ATTENTION OF WOMEN AND YOUNG TALENT TO AERONAUTICS

Ana Costa (1), Daniela Geraldes (2), Filipa Manaia (3), Joana Soares (4), Quaiela Costa (5)

(1) INOVA+ | Innovation Services S.A., Rua Dr. Afonso Cordeiro 567, 4450-309 Matosinhos, Portugal, ana.costa@inova.business
(2) QSR | Quasar Human Capital, Rua Barão Sabrosa, nº 217, 1900 - 090 Lisboa, Portugal, dgeraldes@qsr.consulting
(3) QSR | Quasar Human Capital, Rua Barão Sabrosa, nº 217, 1900 - 090 Lisboa, Portugal, fmanaia@qsr.consulting
(4) INOVA+ | Innovation Services S.A., Rua Dr. Afonso Cordeiro 567, 4450-309 Matosinhos, Portugal, joana.soares@inova.business
(5) INOVA+ | Innovation Services S.A., Rua Dr. Afonso Cordeiro 567, 4450-309 Matosinhos, Portugal, quaiela.costa@inova.business

KEYWORDS: aviation, skills shortages, gender balance, STEM, gender mainstreaming, social cognitive career theory

ABSTRACT:

The aviation sector is being affected by skills shortages, which is getting worse with the rapid sector’s growth and the current wholesale retirement, whereas the sector is having a hard time making young people want to join. The implementation of interventions that could enable substantial and sustainable changes regarding the increase of young talent (particularly women) is a priority.

Academic and/or career choices of young people are influenced by several factors and form gradually more consciously from childhood to adulthood. Therefore, interventions should start at an early life stage and consider factors that help to identify and understand the reasons why students pursue a university course.

This emphasizes the importance and need to implement changes in the educational context that can increase the interest of young people (in particular women) mainly related to the increase of awareness of education and career opportunities, social support and influences in childhood, among others.

CONCEPTUAL FRAMEWORK

1. INTRODUCTION

The aerospace sector seeks to attract and retain young talent and women for its future and growth, not only to face the gender imbalance (that generally affects the transports sector) but also due to the current global shortfall in the numbers of qualified employees that is imposing huge pressures on employers to recruit the greatest number of qualified employees (mainly pilots, mechanics and top managers that nowadays are still traditionally male-dominated areas).

Thus, greater participation of women and young talent in aeronautics is not only an enlargement of the workforce in numbers, but 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 challenges.

The combination of different talents in a cooperative and open-minded environment of equality also promotes the emergence of new ideas and allows pursuing them to active the best results in less time and with reduced effort.

The career inclinations of young people in general begin with a range of factors that influence their choices and can form gradually more consciously from childhood and primary school, through teenage and secondary school, to adulthood and university, with the influence of educators and the
natural family. When considering the importance of the gender in the sector, in fact there are several factors that influence the participation of women in Aerospace: the women interest in the aerospace sector and the women’s self – confidence in STEM (Science, Technology, Engineering and Mathematics) subjects; the educational context, specifically the gender stereotypes that women are exposed to and the employment opportunities and labour conditions and practices for women.

Considering these factors, the implementation of interventions that could enable substantial and sustainable changes regarding the increase of young talent and women interest and involvement in the aerospace sector are required. Despite that, it’s important to emphasis the process of attracting young talent and women to the sector, revising the cognitive process behind the career choice (Social Cognitive Career Theory) and the school practices and policies toward STEM disciplines nowadays, as also possible changes to reframe the difficulties of the Aerospace workforce.

2. SKILLS SHORTAGES

The aerospace is not a gender balanced sector, thus being a consequence - albeit not exclusively - of the existing gender stereotypes in education as such the factors that affect the professional career of women which may not be too apparent in childhood but may have effects in secondary school and university.

According to the EIGE Study and Work in the EU report, gender segregation narrows life choices, education and employment options, leads to unequal pay and limits access to certain jobs while also perpetuating unequal gender power relations in the public and private spheres. Also, it is one of the reasons behind skill shortages and surpluses and thus has large, though often still unaccounted for, effects on numerous policy initiatives, including those to stimulate economic growth and to reduce long – term unemployment.

Policymakers have long ago recognized the need to eliminate occupational segregation, by promoting the participation of women in jobs that are men – dominated. They can contribute to the achievement of gender equality in STEM by an effective gender mainstreaming.

