *Clarify what needs to be done, how, and when it needs to be done;*
- *Eliminate, when possible, conflicting demands, expectations, and role disruptions, and;*
- *Infuse new resources or reallocate existing ones to streamline work procedures.*

11.6 Protection of the Family, Maternity and Parenthood

The protection of the family and children is a fundamental value of society that the law tries to ensure in all situations including employment. There are still cases of dismissal using collateral arguments that cannot be accepted for their consequences and are equivalent to a disguised violation of the prevailing law.

How the parenthood allowance is shared between the parents is a family matter that should not be interfered with. Special circumstances have also to be allowed for. In some cases, a change of type of work or a different assignment can make more compatible company priorities and family needs, by adjusting schedules or timetables.

Although many in modern times advocate complete mobility, there is nothing wrong with children becoming fond of the employer of their parents, whom they grow to see as a reliable part of their life, perhaps wishing to follow a similar career, continuing their parents work for another generation.

The associations that foster women participation in aviation (Key Topic T11.6) are also a forum for their integration and protection of their rights.

KEY TOPIC T11.6 – THE ASSOCIATIONS THAT FOSTER WOMEN PARTICIPATION IN AVIATION

IAWA (International Aviation Women's Association) is a non-profit association providing a worldwide network dedicated to promoting the advancement of women in the aviation and aerospace industries at all levels across the globe. IAWA sponsors informative meetings, hosts receptions and connects, publishes newsletters, and keeps its members updated on the latest industry developments.

The president of this association is Alina Nassar, she holds a degree in Law and a Notary Public graduated with Honours from the University of Costa Rica. She is specialist in aeronautical law and she is the first Latin American women to hold the position of President of the International Aviation Women's Association.

With the objective of enhancing the development of women in aviation, the International Civil Aviation Organization (ICAO) in conjunction with the International Aviation Women's Association (IAWA), is offering an Aviation Scholarship for a professional woman in this field.

Candidates who are selected for the ICAO-IAWA Aviation Scholarship will be able to augment their professional experience in aviation by working on and contributing to specific aspects of the ICAO work programme at the international level for a period of nine months.

IAWA is supporting ICAO in its efforts to promote the development of women in aviation by providing voluntary contributions and by assisting in identifying those candidates who meet the requirements for the ICAO-IAWA Aviation Scholarship (Table 11.2) and Awards (Table 11.3):

Requirements
An advanced university degree (Masters' level or equivalent), in an aviation-related discipline.
A minimum of two years of experience in supporting technical work of an international aviation or aerospace organization, a civil aviation authority, or similar related organization.
Fluency in English is required. Knowledge of any other of the following ICAO languages is an asset: Arabic, Chinese, French, Russian, Spanish.

Table 11.2 - Requirements for ICAO-IAWA Aviation Scholarship

Selected candidates will work under the guidance of experienced professionals in the Air Navigation Bureau at the ICAO Headquarters in Montreal.

The Air Navigation Bureau (ANB) is responsible for providing technical guidance to the Air Navigation Commission (ANC), the Council and the Assembly. ANB provides technical expertise in aviation-related disciplines to States, industry and all elements of the Organization. The Bureau is also responsible for maintaining and implementing the Global Aviation Safety Plan (GASP) and the Global Air Navigation Plan (GASP), including its aviation system block upgrades as well as producing yearly safety and air navigation status reports. The Bureau develops technical studies and proposals for Standards and Recommended Practices (SARPs), and Procedures for Air Navigation Services (PANS) for further processing by the governing bodies of ICAO. The Bureau also develops related procedures and guidance material. The Bureau also manages the Universal Safety Oversight Audit Programme (USOAP) that monitors all States on a continuous basis.

Awards
Be a demonstrated leader in her field of aviation.
Be supportive of mentoring, educating and advancing women in the aviation profession.
Be a role model for young women and a professionally supportive peer to women in her field or company/firm.
Be a respected team player by both men and women.

Table 11.3 - Criteria for the ICAO-AIWA Aviation Awards

IAWA is currently affiliated with the following organizations: Airports Council International, ALTA, Aviation Week, IATA, ICAO, ISTAT, Royal Aeronautical Society, among other.

11.7 Recognition of Professional Achievements

The recognition of professional achievements must of course be objective and fair, using the same criteria applied in the same way, regardless of gender, age or belief. However, fairness also means equal opportunities, and while applying the same final criteria, all should have the same opportunities to attain those objectives.

The adjustment of working conditions, or schedules or responsibilities to account for special individual circumstances of women or other groups is not a favour, but rather having an even playing field inside the company as the company would like to have in the market versus its competitors, promoting a loyal division of tasks within the organization.

Reverse discrimination may not be the best way to correct gender inequalities nor forced statistical equality: women do not need favours they only need equal opportunities and fair treatment, and this applies not only to gender issues, but also to other potential forms of discrimination that could creep into the workplace.

Women have had remarkable successes in aviation (Key Topic 11.7) in spite of modest recognition, suggesting they could achieve more in more favourable circumstances.

KEY TOPIC 11.7 – ACHIEVEMENTS OF WOMEN IN AVIATION

Women were present in aviation activities since the first flights. However, until the 70s their presence was, with rare exceptions, mainly as passengers on-board of male-piloted vehicles. Prejudices formed in the general social life were exacerbated in aviation. Claude Grahame-White (1879-1959), a British pioneer of flight (he is credited with the first night flight) is quoted saying that "women are not temperamentally suited to fly an aeroplane".

This biased opinion persisted over decades, determining a large delay in pioneer women penetrating in male-dominated aviation professions. The notable exceptions were the effect of a combination of factors:

- outstanding qualities (Hanna Reich);
- the encouragement of a political system using women images for propaganda objectives (Valentina Teleshkova, the first woman in space, Lydia Litvyak and Yekaterina Budanova – the only women among the combat flying aces in WWII);
- powerful support from families (e.g. Jacqueline Cohcran's husband was one of the richest men on the planet, Jacqueline Auriol was the daughter-in-law of the French president, Amelia Earhart's exploits were financed by her husband, a press magnate, Marga von Etzdorf who was the first woman to fly for an airline when she began co-piloting for Lufthansa in 1927 was presented her first aircraft by her grandfather for her birthday.);
- luck.

