How to improve the research cultural environment

previous

Chapter IV: Presence and Visibility

In this section the direct correlates of a disproportional underrepresentation of women among researcher and scientific staff are debated, which relates to the GENERA's Field of Action “Presence and visibility”. More specifically, the analysis covers the issues of impediments to gender-balanced representation in science found in recruitment practices and advancement procedures, as well as gendered aspects of retention, attrition and visibility in physics and in science in general.

1. Gender bias in recruitment practices

Human resource processes may pose barriers to gender equality if they are vague, gender-neutral or gender-discriminatory. For example, it has been demonstrated that “women are more likely to succeed in recruitment and promotion when there is clarity about what is required, information about the opportunities freely available and clear criteria used in decision-making. These approaches also benefit men, making clear how organizations function and what their values are” (European Commission 2012a: 19). Similarly, women may be deterred from applying for a position “by gender-neutral or gender-discriminatory advertising and job descriptions or be screened out by male-dominated recruitment panels with no or little gender training” (UNDP 2014: 21). Therefore, recruitment policies, processes and mechanisms require careful consideration using a gender equality perspective.

As for physics this requires also understanding why there is more balanced gender representation in some of its subfields than in others. This was the case of radioactivity in the first half of the XX century in Europe (Götschel 2010), nowadays female physicists seem to be more visible in new branches of physical medicine, biological physics and physics education research (Hasse, Trentemøller 2011; Barthelemy, Van Dusen, Henderson 2015; McPhee 2016). To explain this phenomenon it is argued that women can easier pursue scientific career within “not yet rigidly gendered research structures” of emerging branches of physics, as compared with the more well-established subfields of physics (Götschel 2010: 47). At the same time though, it was also demonstrated that women more eagerly than men place themselves in interdisciplinary fields of useful physics, including research that provide opportunities to help others (Hasse, Trentemøller 2011; Barthelemy, Van Dusen, Henderson 2015). These arguments suggest that stronger representation of female scientists in some subfields of physics may be the results of the interplay between structural factors including patterns of recruitment and promotion and women's informed strategies for retention and advancement.

When comparing recruitment practices and employment behavior in Europe, it should be noticed that there are considerable differences, both at national level and between different types of research organizations. As far as the discrepancies between countries are concerned, it is argued, that employment behavior “is the interplay of gender culture, gender order and the behaviour of women within the framework of gender arrangements which influences this behaviour. Cross-national differences in the development of female labour force participation rate, and of the share of women working part-time, can be primarily explained by differences in the cultural traditions between countries. Culture itself does not immediately determine employment behaviour, however, its influence is mediated by the policies of institutions which may lag behind (or progress in front of) cultural change and can itself be contradictory" (Pfau-Effinger 1998: 164). This observation relates fully to the field of science, which is demonstrated in the next section of this paper with the discussion on the various types of scientific cultures in physics that roughly overlaps different European countries. However, the framework conditions for employment, including those regarding pay, differ not only between countries but also between research organizations, including public universities and public research institutes. Moreover, actors involved in negotiation of remuneration also differ according to academic positions (Lipinsky 2014; DG Research and Innovation 2014).

Among the arguments to act towards more balanced gender distribution in science and research there is an empirically-proven observation that mixed-gender groups outperform mono-gender teams (male-only or female-only). Psychologists argue that a group's collective intelligence - understood as the general ability of the group to perform a wide variety of tasks - is positively correlated with the proportion of females in the group (Woolley et al., 2010). A study on teams in global companies revealed that "the key levers and drivers for innovative processes are positively influenced by having a 50:50 proportions of men and women in teams. This clearly shows that equal gender representation can help to unlock the innovative potential of teams" (Lehman Brothers Centre for Women in Business 2007). Moreover, it has been observed that, for Germany, collaboration between women and men in mixed-gender teams slightly more often leads to interdisciplinary publications than it is in case of mono-gender teams, which may illustrate the idea that "the diversity in gender composition is associated with the integration of knowledge from different disciplines" (Elsevier 2015: 23)[1].

There are various initiatives, programmes and mechanisms that employ recommendations on how to increase the likelihood of hiring and retaining female STEM scientists throughout Europe. For example outreach campaigns encouraging young girls' interest in STEM are well established and individual fellowships for female researchers and women associations in STEM disciplines are available from a variety of research founders. Moreover, in some places target or quota regulations have been introduced. They include a fixed quota system and a cascade model. Fixed quota refers to setting a target of a defined proportion of the unrepresented sex until defined point of time in an organization or its' particular bodies. Cascade model refers to a stepped model of targets in recruitment and promotion procedures. According to this model, "flexible rates are calculated for all relevant career levels depending on the respective discipline, starting with the level of scientific young talent. The target rate of a given career level is calculated by way of a complex formula, which includes the actual percentage at the preceding level"[2] (Id 2014).

It is also argued that the effects of gender bias in the recruitment process can be reduced through toning down elitist language in job advertisements, prior agreement of the search committees on the set of desired qualities of a successful candidate as well as blind reviews (Urry 2015, see also: Isaac et.al. 2009). Among other evidence-based recommendations to reduce bias in hiring settings there are such institutional interventions as: designing process to allow applicants to provide individuating evidence of job-relevant competency, visibly displaying research evidence that men and women are equivalently successful in male sex-typed roles, ensuring that women comprise at least 25% of an applicant pool, designing equity directives and antibias training so that raters do not feel coerced during evaluation, not asking about parenthood status in the application, encouraging raters to spend adequate time and avoid cognitive distractions during evaluation, using structured rather than unstructured interviews, not using man-suffix in job titles (e.g., use "chair" or "chairperson" as opposed to "chairman"), implementing training workshops for personnel decision makers that include examples of common hiring biases and group problem solving for overcoming such biases, and encouraging raters to use an inclusion rather than an exclusion selection strategy in constructing a final list of applicants (Isaac et.al. 2009). However, while all these methods are conducive to increasing the numbers of female scientists, “there is no comprehensive overview available which shows to what extent incentive programmes to hire female researchers effectively diminish gender biases” (Lipinsky 2014: 13) and challenge the masculinity norm of fulltime availability and mobility (Rolin, Vainio 2011). It is argued that “success indicators (…) focus on stepping up women's representation in senior academic positions, instead of assessing the outcomes of changes created at the institutional level” (Lipinsky 2014: 13).

2. Leaky pipeline or vanishing box: patterns of female scientists' retention and attrition

It is a well-established observation that the attrition rate in science and engineering is considerably higher among women than men (Pell 1996; McGregor, Bazi 2001; Committee on … 2006a; Hasse, Trentemøller 2008; Caprile, Vallès 2010; Sretenova 2010; Etzkowitz, Ranga 2011). As in other STEM disciplines, there is disproportionate outflow of women from careers in physics at every stage in the academic hierarchy in the European countries, which contributes to the glass ceiling phenomenon. However, the extent of the loss differs from country to country. It has been demonstrated that there are more female physicists in Southern Europe and Central and Eastern Europe than in Northern Europe, including “the countries which are known for a high degree of gender equality and women's emancipation” (Hasse, Trentemøller 2008: 192). Therefore there is a necessity to not only explore the causes of female attrition at different junctures, but also understand why disproportions between men and women are stronger in some countries compared to others or why some physics environments are more high-ceilinged than others. It has been observed that “(…) statistical figures reveal a kind of paradox - on the one hand the proportion of female researchers in all Eastern countries (except the Czech Republic) is above the EU-27 average (30%); on the other hand the so-called 'glass ceiling index' (which measures the gap between the progress of men and women in science careers) is thicker in the Eastern countries and stands above that of the EU-15. (…) It means that the move of Eastern women researchers into higher position is more difficult in the majority of Eastern countries, in comparison with their female colleagues in the EU-15. We argue that the identified 'good news' for Eastern women academics, i.e. the visible positive trend towards the improvement of gender equality in HES and GOV R&D, does not originate from the adoption of new organizational culture in the respective scientific organizations (universities and research centers) and/or from implementation of gender equality policy in these sectors. Generally speaking, the above statistics are more likely to reflect the current economic situation in Eastern countries and the poor image of science and scientists in Eastern societies, rather than the emergence of a new organizational culture for gender equality in scientific research. Therefore the above statistical data should be interpreted as the interface between science and the economy. We assume that each time a profession becomes low-paid and unattractive, as a rule it tends to be feminized, and vice versa, working in a feminized labour sector might reduce the payment level in the sector itself” (Sretenova 2010: 5; see also: Linková et.al. 2008).