According to the EIGE, gender mainstreaming is a strategy towards realising gender equality and combating discrimination that involves the integration of a gender perspective into the preparation, design, implementation, monitoring and evaluation of policies, regulatory measures and spending programmes. As policies focuses on the general public, they often impact women and men differently. Therefore, this strategy is fundamental to ensure that policymaking and legislative work is of higher quality and responds more effectively to the needs of all citizens.

Gender mainstreaming has two dimensions: (1) it requires both the integration of a gender perspective within the content of the different policies (gender – responsive content of each policy); and (2) the addressing of the issue of representation of women and men in a given policy (gender representation in a policy area). Both dimensions need to be taken into consideration in all four phases of the policymaking process. A brief description of each phase of the gender mainstreaming cycle, as well as the methods and tools that should be used within each phase are presented below (Tab. 1).

| METHOD / TOOL | DESCRIPTION |
|---------------|-------------|
| **1st Phase - Define:** defining the precise policy needs to be addressed by the public intervention in a specific policy field | |
| Gender statistics | Statistics that adequately reflect differences and inequalities in the situation of women and men in all areas of life. Statistics Databases:  |
| | • EIGE’s Gender Statistics Database; |
| Gender analysis | Critical examination of how differences in gender roles, activities, needs, opportunities and rights affect women, men, girls and boys in a given policy area, situation or context. Frameworks:  |
| | • Harvard Analytical Framework;  |
| | • Moser Conceptual Framework;  |
| | • Levy conceptual framework;  |
| | • Capacities and vulnerabilities approach (CVA);  |
| | • Social relations approach;  |
| | • Gender analysis matrix framework;  |
| | • 4R Method; |
| **METHOD / TOOL** | **DESCRIPTION** |
|------------------|----------------|
| Gender impact assessment | Assessment of the impact or effects of any policy of activity implemented to the state of equality between women and men. Toolkit:  
- EIGE Gender Impact Assessment Guide; |
| Gender stakeholders consultation | Consultation of gender experts, women’s organizations and other civil society organizations on the topic at hand to share and validate findings and improve the policy or programme proposal. Tools:  
- Online surveys;  
- Town-hall meetings;  
- Focus group discussion;  
- Individual Interviews;  
- Nominal group technique;  
- Delphi survey; |
| **2nd Phase - Plan:** planning the implementation phase of policies or programmes from a gender perspective | |
| Gender budgeting | Gender – based assessment of budgets, incorporating a gender perspective at all levels of the budgetary process and restructuring revenues and expenditures in order to promote gender equality. Tools:  
- Ex ante gender impact assessment;  
- Gender perspective in performance setting;  
- Gender perspective in Resource Allocation; |
| Gender procurement | Introduction of gender equality requirements in public procurement, this is, in the subject of the contract itself. |
| Gender indicators | Tools for monitoring gender differences, gender-related changes over time and progress towards gender equality goals. Indicators can be quantitative (based on statistics broken down by sex) or qualitative (based on women’s and men’s experiences, attitudes, opinions and feelings). |
| **3rd Phase - Act:** ensuring that all who are involved are sufficiently aware about the relevant gender objectives and plans | |
| Gender equality training | Any educational tool or process that aims to make policymakers and other actors in the EU and MS more aware of gender equality issues, build their gender competence and enable them to promote gender equality goals in their work at all levels. Toolkit:  
- EIGE Gender Equality Training Guide; |
| Gender – sensitive institutional transforming | Process that aims to integrate gender equality into the regular rules, procedures and practices of an institution, leading to its transformation of an institution, thus also impacting on the organisational culture. Toolkit:  
- EIGE Gender Institutional Transforming Guide; |
| Gender awareness-raising | Increasing general sensitivity, understanding and knowledge about gender (in)equality, through the use of different communication channels, such as: large-scale media; social media and social networks; public events; printed materials; static and travelling exhibitions and display; and political advocacy and lobbying. |
| **4th Phase - Check:** monitoring ongoing work and evaluating both ongoing and ex post work | |
| Gender monitoring | Systematic and objective assessment of the design and planning (objectives, results pursued, activities planned), the implementation and results of an ongoing activity, project, programme or policy from a gender perspective. To build up a gender sensitive monitoring set of indicators, each dataset should be disaggregated by sex. |
| Gender evaluation | Systematic and objective assessment of the design and planning (objectives, results pursued, activities planned), the implementation and results of an ongoing or completed activity, project, programme or policy from a gender perspective. Widely used evaluation criteria are: relevance, efficiency, effectiveness, impact and sustainability. |

Table 1 - Gender mainstreaming phases, methods and tools.