Only in 1929 a Canadian was the first woman to earn a master's degree in aeronautical engineering.

In 1930, Ellen Church, a pilot and nurse, who was unable to secure work flying proposed to airline executives that women be allowed to act as hostesses on planes. She was hired on a three-month trial basis by Boeing Air Transport and selected the first seven flight attendants for airlines, requiring them to be under 115 pounds, nurses and unmarried[1].

Only in 1937 Sabiha Gökçen of Turkey became the first trained woman combat pilot, participating in search operations and bombing flights during the Dersim Rebellion. While Gökçen was not the first to have participated in military operations, she was the first woman to have been trained as a military pilot, graduating from the Aircraft School[2]. While in Soviet Airforce certain women-only units were used in combat during WWII, other military strictly prohibited combat participation of women. Only in 1991, the United States Senate lifted the ban on military women flying in combat and in 1993 women were permitted to fly fighter jets. UK had done the same two years earlier.

One of the most dramatic forms of prejudices against women was the refusal by NASA to train any woman-astronaut in the early stages of the space flights in the 60s. US did not send a woman in space until 1983, 20 years after Russia' Valentina Teleshkova orbital flight. And although this first US woman-astronaut, Dr. Sally Ride, was arguably one of the best and the brightest NASA had to offer, she was a Mission Specialist and not a Pilot or Mission

[1] Bednarek, Janet R. Daly; Bednarek, Michael H. (2003). *Dreams of Flight: General Aviation in the United States*. College Station, Texas: *Texas A&M University Press*.

[2] Altınay, Ayşe Gül (25 March 2001). *"Dünyanın İlk Kadın Savaş Pilotu: Gökçen"* [World's First Women's War Pilot: Gökçen] (in Turkish). Istanbul, Turkey: BİA Haber Merkezi

Commander. And it was another 12 years (February 3, 1995) until NASA had a female PILOT (Col. Eileen Collins). And then, 4 years after that, Col. Collins became the first Mission Commander3.

Back in early 60s, Jacqueline Cochran and another outstanding woman pilot, Jerrie Cobb, (a professional pilot who owned 4 FAI altitude record and was a test pilot for North American Aviation) took the initiative to engage a total of 13 women including Cobb (so called "Mercury 13" by analogy with "Mercury 7", the first group of astronauts recruited by NASA) to participate, at a private clinic, in the very same physical and psychological tests that were used to select the original astronaut applicants. All 13 passed the tests. However, NASA was unimpressed. On 17 and 18 July 1962, Representative Victor Anfuso convened public hearings before a special Subcommittee of the House Committee on Science and Astronautics to determine whether or not the exclusion of women from the astronaut program was discriminatory, during which John Glenn and Scott Carpenter testified against admitting women to the astronaut program. Glenn stated at the hearing "men go off and fight the wars and fly the airplanes," and "the fact that women are not in this field is a fact of our social order"4. None of the women who had passed the tests were military jet test pilots, nor did they have engineering degrees, which were the two basic experiential qualifications for potential astronauts. Women were not allowed to be military jet test pilots at that time. On average, however, "Mercury 13 girls" had more flight experience than the male astronauts. "NASA required all astronauts to be graduates of military jet test piloting programs and have engineering degrees. In 1962, no women could meet these requirements." This ended the Mercury 13 programme. The American space programme did not open the ranks of its astronaut corps to women until 1978.

The discrimination was not limited to space flight. The airline industry was also a biased field. United States Commerce Department regulations required pilots to have flown a large number of hours before being licensed for commercial airline flight. Only in the military they could acquire sufficient flight hours, and since the U.S. services barred women from flying (before 1970), they were routinely denied work in commercial piloting. Women eventually began to enter U.S. major commercial aviation in the 1970s and 1980s, with 1973 seeing the first female pilot at a major U.S. airline, American Airlines. American also promoted the first female captain of a major U.S. airline in 1986 and the following year had the first all-woman flight crew.

Even today a strong imbalance is still observed both in the pilot professions and in the non-pilot aviators. Data provided by FAA annual statistics[5] are significant: as of December 31, 2017, women are just over 7% of the total of the certified civilian pilots (both private and commercial) and less than 5% of certified airline pilots. Other positions in aviation show a similar imbalance, e.g. just over 2% of the mechanics are females. The only reverse imbalance is for flight attendants, of which only 20% are male. The total non-pilot professions employ women roughly a third of the total, the strong effect of flight attendants mix (see Table 11.4 below):

[3] *All Hallonquist: http://www.mercury13.com/*

[4] *https://web.archive.org/web/20151211072933/http://nasa.lu/static/qualifications_for_astronauts_hearing_1962.pdf*

[5] *https://www.faa.gov/data_research/aviation_data_statistics/civil_airmen_statistics*

CATEGORY	TOTAL 2017	OF WHICH WOMEN	% WOMEN
Pilot--Total	**609,306**	**42,694**	7.01%
Student	149,121	19,219	12.89%
Recreational (only)	153	14	9.15%
Sport	6,097	229	3.76%
Private	162,455	9,971	6.14%
Commercial	98,161	6,267	6.38%
Airline Transport	159,825	6,994	4.38%
Flight Instructor Certificates	**106,692**	**7,105**	**6.66%**
Remote Pilots	**69,166**	**3,462**	**5.01%**
Non-Pilot--Total	**671,222**	**195,993**	**29.20%**
Mechanic	286,268	6,855	2.39%
Repairmen	35,040	1,847	
Parachute Rigger	6,192	597	
Ground Instructor	66,423	4,924	
Dispatcher	20,664	3,867	
Flight Navigator	64	0	
Flight Attendant	222,037	176,471	79.48%
Flight Engineer	34,534	1,432	

Table 11.4 – Gender imbalance in aviation

When processing the data provided by FAA for the last 20 years one can observe that today women's participation in the aviation sector is still low, but the trend is slowly growing (see Figure 11.31 below):

