



Women in STEM

THE JOURNEY OF WOMEN IN STEM

[INSIGHTS AND RECOMMENDATIONS FROM NORTH
MACEDONIA]



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Intro note & Acknowledgement

In November 2022, the UNDP country office in North Macedonia commissioned two assessment studies aimed at understanding more about the experiences and stories of women that are involved with work in tech, biotechnology and light manufacturing. The first study assessed the motivation and support systems that women have at their disposal whereas the second one focused on identifying gender discrepancies in career choice, advancement, and career opportunities in the respective fields. The key findings of both studies will inform CO`s efforts in decreasing gender gaps and promoting increased participation of women in STEM, in line with the new UNDP Gender Equality Strategy 2022-2025.

Report commissioned by the Acceleration Lab and UNDP country office in North Macedonia

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Executive summary

Why now, why women in STEM, why these verticals (biotechnologies, IT, light manufacturing)

The 2022 Gender Gap Report¹ suggest that gender segregation within education continues by having the highest enrollment of women in Education, Health and Welfare and most underrepresented in Information, Communication Technologies, Engineering, and Manufacturing. Such findings suggest that both women and men continue to enroll in the so-called gender “traditional” professions which results in a gender skills gap in STEM. Gender differences are present in terms of the fields of study of women and men, but are more expressed in enrollment, and disappear in graduation. This is especially the case with STEM education, where men dominate in enrollment, but the opposite is the case in graduation. Enrollment data for North Macedonia shows that young men are more likely to enroll in STEM - 21% of women's enrollment in undergraduate studies is in STEM programs, whereas 37% of male enrollment in undergraduate studies is in STEM programs².

In STEM fields official data shows that in 2019, out of 347 STEM graduates 64% were women and 36% were men in all sciences and mathematics, 52% were women and 48% were men technical sciences and within the technical and technological sciences, 57% were men versus 43% women³. The trend in North Macedonia is in line with global findings⁴ – women are more evenly represented in natural sciences and mathematics but not in the technical and technological sciences. Gender gap in master's degrees is similar – women lead in natural sciences and mathematics with 67% women and 33% men, biotechnical sciences with 46% women and 54% men and in technical and technological sciences there is gender parity. Lastly, in 2019, women earned more doctoral degrees than men: 70% of doctoral degrees in natural sciences and mathematics were received by women compared to only 30% of men. The figure for biotechnical sciences is similar, where 67% of doctorates were women and 33% were men. In the field of technical and technological sciences, 62% of the total doctorates were men compared to 38% women⁵.

Overall, young Macedonians are much less likely than their EU peers to graduate from STEM fields⁶. The number of STEM graduates per 1000 young people in North Macedonia in 2020 was 6.4, far below the average of 18 STEM graduates per 1000 young people in other countries (Figure 2). The share of STEM graduates among total graduates in North Macedonia is low for

¹ World Economic Forum. Global Gender Gap Report (2022). Insight report, Available at https://www3.weforum.org/docs/WEF_GGGR_2022.pdf?_gl=1*baotax*_up*MQ..&gclid=CjwKCAiAy_CcBhBeEiwAcoMRHIHLGWU98w2hJlc9GcWzF9pldzGBq-20Lxc9hyxOz30rs5tmU0L9FxoC1XMQAvD_BwE

² Enrollment in STEM fields in tertiary education (https://ec.europa.eu/eurostat/databrowser/view/EDUC_UOE_ENRT03_custom_4225454/default/table)

³ State Statistical Office 2019, available online at http://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/MakStat_ObrazovanieNauka_VisokoObrazovanie_DipolmiraniStudenti/205_VsObr_RM_T3_ml.px?rxid=fcb37406-d085-4203-9a89-94e6c58b10cb