As a matter of fact, according to the EIGE Study and work in the EU Report, in ten years (2004 – 2015), women’s share among STEM graduates in the EU has fallen from 23% to 22%. However, gender segregation is much stronger in vocational (technical) than in tertiary education in almost all EU countries. Overall, only 13% of EU graduates from STEM vocational education are women, whereas 32% graduate from STEM tertiary education.

Among these female graduates, only one third work in STEM occupations, compared to one in two
men. Among vocational education graduates, the gap is even greater, with only 10% of women but 41% of men working in STEM occupations. Among those moving away from STEM, 21% of women at the tertiary education level work as teaching professionals and 20% of women with vocational STEM education work in sales.

The EIGE Study and work in the EU report also demonstrates that the chances of employment for women graduating from male-dominated files of education are significantly lower than those of men. In 2014, the employment rate of women graduates in STEM at tertiary level was 76% in the EU, which is more than 10 percentage points lower than the average employment rate of women with tertiary education.

In accordance with the studies, since girls are significantly under-represented in STEM subjects at school, at university and consequently in working life, there is potential talent among girls not being fully exploited, which could help fill skills shortages existing in STEM-related occupations.

3. PROMOTING THE ATTRACTION OF WOMEN AND YOUNG TALENT TO THE AERONAUTICS

3.1. Academic and career choices (Social Cognitive Career Theory)

Academic and career choices, as the factors that influence them, can be explained by the Social Cognitive Career Theory (SCCT). According to the Social Cognitive Career Theory, the career and/or academic choices of young people are influenced by personal, cognitive and contextual factors and form gradually more consciously from childhood and primary school, through teenage and secondary school to adulthood and university, as proposed by the Life Span Theory. Therefore, to attract young talent to the aerospace sector, we may start at an early life stage and always keep in mind the factors from SCCT that help identify and understand the reasons why students pursue a university course: prior experience, social support, self-efficacy, and outcome expectation.

Social Cognitive Career Theory (SCCT) is a recent career theory that intends to unify common elements from previous career theorists, such as Super, Holland, Krumboltz, and Lofquist and Dawis, in order to create one framework to understand the (1) development of vocational interests, (2) making (and remaking) occupational choices, and (3) achievement of varying levels of career success and stability.

According to SCCT, three social cognitive variables play a significant role in vocational development: self-efficacy, outcome expectations, and goals. SCCT has guided some of the inquiry on the pursuit (or avoidance) of science, technology, engineering, and mathematics (STEM) activities and academic majors. Findings indicate that individual SCCT variables, for instance, self-efficacy, are good predictors of STEM interests, goals, persistence, and performance.

SCCT proposes that a wide range of individual and environmental factors contribute to a person's learning experiences that serve as a basis for developing self-efficacy and outcome expectations. According to Soldner, Rowan-Kenyon, Inkelas, Garvey, & Robbins (2012, p. 314) self-efficacy are beliefs about one's own personal capabilities, which are hypothesized to affect academic and vocational decision-making by attenuating the judgments a student makes about his or her likelihood of surmounting obstacles that may lie in the path leading to attaining the desired career. Outcome expectations, or a person's anticipated results of performing one or more certain behaviors, shape vocational development differently. Positive future expectancies are hypothesized to motivate individuals to look past proximate situations, particularly challenging ones so that they can maintain focus on the attainment of long-term desires. These self-efficacy and outcome expectations, individually or in concert, lead to the generation of interests and goals. Goals are the intentions to engage in a given activity. Therefore, according to Rogers and Creed (2010, p. 163) "in turn, these social cognitive variables stimulate career choice actions (...) such as career planning and career exploration, which are necessary for the young person to make progress towards identified career goals". Moreover, immediate environmental influences, such as social support and career barriers, can also affect self-efficacy’s influence on an individual's interests, goals, and performance.