The under-representation of women in STEM careers is frequently described through a 'leaky pipeline' metaphor. It describes a loss of female talent at every critical transition within a linear progression through a series of staged roles in research performing organizations, mainly in academia (Etzkowitz, Ranga 2011). This pipeline has several leaks, beginning early at least in secondary school and continuing throughout the whole scientific career (Pell 1996, United Nations 2011; Dasgupta, Stout 2014). Some female students who express interest in science careers change their minds when applying to universities and select other areas of study. Others begin their higher education in a STEM program, but opt out before graduation or after graduating with a STEM degree when they select another field as a career. Average representation of women further drops at every career stage until seniority. One of the major leaks is the critical juncture to tenure-track professorship (Blickenstaff 2005; Bonetta 2010; Mavriplis et.al. 2010). While the numbers of female scientists have improved over the last 20-25 years, their under-representation in STEM persist (Blickenstaff 2005: 369-370; see also: Pell 1996; Etzkowitz, Ranga, 2011).

The pipeline metaphor is widely criticized. While it demonstrates that in case of gender inequality in science it is not enough to activate strategies to “fill the pipeline” (increase the pool of women in the existing science system, strengthen the supply side), because many women, once inside the pipeline, opt out (McGregor, Bazi 2001)[3)], it is accused for oversimplifying the gender dynamics of scientific fields while presenting the fields as overly homogeneous (Alegria, Branch, 2015: 322), assuming the separation of academia and industry institutional spheres by strong institutional boundaries that perpetuate a static social structure of science and technology and paying insufficient attention to the mechanisms of transition across institutional spheres, as they are alternative options for women leaving academia (Etzkowitz, Ranga 2011: 133) and neglecting the impact of gender bias and institutional policies and structures on female-talent loss in science (Roos, Gatta 2009).

An alternative metaphor of “the Vanish Box phenomenon” has been coined. It is a metaphor for the transition from the upper levels of academic science to emerging science-related professions, like technology transfer. It refers “to the recoupment, rather than loss, of women scientists through their reinsertion into an alternative context in which their value may be realised, and possibly capitalized upon to an even greater extent than in the original context from which they were made redundant. Such women scientists find new ways of utilizing their scientific, technical and relational skills in new cross-border occupational areas that translate knowledge into other socio-economically valuable forms” (Etzkowitz, Ranga 2011: 133). They provide not only new career paths with high knowledge content and focus on the creation of new value for society through commercialization of scientific research, but also more favourable work conditions in comparison to academic science and industrial research. The “Vanish Box” transition implies a complex mix of linear and non-linear trajectories that women follow, instead of the more traditional linear career path that is commonplace among male scientists.

The “Vanish Box” model includes four operational phases of this transition:

1. Institutional and individual blockages that remove more women than men at consecutive milestones of science career,

2. Disappearance into a 'reserve army' of unemployed or underemployed women in science created through their marginalization and underutilization,

3. Emergence of a new occupation (e.g. technology transfer (TT) organizations, such as science parks and incubators that aim to close the gap between basic and applied knowledge through new research translation mechanisms)[4)],

4. The reappearance of the 'disappeared' women from academic science in the new occupations (Etzkowitz, Ranga 2011).

The vanishing box metaphor, as well as results of a number of studies (Bennett 2011; Barthelemy, McCormick, Henderson 2015) suggest that it is better to understand women's trajectories in science as pathways rather than linear pipelines.

The pipeline metaphor is also challenged because it is argued that women's lack of access and mobility in academia is no longer simply a 'pipeline' issue, it's also the effect of unintentional biases[5)] and outdated institutional policies and structures (Committee on … 2006a; Roos, Gatta 2009). Such subtle mechanisms - operating as “gender schemas” that work in similar ways for women and men and can function either positively, negatively, or neutrally - may be more difficult to dismantle than more overt exclusionary practices. Social psychologists demonstrate how “implicit beliefs—among both women and men—can hinder women's recruitment to, acceptance in, and mobility into academic positions, especially positions of power and authority” (Roos, Gatta 2009: 8). Therefore there is a need to understand “the reasons why women enter a career break or gap, what their challenges are while in the gap and what, if anything, they feel could change the reasons why they entered the gap or improve their possible reentry into their academic career path in their chosen STEM field” (Mavriplis et.al. 2010: 143; see also Hasse, Trentemøller 2008).

3. 'Push' and 'pull' factors of attrition from science

There is a variety of factors that push and pull individuals out of a workplace. Searching for better work-life balance associated with the need to raise children, accommodate spouses' careers, manage own health issues or care for elderly family members is believed to be an important 'pull' reason for women to leave workplace, including the academia (Hewlett, Luce 2005; Mavriplis et.al. 2010). The results of the UPGEM project demonstrated that in some European countries most female physicists leave their career as scientists when they become mothers (Hasse, Trentemøller 2008: 192)[6]. According to the results of the longitudinal study of astronomy and astrophysics graduate students in the USA, women are more likely than men to encounter the 'two-body problem', resulting in relocation for a spouse or partner. “This type of relocation affected the likelihood of working outside physics or astronomy in two ways: (1) by directly increasing the likelihood of working outside the field and (2) by indirectly increasing the likelihood of limiting career options for someone else, which itself had direct effects on working outside the field” (Ivie, White, Chu 2016: 9).

Aside from being pulled into a career gap women are also pushed away by the features of the job or workplace (Hewlett, Luce 2005). Discontent with science, in particular advancement opportunities it offers, the way it is conducted, and social relations it creates can be an equally important determinant for women's exit from scientific careers as searching for better work-life balance (Mavriplis et.al. 2010: 142). Lack of positions, the short-term contracts and better possibilities of getting a permanent position outside academia were reported to be most frequent reasons given by European physicists - both male and female - for leaving (Hasse, Trentemøller 2008; European Commission 2012c). The study of astronomy and astrophysics graduate students in the USA revealed that “women tended to be less satisfied with their advisors, which increased the likelihood of changing advisors, which in turn increased the odds of working outside physics and astronomy. (…)” (Ivie, White, Chu 2016: 9). Last but not least, the effects of masculinist culture of physics, in which presence of women is seen as “an anomaly” (Fox Keller 2008) are frequently reported to be challenging to female scientists, by making them feel like imposters and disabling their sense of belonging to the field.