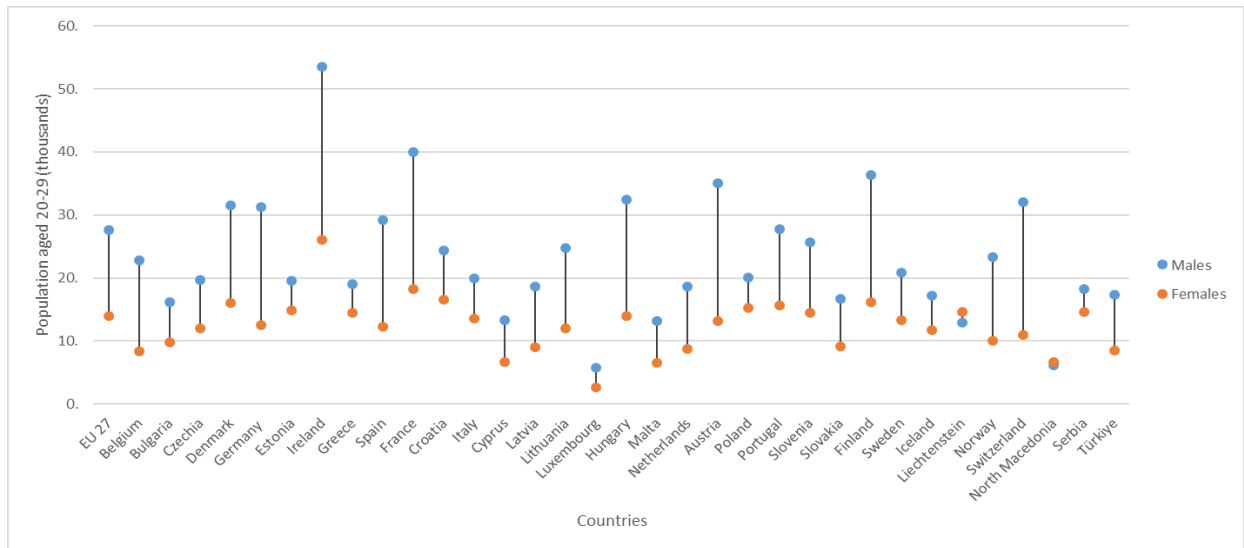
⁴ Hill, Catherine & Corbett, Christianne & Rose, Andresse. (2010). Why So Few? Women in Science, Technology, Engineering, and Mathematics. American Association of University Women, available online at https://www.researchgate.net/publication/234647120_Why_So_Few_Women_in_Science_Technology_Engineering_and_Mathematics

⁵ Women and men in North Macedonia: A statistical portrait of trends in gender equality (2022). Available at https://www.stat.gov.mk/Publikacii/2022/MK_WandM-NMK-Report_WEB_0.pdf

⁶ Graduates in tertiary education, in science, math., computing, engineering, manufacturing, construction, by sex - per 1000 of population aged 20-29 (https://ec.europa.eu/eurostat/databrowser/view/TESEM010_custom_4077100/default/table?lang=en)

both men and women: 6.6 of 1,000 young women (ages 20–29) graduated from STEM fields, whereas this share was 6.2 for young men. The gender gap in STEM graduates is negative of 0.4, indicating that more women graduate in STEM programs than men.

Figure 1: STEM graduates, by gender (2020)



Own calculations based on Eurostat data, at: https://ec.europa.eu/eurostat/databrowser/view/EDUC_UOE_GRAD04_custom_4163518/default/table?lang=en

Considering the above mentioned, this report seeks to identify gender disparities in career choice, advancement, and career opportunities in tech, biotech and light manufacturing industries in North Macedonia⁷.

The reasons for choosing these sectors are multiple.

The Tech industry is a fast-growing service industry, which offers endless growth opportunities and competitive salaries. Furthermore, it is an industry in high demand in the world and in North Macedonia likewise. The Biotech industry is long established in North Macedonia. Biotech industry has impacts for general public health, climate change, an aging society, food security, energy security and infectious diseases. Finally, the Light Industry has been selected as a critical industry for North Macedonia due to its importance in the overall North Macedonian economy and exports. Light industry is responsible for a large portion of Macedonia’s exports. Furthermore, it is a source of foreign exchange inflow.

⁷ Tech industry: businesses that sell goods and services in electronics, software, computers, artificial intelligence, and other industries related to information technology (IT).

Biotech industry: companies whose products or services primarily use biotechnology methods for their production, design or delivery. Biotech companies mainly work in the fields of medicine, agriculture, crop production, non-food use of crops and heavy industry.

Light industry: industries that are less capital-intensive than heavy industry and are more consumer-oriented than business-oriented, as they typically produce smaller consumer goods. Most light industry products are produced for end users rather than as intermediates for use by other industries.

Methodology

In North Macedonia there is lack of in-depth research on women in STEM, including qualitative data on what influences women's education or careers, concrete barriers and discrimination faced by women as well as policy recommendations for businesses, educational institutions and the state to encourage girls and women to engage in STEM. To this end, two complementary qualitative research projects were conducted:

I Analysis to assess the motivation and support systems that women have at their disposal in tech, biotech, and light manufacturing

II Analysis of job market in the country for women in tech, biotech and light manufacturing to identify gender discrepancies in career choice, advancement, and career opportunities.