Self-efficacy has been identified as a major influence on student performance and persistence. Among students in STEM programs self-efficacy beliefs have been found to influence academic performance (e.g., mathematics) and key indicators of academic motivation, including choice of activities and goals, persistence (e.g., graduation rates), and positive emotions. Self-
Efficacious students participate more readily, work harder, persist longer, and have fewer adverse reactions when encountering difficulty than students who doubt their capabilities. Hackett and Betz (1981) further proposed that self-efficacy has additional positive effects on educational and career decision-making, an assertion supported by research by findings from Multon, Brown, and Lent (1991) showing self-efficacy to predict both college-major choices and academic performance.

Some changes can begin in the curriculum and pedagogies, to increase students' opportunities to learn and practice STEM topics necessary to perform tasks successfully and ensure student's mastery experience, one source of self-efficacy on STEM.

Consequently, in order to attract women and young talent to the aerospace sector we may ground in Lent, Brown, and Hackett's (1994, 2000a, 2000b) SCCT to examine the manner in which young people develop and elaborate on career and academic interests, select and pursue choices based on interests, and perform and persist in their occupational and educational pursuits on the aerospace sector.

3.2. Education focused on women

EIGE Study and work in the EU Report defends that positive STEM experiences and development of “STEM identities” start from an early age, even before children enter formal education (e.g. in providing caring toys such as dolls for girls and exploring toys such as cars and planes for boys) through family relations (e.g. a strong bond with fathers increases women’s likelihood to enter STEM studies). Two real life examples illustrate the trend.

On the other hand, in the past, separate boys and girls schools tended to put greater influence on girls away from science and technology, because they induced different choices: majority humanities for girls and majority science for boys. Nowadays, the 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.

Therefore, the traditional attitudes of parents, family and school educators towards which toys girls should play and what careers are more suitable for girls can play a big role in the formation of girls’ personalities and self-concept and therefore influence their future career choices. This influences girls and young women are having in their childhood, adolescence and young adulthood from parents, family and educators should be understood as soon as possible. At the same time, this emphasizes the importance of female teachers’ attitudes regarding gender stereotypes and their responsibility in supporting female pupils that are into STEM.

The five biggest factors identified in the report that can sustain girl's interest in STEM subjects and careers are presented in order of importance in Fig. 1.

1. **Female role models**: having visible female role models both in school and at home to help girls to picture themselves pursuing STEM – related careers

2. **Practical experience and hands-on exercises**: gaining practical experience and hands – on exercises during their education – inside and outside the classroom – to increase girl's interest in STEM subjects

3. **Teacher mentors**: having teacher mentors who talk to girls about STEM subjects, clarifying expectations and providing insights, and actively encourage them to pursue STEM subjects

4. **Real–life applications**: being able to conceive what they can do with STEM subjects, how they can be applied to real – life situations and how relevant they might be to their future

5. **Confidence in equality**: being confident that men and women will be treated equally while working in these subjects

*Figure 1 – Five main factors that can sustain girl's interest in STEM subjects and careers.*
Self-confidence is viewed as one of the most motivational factors that influence the ability and attitudes towards science. In particular, women’s low self-confidence in STEM is due to gender-stereotypes in science, i.e., the dominant association of science as masculine (which makes women start doubting they won’t perform some tasks in STEM fields as well as boys) and the existent gender-imbalance in STEM roles (which leads women to fear being treated differently than men and/or feeling they don’t belong). These two factors demotivate women to aspire to STEM careers and make it challenging to see STEM as a potential career choice. But another important factor was “self-efficacy”: the belief that one can succeed in a domain. People tend to approach domains where they feel are competent and avoid those in which they do not. In fact, girls on average had much lower self-efficacy ratings in STEM, despite outperforming boys across school subjects.

In UNESCO Cracking the code report, it is stated that studies have shown that stereotyped ideas about gender roles develop very early in life. It is found that girls and boys often have different toy preferences by the end of the first year of their lives, they understand gender stereotypes and want to behave like others of the same sex by as early as age two, and they learn to adjust their behaviour according to internalised gender stereotypes by age four. Gender stereotypes about STEM specifically are prevalent throughout the socialization process, during which girls learn and develop gender roles.

There are two predominant stereotypes with relation to gender and STEM - “boys are better at math and science than girls” and “science and engineering careers are masculine domains”. Other common pre-conceptions are that “science is for men, not for women” and that women have a disinclination to science, by her selves or compared with men. This dominant association of science as masculine and the fact that scientists are usually described or drawn as males makes it particularly challenging for girls to see STEM as a potential career choice and, on the other hand, may equip boys with easily available and pre-established roles in science and technology. Women are also found to be less likely to aspire to STEM careers due to expectations of feeling less good in contexts with unfavorable gender stereotypes.