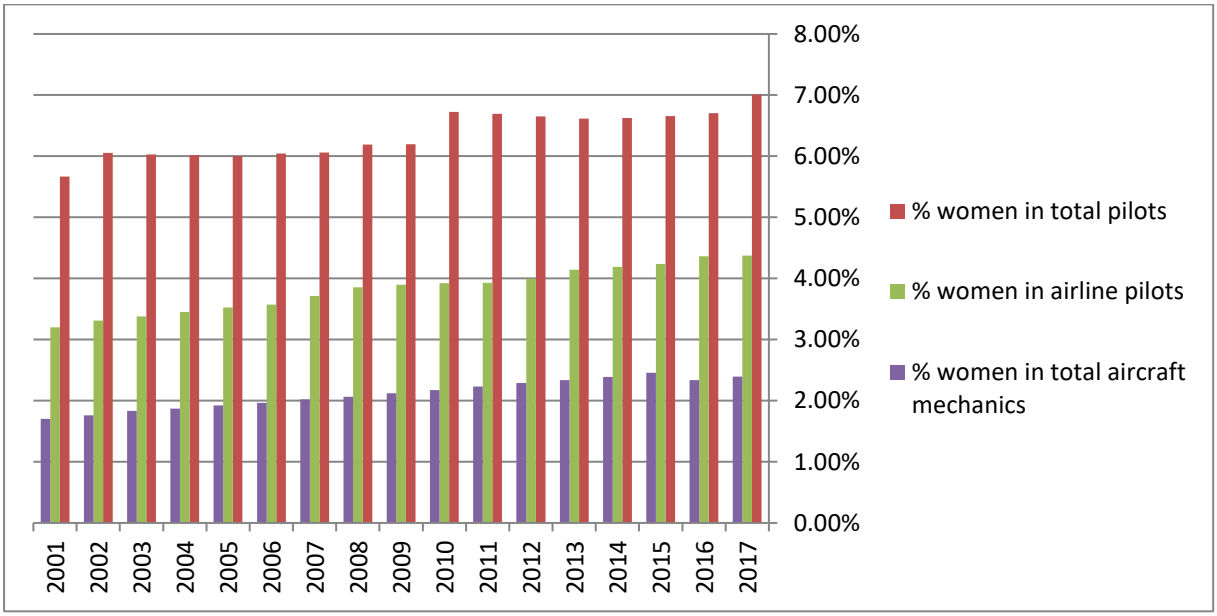

Figure 11.31 – Percentage of women in aircraft jobs

11.8 Reaping the Benefits of Complementarity

Women and men can have different sensibilities, distinct approaches to the same problem and complementary abilities that can be of benefit to the balanced and efficient performance of many tasks. Choosing which skills fit best each task is part of the efficient management of human resources in a company.

Gender based discrimination is not only unfair nut also a loss of valuable talent. The combination of different talents in a cooperative and open-minded environment of equality promotes the emergence of new ideas and allows pursuing them to achieve the best results in less time and with reduced effort.

A greater participation of women in aeronautics is not only an enlargement of the workforce in numbers, it is also an enrichment in quality and talent, which are the foundations of inventiveness and competitiveness, on which depend the continuing European leadership in an ever more competitive world with new challengers.

One of the most common preconceptions is that women have a disinclination to science, by her selves or compared with men. In fact, there are countries where the majority of women choose science (Key Topic T11.8) and they are not necessarily the nations rated as most gender equal.

KEY TOPIC 11.8 – WOMEN CHOOSING EDUCATION IN STEM

Portugal leads (Figure 11.32) the list of OCDE countries with the largest number of women attending high education on STEM courses and with career ambitions in these areas.

According to OCDE statistics, 57% of women are already studying these subjects at national universities. The percentage far exceeds the average of 39% among OECD countries. But the analysis of these numbers is far from linear. If there are reasons to celebrate a greater female presence in science, engineering and mathematics courses, in information and communication technologies women are still fewer. Manuel Heitor, the Portuguese Minister of Science, Technology and Higher Education, says that "we have a good job done, but it's not enough. There is still a long way to go in this matter. "

However, there are reasons to celebrate. Not only, Portugal is being able to attract a growing number of women to highly employable courses that were once recognized as "typically male", moving to the much-desired gender parity, as it is at the top of the list, pushing for middle of the table countries like the United States, Germany or France.

According to Minister Manuel Heitor, the OECD conclusions in the study "The Pursuit of Gender Equality", which analyses gender parity in the various countries, "make clear the international recognition that Portugal has today in the areas of science and technology and that is the result of work done over the last 20 years in programs such as Ciência Viva."

Despite this, the Executive member recognises that the battle for the increasing qualification of the Portuguese and the capture of a greater number of women for the STEM areas is not yet concluded in its several fronts. "If it is true that in higher education courses Portugal has more women than most countries, and even in engineering there is already a specialty of clear

female prevalence, the same does not happen in information technology where gender inequality is still great" says the minister. Manuel Heitor gives as an example the areas of digital, where women, "still remain underrepresented in universities and companies in Portugal", he says.

A sub-representation that is larger as we go through the top positions. "Companies in Portugal still limit women's access to leadership positions and career development opportunities", he recognises.

Only four in every ten embark in higher education

While acknowledging the importance of continuing the policy of attracting women to these areas and the continued investment in the development of STEM skills, for the potential for employability they demonstrate, Manuel Heitor has no doubt that the national battle is far from being limited to the gender parity in higher education. "The great battle we have to fight is to extend access to higher education to all," he explains, recalling that "only four out of every 10 young people come to universities in Portugal, and increasing this ratio should be the top priority."