The abovementioned study of astronomy and strophysics graduate students demonstrated that women were more likely than men to exhibit the imposter/impostor syndrome, which directly affected their thoughts about leaving astronomy (Ivie, White, Chu 2016). The imposter syndrome has been identified among achieving individuals whose work requires intellectual work and is understood as “believing that one's accomplishments came about not through genuine ability, but as a result of having been lucky, having worked harder than others, or having manipulated other people's impressions”(Langford, Clance 1993: 495, see also Evie, Ephraim 2011; Ivie, White, Chu 2016). In other words, a person who feels like an imposter or an intellectual phony believes that she or he does not really belong in a field because of lack of true ability (Evie, Ephraim 2009). While the impostor syndrome is neither gender- nor profession- specific, it appears to be prevalent and intense among female academics and students (Clance, Imes 1978), including women in astronomy and astrophysics (Evie, Ephraim 2001, 2009; Ivie, White, Chu 2016). The impostor feelings are argued to be the effect of the impact of cultural factors, such as highly competitive academic climate (Academic Culture feeds …2005; Hutchins 2015), as well as gender stereotypes, including perception of creativity and brilliance which is commonly associated with males (Clance, Imes 1978; Leslie, Cimpian, Meyer, Freeland 2015; Dasgupta 2016; Pehe 2017)[7].

Another study on the linkage between sense of belonging and academic outcomes makes it clear that "academic success is not solely an individual process driven by differences in abilities and aptitude. Rather, academic success is also a social process influenced by the extent to which students feel a sense of belonging in their academic environment" (Lewis et.al. 2016: 5). The data confirm that on average, women are more likely to opt out than men because they do not feel as they fit and are accepted in STEM, including physics (Hasse, Trentemøller 2008; European Commission 2012c).

Women's sense of belonging to physics can be weakened in a several ways. For example, one of the studies revealed that allocation of projects was not always influenced by appropriate factors, since perceived physical strength was sometimes given as a reason for giving particular assignments to males" (Whitelegg et al. 2002). Similarly, the results of a statistical analysis of gender systematics in the time allocation process at European Southern Observatory revealed that proposals submitted by female scientists showed a significantly lower probability of being allocated time (Patat 2016). Likewise, the study of career paths of the former postdoctoral researchers on the Run II Dzero experiment based at the Fermi National Accelerator Laboratory near Chicago, showed that "the female researchers were on average significantly more productive compared to their male peers, yet were allocated only 1/3 the amount of conference presentations based on their productivity", which appeared to have significant negative impact on their academic career advancement (Towers 2008: 1). The results of interviews conducted with female graduate students additionally proved the existence of sexism and gender microaggression in the physics and astronomy cultures (Barthelemy, McCormick, Henderson 2016). While overt sexism was reported to happen rarely, experience of microaggression including sexual objectification, second-class citizenship treatment and assumption of inferiority, restrictive gender roles, and invisibility was frequent. Reported cases of microaggression and hostile sexism "resulted in ignoring these women's ideas, conveying a message of women as objects, and restricting access to laboratory equipment. These interactions fundamentally changed the relationship these women had to their fields. These women were not able to interact with physics or astronomy as full participants, but as people mediated by the role expectations and restrictions placed on them" (Barthelemy, McCormick, Henderson 2016: 11). Finally, work by Gonsalves demonstrated how female doctoral students in physics had to ensure that they were not 'girly' to be able to assume the characteristics of a 'physicist' (cit. after Barthelemy, McCormick, Henderson 2016). Thus, it is urged that "a reliable route to increased representation of women in physics is to narrow the gap between women's and men's perceptions of belonging and create inclusive environments that affirm women's belonging just as much as men's" (Lewis, et.al. 2016: 8, see also Barthelemy, McCormick, Henderson 2016) .

4. Gender pay gap and New Public Management

Gender pay gap is another issue concerning recruitment, retention and attrition of female scientists as well as their promotion. Acting towards its limiting is a necessary step towards gender equality in science and research. In this context it is argued that the gender pay gap in research needs to be revisited in light of new managerial practices, including introduction of flexible means of remuneration such as endowments, flexible bonuses and other benefits. These initiatives are part of a wider strategy called New Public Management (NPM), which is "intended to resolve the alleged inefficiency and excessive bureaucracy of public institutions by introducing a market logic in the non-mercantile public sector" (Caprile, Vallès 2010: 59; see also: Pritchard 2011)[8)].

Revisiting gender pay gap in light of NPM means implementation of integrated and active policies to monitor and rectify pay gaps in the research sector (Lipinsky 2014). It is important to remember that "gender inequalities occur and are as flexible and evolving as research and innovation systems. Merit-rating in national research and innovation systems, as well as the impacts of economic developments relating to R&I activity (taxation, knowledge-based spin-offs, etc.), should always be carefully reviewed from a gender perspective to identify driving forces that widen gender gaps in innovative spheres of research. Dynamic environments therefore demand equally innovative and practically effective tools to overcome recurring and evolving gender imbalances" (Lipinsky 2014: 8).

However, sex-disaggregated data on pay differences in research is difficult to retrieve from the available statistics. "The difficulty in access to reliable data has been reinforced in the last decade with the universities' financial autonomies allowing academic establishments to become more competitive, flexible and market-oriented — and gender disaggregated reporting on institutional expenditure has not become standard procedure yet. This, in part, makes it hard to monitor institutional compliance with EU law on equal pay in the public research sector. The status of researchers working in universities and public research institutions in the ERA ranges from 'civil servants' (FR, HR, SL) to 'private employees' (LU). In most cases, public and social partners provide a framework in which autonomous institutions negotiate salary and pay bonuses. The payment of bonuses depending on research performance is an increasing trend" (Lipinsky 2014: 27).

While monitoring the gender pay gap is an institutional duty in Austria, Cyprus and in Finland, other countries opt for voluntary measures (Luxembourg, Norway, Spain, UK) or mandate advisory committees with monitoring tasks (Slovenia ('most institutions')). "In general terms, the gender gap needs to be revisited in light of new inequalities caused by managerial practices, such as autonomy in negotiating pays and offering bonuses and endowments" (Lipinsky 2014: 27-28).

In terms of academic culture and consequences, the evidence on the actual status and effects of remuneration is mixed. Beede et al. (2011) point to the fact that women in STEM jobs are generally privileged as they 33 percent more than women at comparable posts holding non-STEM jobs. The STEM premium, which relates to the overall high earnings of this group of professionals, was noted to be higher for women than men. As a result, in comparison to other sectors, the gender wage gap is smaller in STEM jobs than in non-STEM jobs. Conversely, focusing on the disciplinary markers, Ceci and Williams contested that women's salaries are lower than men's in physics and related fields, even when they work in the same sector for the same number of years (Ceci, Williams 2010). This trend has been documented in longitudinal research and persisted despite the growing representation of women in physics and astronomy (Ivie, Ray 2005:21). In a survey of AIP, which collected data from more than 4000 working scientists, women made significantly less than men, even when the findings are controlled for sectorial and temporal variables (i.e. years since earning a degree). The estimated difference is equal to almost 5% of the base annual starting salary for men in academe, although the difference applies to all sectors.