To inform the first analysis, in-depth semi-structured interviews with women, working in tech, biotech or light manufacturing industries were conducted. The sample of women was selected based on the field of work, place of birth, level of education, age, stage of career (entry-level, mid-career or senior role) and workplace. Twenty-five women building a career in tech (7), biotech (8) or light manufacturing (10) were interviewed. Nineteen of the interviewees are in a managerial position, nine of them are general managers, 10 are mid-level managers while six are not in a managerial position. Total of 23 of the interviewees are based in North Macedonia, while two work abroad. Out of the interviewees working in the country, 14 work in national companies and seven at foreign companies while two are professors in national academic institution. Regarding the size of the company, 14 work in large companies, four

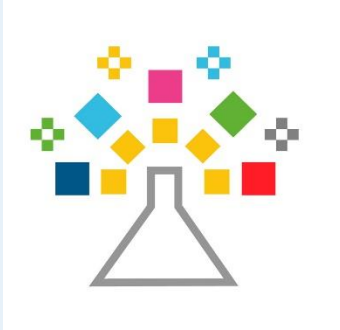
work in medium size companies, five work in small companies, while two work in Academic institutions.

For the second analysis, the data collection methods used are in-depth interviews with human resources (HR) departments of 12 selected companies, and analysis of desk and literature review. Exceptions are small and micro companies, which did not have an HR department. The companies were selected based on several criteria: industry, company size (small, medium, and large companies), years of operation (the sample to include established and new companies), ownership (both domestic and international/mixed ownership companies), etc. Most of the companies in the sample are medium sized (42%), followed by large (33%) and the remaining 25% are small in size. Overall, the large and small companies analyzed in this report are distributed evenly across all respective sectors, with a representative of each sector. Medium sized enterprises are distributed randomly, with two in tech and three in light industry. No medium sized biotech companies were analyzed.

It is important to note that, the two analysis are intersecting with each other only with six companies meaning that only 20% of the interviewed women worked in companies that were covered with the complementary analysis.

Considering that the samples for the research is convenient and non-representative, readers should keep in mind that the presented findings do not reflect the prevalence of the researched phenomenon among the general population in North Macedonia. The findings in these two analyses pave the path to further research and promote increased participation of women in STEM industries.

10 crucial indications



Motivation

Working in the laboratory as an opportunity to apply their creativity
Love towards natural sciences, talent, and exceptional grades in subjects such as mathematics and physics.

Career development

Climbing the career ladder without skipping steps, starting from the lowest position even when the management of the company was inherited from their parents. It is harder for women to build a career in STEM and being promoted due to gender roles, especially those related to pregnancy and childbirth.



Inspiration

A Family member working in STEM or a supportive professor in primary and high school.

Education

Absence of quality internships as a hindering factor in women's career development.

Lack of national scholarships targeting specifically women.



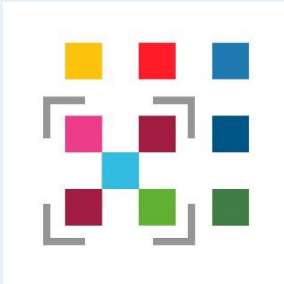
Supporting system

Mentoring as a positive and helpful experience for professional development and transfer of knowledge and skills.

Complaints system

All companies surveyed reported to have a system for employee complaints in place. 75% of all companies surveyed have an employee responsible for receiving company complaints.

The overall impression is that the women interviewed are not aware of gender discriminatory practices at the workplace. Furthermore, they reported fear of considering something as discrimination.



Women representation

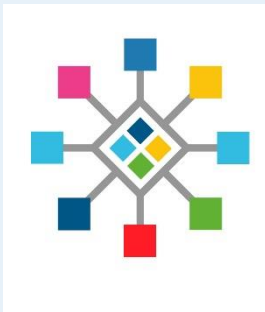
Women's representation is limited and not well-balanced in the companies involved in the research.

In the 12 companies across three industries-tech, biotech, and light manufacturing- 43% of tech-related roles are held by women employees, while in non-tech related positions, 55% are held by women staff. Only five out of 12 surveyed companies across all sectors have over 50% women represented in senior management roles.

Enabling circumstances

Interviews with children and single mothers strongly emphasise the supporting role that their parents played in shaping their career paths.

Unpaid household work is still perceived as women's responsibility limiting their time to work outside of office hours and their ability, holding them back from progressing in their careers.



Gender equality policies

The larger and foreign-owned companies are more likely to gender mainstream their operations, such as collecting and analyzing gender disaggregated data and apply gender quotas to achieve gender parity. The data is used for reporting to managers but also for designing best practices to increase employee engagement and implement fair promotion practices.

75% of the companies surveyed have a policy for dealing with sexual discrimination and harassment in the workplace in place.

Gender discrimination

Experienced by almost all interviewed women during the job seeking process in their younger years regardless of the industry. Young, unmarried, and child-free women's privacy is often being violated and they are being discriminated on the terms of gender in the process of pursuing job-positions in STEM, especially in biotech and light manufacturing.