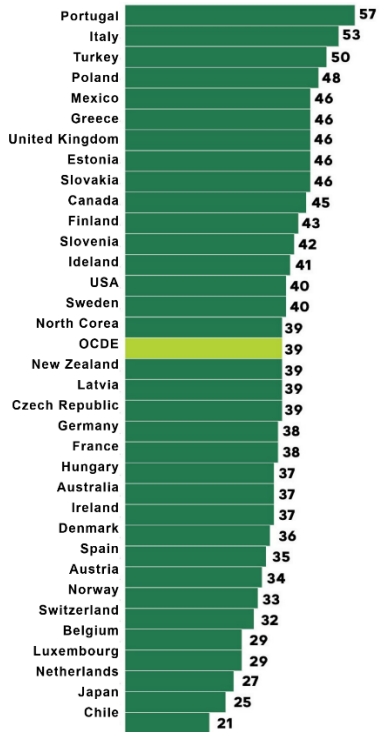

Figure 11.32 – Percentage of women studying in STEM areas

Last year, the OECD's "Education at a Glance 2017" report already warned of this problem by noting that 31% of Portuguese adults aged 25 to 30 did not have the 10th grade completed. A percentage that is double the average of the OECD countries. In older generations, between 25 and 64 years, the percentage of those with no secondary education rises to 53%. In 2016 (data considered by the OECD in the report), only 24% of the Portuguese adult population (between 25 and 64 years old) had higher education. The average of OECD countries was 37%.

Disaggregating the data, we noticed that only 15% of Portuguese university students attended integrated masters (with a minimum duration of five years).

Last year's "Education at a Glance" was already reporting national progress in the presence of women in STEM courses but noted that in the specific case of information technology inequality was all too obvious. The study supported the national increase in the number of graduates in the STEM areas with a higher percentage of graduates in Engineering, since Information and Communication Technologies registered in the last year in Portugal one of the lowest rates of graduates among the OECD countries: 1%.

11.9 Enlargement of a Workforce with Broader Talent

The current dominance of the world aerospace market by two continents (Europe and US) is increasingly challenged by other countries, like BRIC (Brazil, Russia, China and India) with large populations and resources. It is claimed that there are 200 000 university students in aeronautics in China alone, showing how much importance the regime attaches to this sector.

Europe cannot match the number of people in some of the countries that are its main customers and can only sustain its position with smaller number of more talented professionals, that continue to lead the way in basic science and its application in engineering and technology to deliver the goods and services that modern society expects.

The challenge of hard science (STEM – Science, Technology, Engineering and Mathematics) means that there are proportionally less candidates than for soft skills and services. This makes the STEM able professionals the key actors of future prosperity of the aerospace sector in Europe, forming a community in which both genders can contribute equally.

The challenges that women have faced in their professional careers are best demonstrated by the real-life stories of those that distinguished themselves by their achievements is several sectors; a pair of examples is given in 4 areas.

11.10 Examples of Outstanding Women

A – HUMANITIES AND SCIENCE:

- Maria Moliner produced the first literally dictionary of the Spanish language at a time when discrimination was far more severe than today;
- Marie Curie was also discriminated, was more fortunate to receive help from her husband and due recognition during her lifetime.

B – DARING AVIATORS:

- Amelia Earhart was the first woman to fly across the Atlantic with a tragic outcome of an attempt to cross the Pacific Ocean;
- Hanna Reich was the only pilot small enough to fit into the V-1 for the first manned flight tests of this first flying bomb, and carrier out many other dangerous missions during the WW2.

C – WOMEN TEST PILOTS:

- Jaqueline Cohcran held FAI speed records flying the Lockheed F-104 Startfighter;
- Jaqueline Auriol held FAI speed records flying the Dassault Mirage.

D – WOMEN ASTRAUNAUTS:

- Valentina Tereshkova was the first woman astronaut in Soviet times;
- Dava Newman career spans astronaut, MIT professor and NASA deputy administrator.

The achievements of Maria Moliner (Key Topic T11.9) and the challenges she had to overcome (Key Topic T11.10) show the prejudices against women outside the aviation sector. Amelia Earhart daring flights (Key Topics T11.11) contributed to the visibility of women in aviation, consolidated by women astronauts, such as Valentina Tereshkova (Key Topic T11.12) from the Soviet Union and Dana Newman (Key Topic T11.13) from the United States.

KEY TOPIC 11.9 – THE ACHIVEMENTS OF MARIA MOLINER

Maria Moliner produced the first literary dictionary of the Spanish language at a time when discrimination was far more severe than today. The novelty and scope of such a huge task provoked both admiration and envy. She followed her great passion for words to compose a "divergent", revolutionary and innovative dictionary, which was unusual for that time, including among them foreign ones, colloquial usage, slang and acronyms not contemplated in the academic dictionary of the Spanish Royal Academy. The "Diccionario de uso del español" represents her enormous task, but it was not her only one.

Maria Moliner was born in Paniza, Saragossa in 1900 and died in Madrid in 1981. She graduated from the Faculty of Philosophy and Arts, History Section, University of Saragossa in 1921 with a special award. She belonged to the generation of the first women university graduates in Spain who pursued a profession. In fact, in 1922 she passed the state examination to enter the Association of Faculty Archivists, Librarians and Archaeologists. She worked as a public sector employee in this association until 1970.

Maria Moliner is considered as a pioneering figure in librarianship in Spain only when the democracy has been restored in this country. In her early adulthood she dedicated herself mainly to the reorganization of Spain's system of public libraries and to the boost she gave to such libraries, understood that this was the way to give a brief of hope in a rural Spain that was largely illiterate.

Her works and goals were to disseminate culture and literacy. During the dark period of the Second Republic, followed to the Civil War, the ideals of democracy and equal opportunities were subject to oppression and ostracism.

Maria Moliner dedicated herself to the cause of disseminating culture with her outstanding intuition that this would be the right way to mitigate the injustice, irrationality, and misery of a Spain. Moliner alone undertook the enormous task of editing an extremely important book, the famous dictionary that bears her name. This attitude and efforts came from her fascination, passion and interest in linguistic expression and grammar derived from a Spanish cultural historian, philologist and literary critic, Americo Castro, who challenged some of the prevailing notions of Spanish identity.