On a similar note, Racusin et al. (2012) tested for gender bias in deciding on salary and experimentally proved that the faculty hiring committee selected a higher starting salary and offered more mentorship to the selected fake male applicants. Gender bias was found in both male and female staff. Ceci and Williams (2014), however, argued that recent evidence in sex discrimination in STEM is of small magnitude, and, in funding schemes, the bias could not be confirmed in recent data in some countries (Sandstrom, Hallsten 2008), while Wenneras and Wold found even a reverse trend when they reviewed outcomes of 280 funding applications from 2004 and indicated slight favour towards women. Similarly, women were responsive and positive towards the grant schemes that allowed for accounting for career breaks and recognizes that women can take maternity leave by adding the time taken out onto the fellowship at the end of the contract (Whitelegg et al. 2002).

It has to be reiterated, though, that postdoctoral positions funded by short-term research grants are the norm for several years after completion of the PhD and these years coincide with the optimum childbearing years for women (Whitelegg 2002). Interviewed female scientists therefore decided on delaying having children until their thirties, when they hoped to have permanent positions. At the same time, women still feared that there may be discrimination against women with children for hiring and recruitment pertinent to these positions.

5. Mobility and international collaboration

Mobility plays a crucial role in scientific development and career. Geographical mobility is essential for knowledge exchange processes and the relationship building (Ackers 2010), including establishing scientific collaboration (Uhly et.al. 2017). While it is not the only path to career advancement, geographical mobility is also “a common prerequisite for having access to tenured positions in some scientific fields, academic institutions or national contexts” (Caprile, Vallès 2010: 26). While “traditionally researcher mobility has been implicitly characterised as involving an extended period of residence abroad (often 2-3 years), usually implying a period of employment (or a scholarship) at doctoral/post-doctoral level” (Ackers 2010: n.p.), since recently mobility has been viewed as a continuum, covering also short-term stays at partner labs or at workshops and conferences (Ackers 2010).

The study on the views of the EU researchers on the factors that inhibit - mainly long-term - mobility revealed that much reference was made to 'quality of life' issues, including the necessity of dual income families, the difficulties in maintaining two careers and the problems encountered in moving families and partners. Other concerns emerged around the issues of pension, tax, pay and benefits, career progression and availability of posts (EC 2008b). Among them a lack of pension transfer system and suitable social security schemes were frequently discussed.

In this context it is worth to signal a trend towards the feminization of academic migration that was identified in Central and Eastern Europe. The ENWISE Report reveals that women scientists in Central and Eastern European countries and in the Baltic States, facing difficult economic situations, are inclined to accept jobs below their qualification and in general to work for lesser wages, which is rarely the case for their male counterparts. This flexibility of attitude towards the labour market in fact makes them prospective emigrants (Sretenova 2010). The very process of academic migration incorporates a ***gender dimension*** that has been highly neglected and under-researched in mainstream research on brain drain issues. It can be assumed that gender plays a crucial role at each stage of the academic migration process - at the stage of decision-making on emigration, at the stage of immigration to the receiving country and at the stage of possible return back to the home country (Sretenova 2010).

While there is some evidence that women are generally less internationally mobile than men (Elsevier 2017), a few studies reveal the correlation between a researcher's life stage and the level of his or her mobility. According to them, whether people are mobile or not, does not depend so much on their gender, their life stages is more important. The results of the UNITECH International Study demonstrate that at the beginning of their professional career both women and men are very mobile and flexible. Depending on different stages of life the mobility of both women and men decreases (Trübswetter et al. 2015; Schraudner 2015). However, at least in the American context ”®estrictions to mobility due to bringing up children have different timing for men and women. In the case of men they coincide with the middle years of their career, a period of relative stability whilst mobility constraints for women are especially acute during the early years, the time of career formation, when the lack of geographical mobility may be most detrimental to the scientists' future career“ (Caprile, Vallès 2010: 26).

While mobility has been playing an important role in scientific development and careers for many years, the evolution of the European Research Area (ERA) and the European Area of Higher Education (EHEA) - including adopting the “European Charter for Researchers” and the “Code of Conduct for the Recruitment of Researchers” in 2005 - have together increased the emphasis on researcher mobility (Ackers 2010). It is emphasized that “the availability of scientific talent in the EU requires greater mobility of researchers, as well as greater movement between academia and industry” (European Commission 2012a: 39). Therefore, actions contributing to women's mobility in the scientific system are highly expected to be taken. They should include: wider availability of inter-sector mobility for both early stage and established researchers; gender sensitive advertising of vacancy positions and providing access to researchers' industry relevant expertise online; putting in place adequate evaluation criteria, and a fair and transparent career evaluation process; as well as gender aware, trained evaluators and researchers from both sectors in the evaluation committees (European Commission 2012a). Additionally, it is argued that the facilitation of mobility also requires assessing “the concept itself and the benefits of targeting forms of mobility that do not require the upheaval associated with longer term residential moves and employment changes” (Ackers 2010: n.p.)

On individual level international mobility significantly correlates with international research collaboration (Scellato, Franzoni, Stephan 2012; Uhly et.al. 2017). To understand gaps in international research collaboration, Uhly et.al. (2017) introduced the concept of 'glass fences' - gendered obstacles and barriers that keep women from this engagement. Calculating the data from an International Survey of the Academic Profession conducted in 2007 of 19 countries, they provided evidence that the practice of international collaboration in academia is gendered as women are significantly less likely than men to collaborate internationally. While the presence of children does not result in insurmountable glass fences for women in terms of their participation in international research collaboration, partner's employment status matters. Female faculty members with academic partners have greater odds of participation in international research collaboration, regardless of the presence of children, in comparison with women faculty members whose partners hold full-time positions in other domains. This finding may indicate that “academic partners understand the academic professional structure and its demands, and may therefore encourage the engagement of their partners in international work” (Uhly et.al. 2017: 773; se also Elsevier 2017).

6. Different paths of career development

In Europe regulations defining promotion requirements and procedures differ between universities and research institutes; they also differ in relation to academic status, in particular between professorial and non-professorial academic staff. In most cases universities themselves define those requirements and procedures, and responsibility for promotion lies either at central or at de-central level. While the central level refers to the head of the institution, rector, academic senate, council or board of the institution, decentralization means giving responsibility for promotion to 'heads of units in collaboration with the human resources department' or institutions in which the 'departments implement procedures'. (Lipinsky 2014).

In spite of differences in promotion requirements and procedures there is a general model for academic advancement in scientific disciplines. It “includes a preference for a lock-step career progression from undergraduate to graduate education, to a postdoctoral position and then to an academic position with continuous employment, (…) and large amounts of contact time especially in lab-based disciplines, accompanied by an expectation that one's career is "made" in one's 30s (…)" (Mavriplis 2010: 142). This model does not provide for "women's biological clocks, disproportionately penalizes them and contributes to their slow advancement. While many women persevere in the field choosing their own path, they more often than men may find themselves in a "career break" or "gap", understood as a time without the full-time employment necessary to lead toward progress in the chosen field or career" (Mavriplis 2010). As a consequence, "the time required for promotion for women is usually longer than for men of comparable achievement" (Pell 1996: 2847). While overt sexual discrimination has been reduced (Ceci, Williams 2010; Hughes 2014), slower promotion of female scientist can be assigned to inequitable access to resources, failure to network and receive appropriate recognition (Pell 1996; Ivie, Tesfaye 2012; Ivie et al. 2013). However, while there is a recognition of a need to enhance advancement of female scientists, there is some resistance to women-only career development programmes and networks. A study on female engineers revealed that many of them opposed such programmes "for fear that this will create unwanted barriers with their men colleagues, or be seen as meaning women need help to get on. (…) This view clearly brings into question the competence of women engineers, and serves to further undermine their professional self-esteem" (Lee, Faulkner, Alemany 2010: 93-94).