3.2.1. Good practices and strategies in education

From the selected initiatives concerning women attraction to the transport sector, several were implemented in educational context, mainly in primary and secondary schools. The following initiatives originated DG MOVE’s 3rd good practice - “Going into schools, colleges and universities” and, even though they were oriented for children in general, they can serve as an inspiration for initiatives to attract girls to STEM subjects:

- ‘Zeebenen in de Klas’ (‘Sea legs in class’): implemented in the Netherlands with the aim of getting children excited about working in the maritime transport. The initiative involved over 300 school visits to 200 schools, interacting with a total of 10.000 children. Each visit consisted in a guest lesson from a ship worker, who tried to convey his/her experience of working in the sector in a fun and inspiring way for children;

- Five employee volunteers from the Raben Group in Poland conducted visits to kindergartens and schools, and together with the local police, talked about safety and the importance of transport. The idea was to “put transport into pupils and children DNA” to be able to draw on their knowledge and potential interest later in their lives.

Also, as said before, the initiative ‘Women in Motion’ (DG MOVE’s 5th good practice - “Showcasing real people as role models”) involved the selection of 80 successful female employees of an Italian rail operator as positive examples of young women working in the rail sector. Afterwards, these women, all under the age of 45, 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. Within this visits, girls had the chance to establish personal contact, ask questions and get more insights about all the different career pathways girls can follow in the rail industry.

Therefore, some measures have been adopted so far in Europe to minimize the existing gender differences, thus influencing girls’ and women’s participation, progression and achievement in in STEM fields. Other examples include:

- Making available on the internet and to primary school’s children stories and cartoons where girls drive cars and fly aeroplanes as much as boys do
and let them play with vehicle models or ask for them as presents;

- Developing a toolkit for primary and secondary school teachers to fight gender stereotypes and raise awareness about transport professions among young people, e.g. including flight experiments equally accessible to boys and girls in the primary and secondary school programmes and activities;

- Identifying good practices on how to organize rosters in the best family friendly way, to be made available to all stakeholders;

- Reinforcing and accelerating visits to universities and industry, role models of success stories and the same fascinating technologies.

These practices should be extended to the university. According to the article “Girl Power” published in 2018 in the Social Sciences open access journal, 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).

Additionally, 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).

The report also defends that 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 (Woodock 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. CONCLUSION

The aviation sector is being widely affected by skills shortages, which are likely to get worse with the rapid sector’s growth and due to the current wholesale retirement whereas is having a hard time making young people want to join. Taking this into account, the implementation of interventions that could enable substantial and sustainable changes regarding the increase of young talent, including young women, in the sector are a priority.

This is particularly relevant since closing the gender gap in STEM would contribute to an increase in EU GDP per capita of 2.2 - 3.0% and would increase total employment in the EU by 850 000 to 1 200 000 jobs by 2050. In monetary terms, closing the STEM gap leads to an improvement in GDP by EUR 610 – 820 billion in 2050.

In fact, and as seen in some reports previously, when we see the share of women in STEM occupations in EU – 27 was less than 15% in 2014 and in ten years (from 2004 to 2015) has only increased one percent. Analysing by country, Bulgaria (26% share of women), Lithuania (21%) and Portugal (21%) had the most balanced STEM workforce while in Luxembourg (10%), the Netherlands (9%) and Austria (10%), the gender segregation was the highest.

To sum up, in order to attract women and young talent to the aerospace and try to solve the discrepancies related in the studies, it’s important to analyse the context and the influences since an early age (SCCT) and, therefore, reorganize the education context, specially for the girls. Some strategies are mentioned and should be implemented in order to maximize the self confidence of the women in STEM, starting in school and obviously continuing, later, in organizations.

Once students are attracted to the STEM area, it should be a priority to reinforce this interest and
make sure that external factors (as the beliefs of the society about girls) wouldn't negatively impact this path.

REFERENCES

1. PARE Deliverable “YR1 – Perspectives for Aeronautical Research in Europe”. Online Version since September 2018.
2. PARE Deliverable “YR2 – Perspectives for Aeronautical Research in Europe”. Online Version since January 2020.