KEY TOPIC 11.10 – THE CHALLENGES OF MARIA MOLINER

1. Life

María Moliner was born in Paniza (Zaragoza, Spain) on March 30, 1900 within a family composed by the doctor Enrique Moliner Sanz and Matilde Ruiz. Her parents moved to Almazán (Soria) in 1902 and then almost immediately to Madrid. In the capital city, María Moliner studied at the Free Education Institution. In 1912, her father travels to Argentina as a Navy doctor but never returns, a fact that deeply marked María. The family circumstances forced her to collaborate in family maintenance from very young. She continued her baccalaureate studies at the General and Technical Institute of Zaragoza. After that, she graduated from the faculty of Philosophy and Arts, History section at the University of Zaragoza in 1921 with an outstanding qualification and an extraordinary award. In 1922, she passed the state examination to enter the Association of Faculty Archivists, Librarians and Archaeologists. It was the sixth woman who entered in the Association. In 1923, she obtained her first posting in the Simancas Archive in Valladolid, Spain. After that, she requests the transfer to the National Historical Archive but she did not achieve it. However, she obtained a post in Murcia, in the Archive of the Treasury Department. In 1925, she married Fernando Ramón y Fernando, a physics professor, with whom she had four children. At the beginning of the 1930s, the family moved to Valencia: Fernando to the Faculty of Sciences and María transferred there by the Treasury Department.

The period in Valencia was a high point in Moliner's life, both personally and professionally. In the professional sphere, she became fully involved in cultural enterprises that reflected the spirit of the Second Republic. Moliner taught grammar and literature at the Cossío School and was a member of the governing board and secretary of the Friends' Association. She was involved in the organization of popular libraries, public libraries today). She also managed the library at the University of Valencia (1936-37), where her husband was a lecturer, as well as the Office for Book Purchases and International Exchanges. She undertook teaching duties at the Free Education Institution, and during the Second Republic, she introduced a ground-breaking system of rural libraries. Once war broke out in 1936, she found ways of sending books to soldiers in the front line. After the war was over, she and her husband both suffered reprisals: she was dropped eighteen places on the promotion scale, and he was suspended from his job without pay for three years (they would both be reinstated years later). In 1946, they moved to Madrid with their four children, and she became head librarian at the capital's Higher Technical School of Industrial Engineers.

Moliner dedicated these years, in which she was not involved in the major decision-making spheres of either politics or culture, to the mammoth task of compiling a dictionary of Spanish usage, which is acknowledge throughout the world as a vital tool for this language.

Nevertheless, her candidature to the Spanish Royal academy in 1972 was rejected. If she had been accepted, she would have been the first woman to join the academy.

It was in her early adulthood that she dedicated herself mainly to the reorganization of Spain' system of public libraries and to the boost she gave to such libraries, understood to be centres of literacy and cultural dissemination in a rural Spain that was largely illiterate.

In 1975, she was diagnosed a cerebral arteriosclerosis and she finally died on January 22, 1981.

In the following points, it is included the achievements that she reached throughout her life as well as the challenges that she had to overcome.

2. Challenges

- In 1912, her father travels to Argentina as a Navy doctor but never returns, a fact that deeply marked María;
- From very young, she was forced to collaborate in the family maintenance due to the family circumstances;
- María Moliner was part of a generation of pioneers who accessed the University as a result of the 1910 decree and, for that reason, she had to compete in a world of men;
- After the Civil War was over, she and her husband both suffered reprisals: she was not allowed to hold leadership posts, and he was suspended from his job without pay for three years.
- During the Franco's dictatorship, she was barred from taking part in Spanish politics and cultural policy, losing her professional category. She did not fully recover it until 1965.

3. Achievements

- In 1921, she graduated from the faculty of Philosophy and Arts, History section at the University of Zaragoza with an outstanding qualification and an extraordinary award;
- In 1922, she was the sixth woman who entered in the Association of Faculty Archivists, Librarians and Archaeologists;
- On the one hand, she obtained her first posting in the Simancas Archive in Valladolid in 1923 and, on the other hand, she obtained her second post in the Archive of the Treasury Department in Murcia in 1924;
- In 1931, she ascended to the maximum category of the Faculty Corps and began to manage the Valencia Archive;
- In 1933, she was appointed a member of the Valencian delegation of the education trust, the Patronato de Misiones Pedagógicas. In addition, she was commissioned for the organization of rural libraries;
- In 1935, she participated in the creation and development of the Cossío School and managed the School Library in Valencia;
- In 1936, she was appointed Director of the Valencia University Library and occupied several positions in the Central Board of Archives, Libraries and Art Treasury;

- In 1937, Moliner published the "Instructions for Attending to Small Libraries" and she assumed a new responsibility: the direction of the Office for Book Purchases and International Exchanges;
- In 1946, she moved to Madrid where she incorporate to the Higher Technical School of Industrial Engineers;
- In 1966/67, the first edition of the Dictionary of Spanish usage was published by the Gredos Publishing House in two volumes;
- Numerous libraries in Spain bear María Moliner's name, as does a prestigious award funded by Spain's Ministry of Culture for projects encouraging reading in small local, rural, public libraries.

KEY TOPIC 11.11 – THE DARING FLIGHTS OF AMELIA EARHART

The 20th century marked a positive change for aviation in general and for women in aviation as in another field. In fact, in 1930s, America women power started to be in more demand and the fledging air transportation industry began to see the advantage of women in aviation and as a passenger to keep the aircraft industry running. Furthermore, women were encouraged to educate themselves for engineering. As an examples Boeing Air Transport hired the industry's first stewardesses. It is worth to mention that a major breakthrough for women followed in 1934 when Helen Richey was hired as a pilot for Central Airlines. Unfortunately, her employment lasted only a few months because of pressure from male airline pilots.

Looking deeply in the past, although women have flown since 1908, and give a great contribution in aviation and in women consideration only in 1930, nearly all of them were restricted to general aviation such as private planes or support jobs. Thanks to their efforts, leading women pilots also took part in the development of commercial air travel by writing articles and giving speeches on the safety, convenience, and even luxury of air travel. Among those women, Amelia Earhart is the most-known one, even if she was not the pioneer female pilot (before America had a notable number of other memorable female pilots), which gained international attention. Earhart's fame grown immediately after her first achievement. She was the first woman to cross the Atlantic by air as a passenger.

Furthermore, she defined for the decade what women pilots were trying to prove: ***Flying is safe, and women make good pilots***. The Hollywood film Amelia, 2009 has increased her notoriety to the vast public.