Taking everything into consideration it can be suggested that successful career development programmes that would enhance gender equality should combine individual programmes to equip women scientists with the necessary soft skills to advance, such as networking (EC 2008a), mentoring, stipends, training, the provision of role models and programs that help them secure part-time work or create ana maintain social network for "gap" women, with incentives encouraging structural changes in research organizations through "increasing diversity in recruitment; introducing promotion and retention policies; updating management and research-assessment standards; developing course content to successfully attract women as well as men; policies for dual career couples; and schemes that allow women to return to work after career breaks" (Muhlenbruch, Jochimsen 2013: 41), including practices to sustain scientists during a career break, through reduced membership rates in professional societies and reduced conference fees for unemployed persons, as well as onsite child care at conferences (Mavriplis et. al. 2010). It is also argued that a common organisational response to resistance is either to make the policies available 'for all', or to persuade staff (and their managers) of the reasons why radical measures are needed (Lee, Faulkner, Alemany 2010: 94).

Paths to career development are closely linked how gender affects performance measurements. In this realm, mail survey of science faculty led Fox to address and challenge the issues surrounding academic publication productivity, which is a central process for science. She argues that it is "through publications that research findings are communicated and verified, and that scientific priority is established" (2005:131). Therefore, research must seek to understand factors that are associated with productivity, and variation in productivity by gender in order to "correct inequities in rewards, including rank, promotion, and salary". For Fox, this is because publication productivity operates as both cause and effect of one's status in science: it both reflects women's depressed rank and status, and partially accounts for it (ibid, see also Fox, Stephan 2001; Fox, Mohapatra 2007; Fox, Colatrella 2006). Moreover, comparable levels of publication produce neither the same assessment, nor the same rewards for women and men (Sonnert & Holton, 1995; Nosek et al. 2002; Moss-Racusin et al. 2012; Hill, Corbett, Rose 2010; Sheltzer and Smith 2009; Ecklund et al. 2012).

Dever and Morrison (2011) establish that university research work is marked by increasing attention to performance indicators (Bruneau & Savage, 2002; Morley 2003; Ramsden, 1999) for academic staff (including, e.g., the auditing of publications and grant income) and by the implementation of research quality assessment exercises in a number of countries (French, Massy, & Young, 2001; Harley, 2003;

Mace, 2000). Considerable work has gone into investigating the impediments to women's full participation in research and a range of contributing factors have been identified, but investigating the conditions that support high research performance in women were less prevalent (Dever, Morrison 2011).

Studies pointed to the benefits arising from structured programmes focusing on building women's research capacities, as well as certain forms of formal and informal mentoring (Groombridge & Worden, 2003; Higgs, 2003). It has been specified further that women oftentimes perceived assistance and mentoring as “a privilege” than as a right, a perception that impeded women in physics from fully benefitting from this relationship as early-career researchers (Whitelegg et al.2002). Women, conversely, had a tendency to link mentorship with passionate interest in a research topic and congenial methodology to the effect of an improved research productivity for women (Gallos, 1996; King, 1996). On mentorship, both Ecklund et al (2011) and Dabney and Tai (2013) underscore the expansion of mentorship curricula to work/family life issues, which remain the most problem-generating for women in physics. Persistence in the field is conditioned upon the plethora of support, including departmental assistance, advisers, mentors, peers, and women's support groups.

One persistently difficult to address area is the measurement of countable indicators of male vis-à-vis female performance. For instance, Jagsi et al. (2006) sought to analyze gender gap in medical literature authorship and calculated original articles from six prominent medical journals over the past four decades to explore the disparities among men and women in academic medical publishing. Although the proportion of women authors of original research has increased, women still compose a minority of the authors of original research and guest editorials. Likewise, an analysis of a complete sample of over 200,000 publications from 1950 to 2015 from five major astronomy journals demonstrated that while fraction of papers which have a female first author has increased from less than 5% to about 25%, this rise is slowest in the most prestigious journals. At the same time, papers with male first authors continue to receive more citations than papers with female first authors, however this gap has been decreasing with time (Caplar, Tacchella, Birrer 2016). In effect, this type of “improvement”-hailing is typical, yet it rarely addresses the root causes of the continued imbalance, instead praising a victory. Furthermore, indicators like number of publications are inherent to parametric systems of performance assessment, yet they have also been highly contested over the years.

Finally, in the review by Lincoln and colleagues (2012), awards and prizes are analysed as performance indicators, which depict stratification of science and unequal distributions in rewarding processes. Trajectories shaped by awards are pivotally exhibited by those already boasting good reputation, which is demonstrative of the Matthew Effect. This, in turn, is tied to a great deal of evidence about lacking meritocracy and the fact that scientific efforts and achievements of women do not receive the same recognition as do those of men, namely due to the Matilda Effect. According to Lincoln et al (2012), “awards in science, technology, engineering and medical (STEM) fields are not immune to these biases (…) while women's receipt of professional awards and prizes has increased in the past two decades, men continue to win a higher proportion of awards for scholarly research than expected based on their representation in the nomination pool”. The effects, which the researchers call “powerful twin influences of implicit bias and committee chairs, illuminate the relationship of external social factors to women's science careers. Further, the researchers challenge the ghettoization of women's accomplishments into a category of 'women-only' awards.

In sum, Fox highlights the ideological and practical incompatibilities by stating that the mythology of science (Bruer, 1984) has it that good scientists are either men with wives, or women without husbands and children (Fox, 2005). This conventional wisdom has been challenged, as studies indicated that married women publish as much as or more than unmarried women (Cole &

Zuckerman, 1987). Similarly, there is no consensus on the presence of children having effect on women's productivity, ranging from no effect (Cole & Zuckerman, 1987), a slightly negative, non-significant effect (Reskin, 1978; Long, 1990), or a positive effect (Astin & Davis, 1985; Fox & Faver, 1985). For Fox, these patterns remain puzzling and somewhat counter-intuitive (2005, see also Whittington 2011).

7. Tokenism and non-events

Making female scientists visible inside and outside of the research organization has various purposes. It not only informs wider public on women's presence and achievements in science and, therefore, enables to challenge gender stereotypes, but also "allows for students and staff to see a number of possibilities in achievement and to choose from a variety of role models" and "encourages women already present in scientific institutions to reach higher positions" (European Commission 2012a: 31; see also EC 2001; EC 2008a). Therefore it is recommended that "all public relations activities from scientific institutions should be gender-proofed (represent women appropriately), while avoiding tokenism" (European Commission 2012a: 31). Gender proofing would mean including women in all promotional campaigns for scientific careers, nominating women for prizes, and recognizing their achievements appropriately.

The problem of tokenism needs further elaboration. It has been demonstrated that tokenism occurs in skewed work groups where the representatives of a minority group find themselves in the position of the very few among the very many and represent less than 15%. They are referred to as 'tokens' (representatives of their category rather than independent individuals), which "accounts for many of the difficulties such numerically scarce people face in fitting in, gaining peer acceptance, and behaving 'naturally'. The existence of tokens encourages social segregation and stereotyping (…)" (Kanter 1993: 6). Being a token means standing out compared to dominant group members, being under the constant scrutiny, exclusion from communication networks and entrapment in organizational roles that are deemed fitting or appropriate according to stereotypical assumptions. This exacts psychic costs, which may lead the individuals in the position of a token to overcompensate through either making themselves and their achievements invisible, or overachieving, or turning against people of his or her own kind (Kanter 1993: 6). Combined with negative stereotypes, tokenism may also lead women to experience identity threat, understood as appraising "the demands imposed by a stigma-relevant stressor as potentially harmful to his or her social identity, and as exceeding his or her resources to cope with those demands'" (cit. after Hirshfield 2010: 16). It is argued that "identity threat may then lead to gender segregation within STEM departments, which reproduces negative stereotypes about women in science and may explain their overrepresentation in lower-prestige subfields within their disciplines (Hirshfield 2010: 6-7). Tokenism refers to women in male-dominated fields, but may apply to men in female-dominated fields and can be extended to the experiences of racial/ethnic minorities (Kanter 1993; Shachar 2000; Stroshine and Brandl 2011)[9].

In the context of visibility of female scientists within and outside of the organization it has been argued that women pursuing career in science are affected not only by things that happen to them (e.g. discrimination), but also by 'non-events'. "Non-events are about not being seen, heard, supported, encouraged, taken into account, validated, invited, included, welcomed, greeted or simply asked along[10]. They are a powerful way to subtly discourage, sideline or exclude women from science. A single non-event — for example, failing to cite a relevant report from a female colleague — might seem almost harmless. But the accumulation of such slights over time can have a deep impact. Non-events can be manifold. Superiors or colleagues might ignore or bypass women's research and performance; fail to invite or welcome them to important informal and formal networks; bypass them for awards, prizes or invitations; fail to give them merit advancing tasks such as representing the research group in public forums; not ask them to design or participate in scientific meetings, conferences, panels or as keynote speakers; or simply stay silent when it comes to career support, advice and mentoring. Even supposedly small non-events can send a powerful message, such as when a female postdoc publishes a high-profile article that generates no reaction from senior local colleagues, while her male counterpart's parallel article is celebrated with high-fives all round. Non-events are challenging to recognize and often difficult to respond to. Nothing happened, so why the fuss? Often, nonevents are perceived only in hindsight or when comparing experiences with peers" (Scientists of the World 2013: 38; see also Caprile, Vallès 2010: 33). Hence, it is believed that "learning to recognize various non-events would help women scientists to respond to them, individually or collectively, with confidence and without embarrassment" (Scientists of the World 2013: 38). Anonymous pooling of non-event experiences, monitoring the practices of support, encouragement, inclusion and exclusion in research groups, projects, networks, conferences and science institutions from a gender perspective, addressing the issue of no-events in management, supervisor training and early-career coaching are considered to be necessary tools for change (Scientists of the World 2013: 38).

8. A role model, a mentor and a queen bee

It has been argued that women's choices of careers in science are heavily influenced by role model relationships and both genders have been shown to benefit from identifying with successful examples in various fields (Bonetta 2010; European Commission 2012a; Kelly 2016). However, the persistent problem is that there is, statistically speaking, a limited pool of female top-level physicists able to serve as role-models. Ivie, Ray (2005:9) specify that not only are the percentages of physics degrees earned by women very low, the percentages of physics teachers and faculty who are women are even lower. In early 2000s, just 29% of high school physics teachers were women (Neuschatz and McFarling 2003), while the ratios drop even lower at later levels, with women scientists serving as faculty at degree-granting university and college departments staggered at 10% during that period (Ivie et al. 2003).

The presence of more women in the workplace or laboratory was generally felt to reduce the male atmosphere, but a contrary view was also given that sometimes it could be a good thing to be in a minority as it increased visibility and this may be to women's benefit (Whitelegg et al. 2002). In this study, "good role models were felt to be women who managed to combine their working and family lives efficiently and were felt by the interviewees to be more effective during the time they spent in the lab than some men who worked very long hours". Early-career women suggested that senior female role models with success and interest outside the lab/academia, tended to think about creative solutions to problems, unlike men who were viewed in a stereotypical manner of being fully devoted to science only (see also Whitten et al. 2004)[11].

Mentoring as an initiative for enhancing gender equality is also widely discussed. It is argued that mentoring programs in academia can ease adaptation of new faculty (and graduate students) who are unfamiliar with the dominant culture of the department and protect them from failures in scientific careers caused by incomprehension of rules (Pell 1996: 2847; O'Laughlin, Bischoff 2005). Similarly, "a dearth of guidance and mentorship early on" was recognized as the main reason for the lack of female physicists in American science (Scientists of the World 2013: 37). It has also been found that if male and female astronomy students are mentored, they are less likely to feel like imposters, to have difficulty internally recognizing their own achievements (Ivie, Ephraim 2011).

However, even if mentors are available and they support female scientists in their careers, they often promote women less decidedly than their male colleagues. On the basis of the analysis of recommendation letters submitted by researchers from all world regions it has been revealed that female applicants were significantly less likely than their male counterparts to receive from their mentors - both men and women - 'excellent' letters of recommendation for postdoctoral positions in the earth sciences (Dutt et. al. 2016; Skibba 2016). Similar results came from the fields of chemistry, medicine, and psychology (Trix & Psenka 2003; Skibba 2016). Addressing the problem of hidden biases in letters of recommendation - as well as in the review of curricula vitae of applicants to scientific positions - is vital as application to faculty position has been identified as one of “the key non-structural bottlenecks restricting female participation in academia” (Shaw, Stanton 2012: 3736)[12]. Career transition from post-doctoral researcher to the professoriate has been widely identified as difficult for female scientists (Ceci et. al. 2014; Martinez et al. 2007; Shaw, Stanton 2012). While family considerations seems to be one of the main factors that deter women from pursuing scientific career at this stage (Martinez et al. 2007), gender bias in evaluation, hiring and promotion are argued to be of equal importance in the explanation of gender inequality in science and research, including physics (Urry 2015).

In this context the 'queen bee' syndrome is discussed. Is it so that women who “have attained senior positions do not use their power to assist struggling young women or to change the system that they have struggled through”, tacitly validating it (Pugel 1997: no pages; see also: Młodożeniec, Knapińska 2013: 60). Studies do not provide the conclusive answer to this question. A few surveys of American workers demonstrated that women who achieved success in male-dominated environments were at times likely to oppose advancement of other women, using various mechanisms including bulling (Drexler 2013). However, studies conducted for over 20 years in top management teams at 1500 American companies found that a female chief executive was more likely to appoint women in senior positions (Knapton 2015). However, studies on queen bee syndrome in science and outside the US context are lacking.

Another remark in this area is that, according to Barthelemy, Van Dusen, Henderson (2015), subfields within STEM vary significantly regarding the underrepresentation of women. While women in physics continue to be few and far between, the subfield of physics education research (PER) has a higher representation of women than physics as a whole. More specifically, an online survey to assess PER graduates' demographics, trajectory, climate experiences, and goals for their research revealed that women in PER experience similarly positive working relationships with faculty and fellow students. Last, both men and women reported building a stronger scientific workforce and becoming better teachers as goals for their PER research.

9. Networking as an instrument to empower female scientists

At the same time it has been recognized that formal and informal networking is important to boost career progression opportunities. It is argued that 'old boys networks' are still an obstacle to career progression in various fields. “In addition to gender bias that is common in these networks, many women are not able to network informally during and after work because of social norms, family obligations and other considerations” (UNDP 2014: 42). It has been observed that “missing out on opportunities to network and build social capital has especially negative consequences for middle and senior women managers and is partly responsible for the construction of the so-called 'glass ceiling', . Many work-related social activities do not formally exclude women, but because of broader gendered social divisions in society, women can feel less comfortable in such settings or have less time to participate. These out-of-work events, however, are vital for access to information and afford opportunities to form strategic alliances, both of which are essential for managers and professionals” (UNDP 2014: 24).