Her life was dedicated to improving the women's self-confidence, not only in aviation field. Her outstanding experiences and dissemination brought her global fame and charm, persisting still today as an icon to women. In addition to her flying, Earhart served as president of the NinetyNines, vice president of the National Aeronautic Association, assistant general traffic manager of Transcontinental and Western Air, and a member of the Guggenheim Committee for Aeronautical Education in Primary and Secondary Schools. During her life, she wrote best-selling books and popular columns about her experiences, endorsed commercial products, and lectured in the aviation department at Purdue University in 1935. She performed aviation records at a time when there were hardly any female pilots bring the women freedom and capable to perform the same duty and mission, even better than men.

Amelia Earhart was born on July 24, 1897 in Kansas. She grew up "here and there" spending her youth moving between Kansas, Iowa and Canada - due to the continuous changing's job of her father. She entered in Chicago High School where she graduated in 1915 and entered college in 1916, attending the Ogontz College in Rydal, Pennsylvania. In 1918, Amelia spent the Christmas time, visiting her sister in Toronto and she was very affected by a "tragic" view; the sight of four wounded soldiers walking on crutches together down the street. Amelia decided not to stay and graduate in Ogontz School, but to move to Toronto and join in the war effort. She became a Voluntary Aid Detachment nurse at the Spadina Military Convalescent hospital in Toronto, caring for wounded World War I soldiers. Many of the patients at the hospital where she worked were pilots. In 1918, she attended her first flying exhibition while serving as a Red Cross nurse's aide in Toronto, Canada.

In early 1919, she enrolled at Colombia University in New York entered in the premedical program. Furthermore, she took her first flight in California in December 1920, with veteran flyer Frank Hawks, and declared, "As soon as I left the ground, I knew I myself had to fly." In 1921, Earhart passed her trials for a National Aeronautic Association license and she participated in exhibition flying at the Pacific Cost Ladies Derby at the Sierra Airdrome in Pasadena and she bought her first airplane, a Kinner Airster.

In 1922 she performed her first aviation record, obtained a women's altitude record of 4,267 meters (14,000 feet), at Rogers Field. Amelia was among the first score of women received the FAI certificates. On May 16, 1923 Amelia was issued certificate number 6017 by the FAI becoming the 16th woman to receive an official Fédération Aéronautique Internationale pilot license. By the end of 1923 Amelia had accumulated almost 300 solo flight hours and became the first woman which had ever fly higher before.

In 1928 Amelia received an exciting offer. The Captain Hilton H. Railey, asked her if she would like to be the first woman to fly across the Atlantic. Amelia enthusiastically agreed to this adventure. The Table 11.5 lists some major records set by Amelia Earhart:

Amelia Earhart Record Setter
1922 — Feminine altitude record of 4,267 meters (14,000 feet).
1928 — First woman to fly across the Atlantic as a passenger in the Fokker F.VII *Friendship*.
1929 — Feminine speed record
1930 — Feminine speed record
1931 — First woman to fly an autogiro
1931 — Autogiro altitude record of 5,612 meters (18,415 feet).
1932 — First woman (and only the second person) to fly solo and nonstop across the Atlantic. Also first person to cross the Atlantic twice by air
1932 — First woman to fly solo and nonstop across the United States.
1933 — Reset her transcontinental record.
1935 — First person to fly solo from Honolulu, Hawaii, to the U.S. mainland (Oakland, California)
1935 — Speed record between Mexico City and Washington, D.C. **1935** — First person to fly solo from Mexico City to Newark, New Jersey.

Table 11.5 – List of Amelia Earhart Record Setter.
(Source: https://airandspace.si.edu/explore-and-learn/topics/women-in-aviation/earhart.cfm)

Amelia did not try to make any money from her flying. She considered it not only a sport, a passion, a dream, but also a way where women can find the freedom which they are seeking. She tried to demonstrate that women could learn to fly as quickly as men, obtaining same results and progresses in all fields. She was truly an inspiration to women, her attitude toward success and failure outlined in the following quote, "Women must try to do things as men have tried. When they fail, their failure must be but a challenge to others." Earhart's goal was proving that flying is safe and that women make good pilots. She was constantly training, learning, writing, and prone to divulgate her experience with a key message for all the women. Thanks to these outstanding features and her perseverance she realized ones of her goals: on 21-22 May 1932, Amelia Earhart pilots this Lockheed Vega 5B (Figure 11.33) in a solo flight across the Atlantic from Newfoundland to Ireland, and nonstop across the United States, both first for a woman. This flight made her the first person to fly across the Atlantic twice. Because her flight was five years to the day after Lindbergh's and because there was a perceived physical resemblance between them, Amelia's nickname was "Lady Lindy.

Figure 11.33 – Amelia Earhart's Lockheed Vega 5B.
(Source: https://airandspace.si.edu/collection-objects/lockheed-vega-5b-amelia-earhart)

During her aviation career, Earhart wrote books and articles endorsing automobiles and other products, driving women to encourage their husbands to fly instead of driving or taking a train on business trips, and suggesting that flying was the best method of travel for a family vacation. By this way she helping airlines promote travel to female passengers and improvement in industry. Furthermore, she is designing women's clothing and luggage, launched a fashion house to manufacture and market clothing designed by her, opening her first shop in New York.

In 1935 Amelia became the first person to fly solo across the Pacific Ocean from Hawaii to California. This was also the first flight in which a civilian aircraft carried a two-way radio. In the same year, she became the first person to fly solo from Los Angeles, to Mexico City. Amelia testified before the U.S Senate regarding plans to place aviation under control of the Interstate Commerce Commission.

During 1936 and 1937, Earhart formed a close alliance with Purdue University and became a visiting professor stared as a part-time career consultant in the Counsellor in Careers for Women which represented the culmination of her career, where she could share her

philosophies with young women. She continued her job at Purdue, serving as a part-time career counsellor for women and an advisor in aeronautics.