Benefits from networking are equally evident in science. Networking is necessary for acquiring information on time, for cooperation in research projects, for securing funding for research projects, for recruiting qualified staff members, for developing an academic career and for enhancing women's' influence in implementing their ideas” (Sagebiel 2014: 99-100). Moreover, networks of women scientists have been identified as key players in the research policy process, not only for being instrumental in the empowerment of women scientists, but also in the efforts to increase the number of women scientists in top positions (Williams, Diaz, Gebbie, El-Sayed 2005), and to make the voice of women scientists heard in the policy debate on a national, regional and international level (cit. after EC 2008a: 35)

10. Recommendations and good practices

This subsection summarizes main recommendations how to attain and sustain greater presence and visibility of female researchers. Where possible, examples of good practices utilizing these recommendations are added.

According to the results of literature review, greater **presence and visibility of female researchers may be achieved and sustained through**:

- clarity and transparency of hiring criteria, job requirements (European Commission 2012a; Urry 2015)
- blind reviews (Urry 2015)
- toning down elitist language in job advertisements and avoiding gender-neutral or gender-discriminatory advertising and job descriptions (UNDP 2014; Urry 2015)
- supporting the development of emerging branches of physics and interdisciplinary fields of useful physics (Götschel 2010, Hasse, Trentemøller 2011; Barthelemy, Van Dusen, Henderson 2015)
- introducing target or quota regulations including a fixed quota system and a cascade model (Id 2014)
- comprehensive overviewing “to what extent incentive programmes to hire female researchers effectively diminish gender biases” (Lipinsky 2014: 13)
- acknowledging that female-talent loss takes place at every career stage (McGregor, Bazi 2001, Etzkowitz, Ranga, 2011) and it is not enough to fill in the pipeline
- understanding women's trajectories in science as pathways rather than linear pipelines (Bennett 2011; Barthelemy, McCormick, Henderson 2015) “The linear career path of the modal male scientist of the past may not be the only route to success, and departments and universities should be encouraged and funded to experiment with alternate life course options. A partnership between the academy and funding agencies could be instrumental in researching such alternatives” (Ceci, Williams, 2011: 3162)
- recognizing that the dominant model for academic advancement in scientific disciplines does not provide for “women's biological clocks, disproportionately penalizes them and contributes to their slow advancement” (Mavriplis 2010)
- implementation of integrated and active policies to monitor and rectify pay gaps in the research sector (Lipinsky 2014)
- acknowledgment and dealing with career breaks is equally about: 1. addressing women's needs such as searching for better work-life balance associated with the need to raise children, accommodate spouses' careers or care for elderly family members; and 2. addressing the STEM culture including the way science is conducted, social relations it creates, and advancement opportunities it offers (Hasse, Trentemøller 2008; Mavriplis 2010; European Commission 2012c; Ivie, White, Chu 2016)

- acknowledgement that successful career development programmes should combine individual programmes to equip women scientists with the necessary soft skills to advance, such as networking (EC 2008a), mentoring, stipends, training and the provision of role models with incentives encouraging structural changes in research organizations through "increasing diversity in recruitment; introducing promotion and retention policies; updating management and research-assessment standards; developing course content to successfully attract women as well as men; policies for dual career couples; and schemes that allow women to return to work after career breaks" (Muhlenbruch, Jochimsen 2013: 41)
- learning to recognize various non-events through anonymous pooling of non-event experiences, monitoring the practices of support, encouragement, inclusion and exclusion in research groups, projects, networks, conferences and science institutions from a gender perspective, addressing the issue of no-events in management, supervisor training and early-career coaching are considered to be necessary tools for change (Scientists of the World 2013: 38). This applies as well to awards in science (Lincoln et al 2012).

Examples of good practices:

CNRS (France). Aimed at developing outreach actions to attract more women in STEM fields (a communication kit, featuring videos of women physicists working in CNRS labs, was conceived as a tool for interventions in high schools; partnering with the "*Femmes et mathématiques*" national association to further develop the annual "*Forum des jeunes mathématicien-ne-s*", which targets female PhD and Masters Students in mathematics) (Pépin et al. 2014).

National University of Ireland Galway (Ireland). Radical gender equality plan with quotas was implemented after research found discrimination and unconscious bias as key reasons behind low proportions of women in leadership positions.

Imperial College London (United Kingdom). Deploys an Academic Gender Strategy Committee: the diverse member-body of this committee includes the Chair of the Athena Committee, which in turn ensures changes in practices and culture at the departmental level to win or retain Athena SWAN awards. Representatives from award-holidng entities take part in regular bi-weekly progress meetings.

University of Nottingham (United Kingdom). The teams implementing Athena Swan charter's awards conduct self-assessment in order to monitor progress. This is a type of visible networking of prestigious award holders that can serve as role models.

University of Cambridge (United Kingdom). CV mentoring scheme initially in STEM, then expanded to non-STEM schools. Assistance with career-building and preparing job application documents from senior staff.

University of Edinburgh (United Kingdom). "There has been a progressive increase in the proportion of women appointed in our flagship "Chancellor's Fellows" scheme from 2012 to 2014 in response to strategies to make the advertisement more appealing to women, by using female role models and alternative media for advertisements. We will conduct a gender audit of all future large recruitment campaigns to inform improvements (AS 2015 Action 2.3 (iv))".

CNRS (France). It is organizing professional development trainings on careers for young women researchers and professors, which had strong impact at the Institut Néel target laboratory in particular, and helped create a women researchers' network. First steps have also been taken in developing a CNRS women researcher's database, which could be used by conference/event/award organizers and the media (Pépin et al. 2014).

Helmholtz Association (Germany). The mentoring program aims at individual career development. An experienced executive (the mentor) passes on his or her knowledge and experience to a younger junior employee. At the same time, the mentor supports the mentee in her personal development and integration into networks. The MDC internal mentoring program for female postdocs aims at helping them to recognize and use their own potential, to increase their competences and make their decisions for the next steps in their careers (https://insights.mdc-berlin.de/en/2014/08/joined-for-a-time/).

Uppsala University Department of Physics and Astronomy (Sweden). Its Gender Equality Plan 2014-2016 incorporates several components:

- Goal: making the physical workplace less male dominated. Background: a space at the department was filled with pictures of male professors and scientists. Tools: it was suggested that new lecture halls could be named after female scientists. A number of pictures of male professors should be kept to a minimum (instead of them there should be more object-related pictures)
- Goal: at least one teacher of one gender for the courses with more than one teacher (to build a presence of role models for female students). Tools: engaging female researchers to be tutors in the laboratory classes as well as inviting guest lectures to teach courses with only one teacher
- Encouraging young female researchers to stay at the university after their first Post-doc position by establishing an efficient grant programme, in which the biggest portion goes to young female researchers. The programme supports as well female guest researchers' stay at the department. The gender equality grants programme is evaluated (Gender Equality Plan 2014-2016, 2014, http://www.physics.uu.se/digitalAssets/577/c_577016-l_3-k_ifa_equalityplan_2014-2016.pdf).

Umeå University (Sweden). It deploys:

- special funds to recruit female professors from other countries or to support senior female researchers aiming to be professors (Status Report: Women in Physics in Sweden 2011)
- network for all women with PhDs (KVINT) which works as a platform for support, inspiration, planning and information (Status Report: Women in Physics in Sweden 2011, http://www.norwip.org/files/otherfiles/0000/0028/SwedenStatus_report.pdf).

Seadrop Prize (Tengercsepp Díj, Hungary). It is given at the Faculty of Natural Sciences at the Eszterházy Károly College (in Eger Hungary) since 2010. This prize is awarded to female professors who have furthered the good reputation of the University by demonstrating at least one of the following achievements at an exceptionally high level: 1) excellence in teaching; 2) well-acknowledged professional results; 3) has helped the professional development of young talents; 4) has developed (funded) projects that supported the positive future of the Faculty; or 5) has participated in innovation of national or international reputation.

DFG (Germany). Research-oriented Standards on Gender Equality introduced by the German Research Foundation (DFG) - Germany's largest research-founding organization, the self-governing organization for science and research in Germany. It serves all branches of science and the humanities. The DFG is an association under private law. Its membership consists of German research universities, non-university research institutions, scientific associations and the Academies of Science and the Humanities. One of the elements of the standards is the 'cascade model', which implies that the institutions define targets for the proportion of women at each qualification level that must be higher than the proportion of women at the level below (Mühlenbruch, Jochimsen 2013; Lipinsky 2014; Zippel, Ferree, Zimmermann, 2016|;

http://www.dfg.de/en/research_funding/principles_dfg_funding/equal_opportunities/research_oriented/index.html;
http://eige.europa.eu/gender-mainstreaming/tools-methods/gear/legislative-policy-backgrounds/germany).

Excellentia Program (Austria). Excellentia Program increased the percentage of female full professors at Austrian universities from 13% (in 2005) to 18% in 2010 offers additional funds for universities hiring female professors (Ritsch-Marte, Durstberger-Rennhofer 2009).

AMIT (Spain). Association of women scientists and women in technology http://www.amit-es.org The aims of the association are to promote gender equality in access to research positions, raise awareness about the issue of discrimination, make visible the success of women-scientists and women-researchers. It works to achieve full participation of women in research, science and technology.

The CERCA Institute (Spain). At the CERCA Institute (http://cerca.cat/en/women-in-science/), in 2013 the Equal Opportunities and Diversity Management Committee has been established. The committee was set up in order to fight gender bias in recruitment has decided to create a diversity commission to: “discuss and propose tools and measures to remove such bias and obstacles and to prevent waste of such highly qualified human capital, along with an equality plan to provide a model for research centres. The CERCA centres' diversity commission has drawn up a pioneering protocol to inform faculty, both men and women, that make up evaluation panels of the scientific data and theories that show bias in evaluation, which is particularly detrimental to women and which leads them to see evaluation as something hostile.”
http://cerca.cat/en/women-in-science/bias-in-recruitment/ The video about bias in recruitment: http://cerca.cat/en/women-in-science/bias-in-recruitment.

Universidad Politécnica de Madrid/Technical University of Madrid (Spain). To raise visibility of excellent women scientists, each year a nomination of a women for the Doctorate Honoris Causa is put forward. http://triggerproject.eu/wp-content/uploads/2014/05/Newsletter-3-_def.pdf (page 7)

AMONET (Portugal). Portuguese association of women in science AMONET http://www.amonet.pt/. “The Portuguese Women in Science Map is a project from AMONET. The historical interactive map contains information about Portuguese women that made a significant contribution to the advance of her main field of research and science in general. The digital map in divided in 12 main scientific areas: Architecture, Medicine, Chemistry, Physics, Biology, Engineering, Mathematics, Informatics, Geology, Meteorology, Law, and Human and Social Sciences.”

Delft University of Technology (the Netherlands). At Delft, in order to increase the number of female faculty members offers high-profile, tenure-track positions to top female scientists in diverse research fields. The 5-year Fellowships are awarded to outstanding female scientists from any country and from any of the existing disciplines in the university, who are currently not employed by Delft University of Technology. The researchers establish their own research programme, receiving generous funding. After five years, if successful, the tenure is awarded and the researcher continues working at the institution.
http://www.tudelft.nl/en/about-tu-delft/working-at-tu-delft/tu-delft-as-employer/delft-technology-fellowship/

FOM (the Netherlands). Funding programme for female physicists: provides postdoc positions or bridge the gap to a regular position (started 1999). On average two to four female scientists per year are funded. This tool is highly effective as many female scientists could improve their careers, e.g. got an assistant professor position or professorship later on. One of the FOM board members was funded by this tool.

Radboud University (the Netherlands). A mentoring programme for women academic and administrative staff: “The programme organises mentor groups for talented scientists to gain more insight into their current work position and what activities and skills are necessary for them to grow. (…) Evaluation of the programme has shown that the mobility of scientists can be improved by mentoring, e.g. many received important grants and improved their position. The aim of the programme is to provide practical support and advice for women talents (particularly post-docs, assistant and associate professors), who want to develop their academic careers. (…) On average, mentees have five to six meetings with their mentor per trajectory, which maximally takes up to one year. In addition to the mentoring programme, a career coach can be contacted within the Human Resources department.” http://eige.europa.eu/gender-mainstreaming/tools-methods/GEAR/examples/stimulating-personal-developmentc.

next

1)
However, the same study revealed that the higher the ratio of women among authors, the lower the citation impact of the publication (Elsevier 2015: 21).

2)
For example, Helmholtz Association’s goal is to increase the percentage of women holding W2/W3 professorships to about 20% (from currently 11%) by the end of 2017 (Id 2014).

3)
It is the “pump-priming” hypothesis assuming that “upward mobility in professional hierarchies would occur naturally once entry was assured remained unrealized and reality contradicted expectation: women in science, engineering and technology (SET) careers are lost at every educational transition stage” (Etzkowitz, Ranga 2011: 132).

4)
The TT profession emerged in academia in response to recognition by universities that it was in their interest and the public interest to regulate the introduction into the market of discoveries made on campus to insure ethical manufacture (Etzkowitz, Ranga 2011).

5)
They are measured with the Implicit Association Test (IAT), which measures “actions or judgments under the control of automatically activated evaluations, without the performer’s awareness of that causation.

6)
Ironically quitting or breaking scientific career after becoming a mother most often takes place in countries which are known for a high degree of gender equality and women’s emancipation, including Denmark (Hasse, Trentemøller 2008).

7)
It was demonstrated that there is a negative correlation between the extent to which practitioners of a discipline believe that success depends on sheer brilliance and women’s (as well as African Americans’) representation in this field. Physics is among the disciplines, where the belief that raw, innate talent is the main requirement for success, is especially strong (Leslie, Cimpian, Meyer, Freeland 2015).

8)
For the review of research on the impact of NPM on gender equality see: Caprile, Vallès 2010.

9)
In this context the fact that biographies and media representations of female scientists perpetuate gender stereotypes is very informative. Female scientists are often portrayed in their private roles as wives and mothers, the focus is on their appearance rather than their expertise and their scientific interests are framed as unusual (Shachar 2000; Chimba and Kitzinger 2010; Fara 2013).

10)

Non-events can also be seen as a category of microaggression, discussed above (see: 3. 'Push' and 'pull' factors of attrition from science).

11)

The issue of role models in science and academia is further developed in the next section of this paper.

12)

Similarly, transition from undergraduate to graduate studies is argued to be critical for women (Shaw, Stanton 2012).