In 1936, Amelia was honoured by women geographers and she illustrated before a Senate sub-committee on air safety. That same year she acquired a Lockheed Electra 10E airplane, financed by Purdue University. With her new airplane, she started planning for a flight around the world at the equator. Earhart used the aircraft, which had a ceiling of 27,500 feet, to test and observe human reaction to flights at high altitudes. In fact, in 1937, Earhart began her round – the – world flight at the equator in Oakland, California and set a new record for fastest east to west (Oakland to Honolulu) travel in 15 hours and 47 minutes in March. A second round-the-world attempt started, departing from Miami, and traveling form west to east. After completing 22,000 miles of the flight, Amelia route to tiny Howland Island, losing radio contact with U.S. Her disappearance on July 2, 1937, while trying to land on tiny Howland Island in the Pacific Ocean, came as she attempted to set a spectacular new record—a circumnavigation flight near the equator. Amelia Earhart was declared legally dead in superior court in Los Angeles, CA on January 1939.

In Figure 11.34 is depicted Earhart in the cockpit of her Electra plane in 1937, not long before her disappearance at the age of 39 on an attempted circumnavigation flight.

Figure 11.34 - Earhart in the cockpit of her Electra plane in 1937.
(Source: Beyond Amelia Earhart: Teaching about the History of Women Aviators. OAH Magazine of History, July 2010 (Courtesy George Palmer Putnam Collection of Amelia Earhart Papers, Purdue University Libraries))

Amelia Earhart succeeded well in her dual goals—the air transportation industry and women pilots.

Nowadays, women have gained full access to military and commercial cockpits, Space Shuttle and aerospace technology as well. The website of the Smithsonian's National Air and Space

Museum (http:// www.nasm.si.edu/research/ aero/women aviators/womenavsp.htm) is dedicated to review the history of female pilots and highlight the growing contributions of woman in that sector (Figure 11.35):

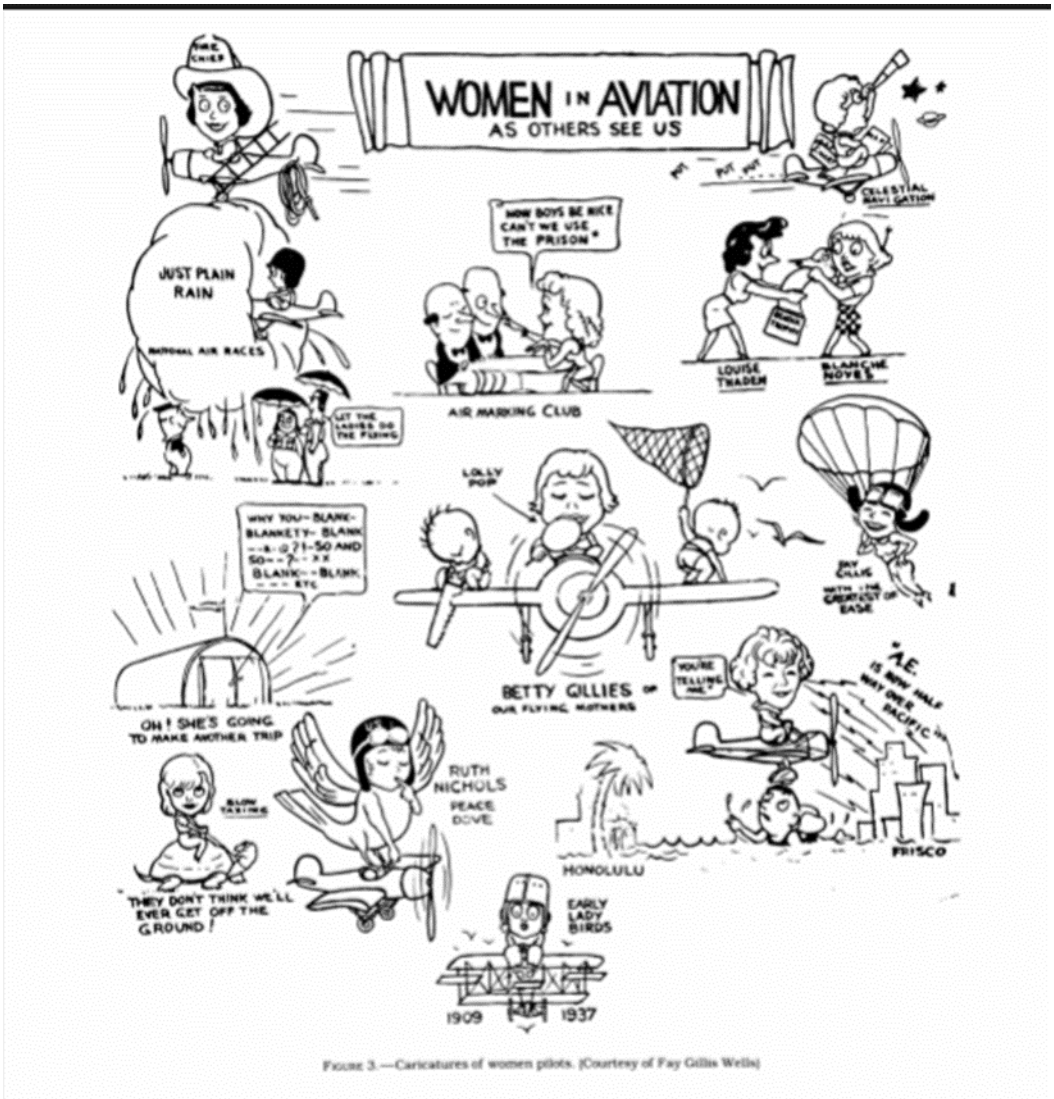

FIGURE 3.—Caricatures of women pilots. [Courtesy of Fay Gillis Wells]

Figure 11.35 – Women in aviation

KEY TOPIC 11.12 – VALENTINA TERESHKOVA

Figure 11.36 – Valentina Tereshkova as astronaut

Valentina Vladimirovna Tereshkova (Figure 11.36) was the first woman to go into space. She is the only woman in the world who made a space flight alone. In 1963, she spent almost three days in space and orbited Earth 48 times in her space capsule, 'Vostok 6'. That was her only trip into space. Tereshkova later toured the world to promote Soviet science and became involved in Soviet politics.

After Yuri Gagarin became the first man in space in 1961, Tereshkova volunteered for the Soviet space program. Although she did not have any experience as a pilot, she was accepted into the program because of her 126 parachute jumps. At the time, cosmonauts had to parachute from their capsules seconds before they hit the ground on returning to Earth.
[https://www.space.com/21571-valentina-tereshkova.html]

In choosing Tereshkova for the role of the first woman-cosmonaut, in addition to the successful completion of training, the ability of the candidate to conduct active social activities was also taken into account, to appear in public on numerous trips around the country and the world.

Valentina Tereshkova easily communicated with journalists and other people, gave laconic and natural answers to questions.

In 1968-1987, Valentina Tereshkova headed the Committee of Soviet Women. In 1969, Vice-President of the International Democratic Women's Federation, a member of the World Peace Council.

In 1987-1992, she was a Chairman of the Presidium of the Union of Soviet Societies of Friendship and Cultural Relations with Foreign Countries. In 1989-1992, she was a People's Deputy of the USSR from the Union of Soviet Societies of Friendship and Cultural Relations with Foreign Countries and the 'Rodina' Society.

In 1992, the Chairman of the Presidium of the Russian Association for International Cooperation. In 1992-1995, First Deputy Chairman of the Russian Agency for International Cooperation and Development. In 1994-2004, the Head of the Russian Centre for International Scientific and Cultural Cooperation.

In 1983, a commemorative coin with the image of Valentina Tereshkova was produced - she became the only Soviet citizen whose portrait was in life placed on Soviet coins.

Tereshkova remains active in the space community, and her legacy is widely celebrated in everything from books to museums to stage productions.

In 2017, London's Science Museum opened a temporary exhibit called "Valentina Tereshkova: First Woman in Space," which celebrated her contributions through artefacts as well as photographs (Figure 11.36 to 11.38).

[https://www.space.com/21571-valentina-tereshkova.html]

Figure 11.37 – Valentina Tereshkova with decoration

After her flight, Valentina Tereshkova no longer flew into space. She became an instructor-cosmonaut, worked in the Cosmonaut Training Centre as a senior research fellow, even graduated from the Zhukovsky Air Force Engineering Academy, becoming a candidate of technical sciences, professor and writing over five dozen scientific papers.
Valentina Tereshkova now.

Figure 11.38 – Valentina Tereshkova now

81 year of her life Tereshkova celebrated on March 6, 2018. She is a retired Major General, spends a lot of time with her family, and also continues to pursue a political career. So, in 2016 during the next parliamentary elections Tereshkova was elected a deputy of the State Duma of the Russian Federation. The first woman cosmonaut is very fond of her native region, strives to help Yaroslavl orphanage, native school, to improve the city and help to open new educational, production and infrastructure facilities in it.

KEY TOPIC 11.13 – DANA NEWMAN

She was born in 1964. She is a former Deputy Administrator of NASA. She is also the Apollo Program Professor of Aeronautics and Astronautics and Engineering Systems at the Massachusetts Institute of Technology and a Harvard–MIT Health, Sciences, and Technology faculty member in Cambridge, MA. She is a MacVicar Faculty Fellow (awarded for contributions to undergraduate education), former Director of the Technology and Policy Program at MIT (2003–2015), and former Director of the MIT–Portugal Program (2011–2015).

Figure 11.39 – Dana Newman now

As the Director of MIT's Technology and Policy Program (TPP), she led the Institute's largest multidisciplinary graduate research program. She has been a faculty member in her home department of Aeronautics and Astronautics and MIT's School of Engineering since 1993.

In the following points, it is included the achievements that she reached throughout her life as well as the challenges that she had to overcome.

Achievements

- Investigating human performance in varying gravity environments
- She was the principal investigator on four spaceflight missions
- She was a Co-Investigator on the Mental Workload and Performance Experiment (MWPE) that flew on STS-42 to measure astronaut mental workload and fine motor control in microgravity
- She also developed the MICR0-G space flight experiment to provide a sensor suite and study human adaptation in extreme environments
- She was the MIT Principal Investigator on the Gravity Loading Countermeasure Suit, or Skinsuit, which flew the International Space Station as an ESA technology demonstration from 2015 to 2017
- She is the author of Interactive Aerospace Engineering and Design, an introductory engineering textbook, has published more than 300 papers in journals and refereed conferences, and holds numerous compression technology patents

Challenges

- Promoting the development of space activity suits, namely the BioSuit;
- Sending American astronauts to Mars in the 2030s;
- NASA teams are doing some of the most impressive work anywhere on Earth to support exploration, discovery, and technology off of it;
- Reach for new heights, and work to expand humanity's presence in the solar system while strengthening America's leadership here on Earth;
- On the ground, astronauts will be expected to explore extreme environments like the Olympus Mons, a volcano the size of Arizona that's nearly three times the height of Mount Everest;
- They also developed a custom robot that can simulate a full range of human movement and withstand the uncomfortable prodding required to ensure a proper fit.

Figure 11.40 - Female astronaut spacesuit designed by Dava Newman

Suits will need to be easier to don and doff, provide greater freedom of movement, and be comfortable for long haul journeys. Newman's solution is called the BioSuit and looks a bit like a superhero's costume, but it's actually just a form-fitting math problem.

In order to survive in the vacuum of space, human bodies require pressure. EMUs[6] solve this problem by creating a pressurized vessel, sort of like a mini airplane cabin. By contrast, the BioSuit employs semi-rigid ribs traced across the body to provide mechanical counter pressure while letting the wearer retain a full range of movement.

[6] The Extravehicular Mobility Unit (EMU) is an independent anthropomorphic spacesuit that provides environmental protection, mobility, life support, and communications for astronauts performing extra-vehicular activity (EVA) in Earth orbit.

Gold fibres are woven through the outfit and paired with biometric sensors to collect data that helps mission control keep tabs on the crew. The snug units protect astronauts, provide greater freedom of movement and more physically taxing experiments.

Beyond its good looks, the BioSuit will also be safer. If a micrometeorite or piece of space junk pierced an EMU, the suit would rapidly depressurize, leaving the astronaut out of luck in outer space, but the BioSuit could be patched with next-gen duct tape.