The perception of motherhood in the society and the expectations that mothers are the primary caregivers are considered the preeminent barrier in building a career in STEM.

Key findings

Both analyses have certain limitations, mostly due to small and non-representative sample and no comparable data to affirm the identified gender differences, regarding the situation of men in the selected industries. However, considering the time limitation, these two analyses were commissioned to provide initial insights that could inform future more comprehensive research on existing gender equalities in STEM industries. Despite the limitation some key findings can be drawn from the data collection.

The analysis of existing data shows that North Macedonia has a very robust legal framework on gender equality and discrimination against women. However, gender discrimination still exists due to lack of enforcement and implementation of the laws. The perceptions of gender discrimination in tech, biotech, and light manufacturing industries of interviewed women differ from the ones of HR staff. Role models in women and girls' s lives play an important part in influencing their decision to pursue education and careers in STEM. At school, the importance of teachers and professors and their role in motivating students continues to play a crucial role in encouraging women to focus on natural sciences. This is particularly the case for women professors, who can act as role models, break down stereotypes and encourage girls to pursue careers in STEM.

The quality of the education system is crucial when it comes to building a career in STEM. Overall, within the educational setting, a systematic approach is much needed which includes practical work starting from primary school, mentoring both during formal education and in professional settings. A majority of the women interviewed, (80%), chose to continue their secondary education in a gymnasium- specifically 44% in the natural-mathematical area while 36% in the

social and humanities areas. Only two of the interviewees have completed a vocational high school in chemistry. A total of 22 interviewees have initiated the first cycle of studies at a faculty in North Macedonia. However, only 15 have continued to the second cycle of studies, while eight of them chose a faculty in North Macedonia, while 7 studied abroad. There are eight interviewees who enrolled in the third cycle of studies, half in North Macedonia while the other half abroad. Furthermore, 10 of the women interviewed received a national scholarship for good results while only two received a scholarship for studying in areas underrepresented by women. Both types of scholarships were general and for both women and men.

The representation of women in the companies surveyed is overall assessed as limited and unbalanced. Five companies across all sectors have over 50% women represented in senior management roles, whereas three of the five small companies represent all three analyzed sectors. Similarly, one medium and one large company in the light industry have over 50% women in senior management roles. Furthermore, in two medium-sized companies, one in the tech industry and one in the light industry, no women are represented in senior management. Both companies have a small representation of women in middle management positions, 27% and 11%. In one of the companies in the tech sector, which is medium in size, 73% of middle and low managers are women, while in the other three companies in tech, women are poorly represented in the middle and low management, 27%, 22% and 10%. The surveyed biotech companies show an equal representation of women and men in middle and low-management positions. Finally, in the light industry, two of

the middle-sized surveyed companies have approximately 50% women representation in middle and low management positions, while the rest have closer to 20% in the same positions. Additionally, of the surveyed companies in the tech industry, 42% of technical roles are held by women, in biotech 65%, while in the light manufacturing industry 22% of technical roles are held by women.

In the region, North Macedonia stands out in positive terms with a greater representation of women speakers in tech conferences than the regional average, but even in North Macedonia there is an underrepresentation of women among speakers and keynotes .

Macedonian job postings are gender neutral , though for certain positions that require higher levels of manual work, men are preferred. Interviewed women have the impression that they are constantly under pressure that despite all the capabilities, education and skills they possess they are still not good enough if they cannot do the physical work.

The qualitative research shows that women working in tech have entered the labor market more smoothly than the ones working in biotech or light manufacturing. The first working experiences and the job-seeking process are identified as the most challenging parts of the process due to gender discriminatory practices. Nevertheless, appealing is the fact that each of the interviewees climbed the career ladder without skipping steps, even when the management of the company was inherited from their parents. Even though women in STEM perceive themselves as the good examples why there should not be a gender divide in STEM, the interviews showed they have lack of self-confidence and undervalue themselves and their capabilities. Overall, women consider themselves highly successful only if they fulfil all the societal expectation (balance work with family) which is not the standard for men.

Employers, as expressed in interviews with HR departments and in online job ads, implement gender-neutral hiring practices, but men are preferred for manual work. Secondary data analysis shows that men employees have longer work experience in general, while women are more loyal to the company of work and have longer job tenure relative to comparable men. Despite women being more likely to stay longer in the company (have longer job tenure), HR departments view men as more loyal workers, which may be related to how loyalty is viewed and measured. Overall, across all sectors, 67% of analyzed companies stated that men employees are more loyal, 8% said the same about women employees, while 25% of companies reported no difference between genders. On the contrary, women interviewed in high management positions in STEM believe women employees in STEM are more loyal, detail oriented, more dedicated as well as more responsible and accountable. There are three main reasons among the women interviewed for changing the workplace: need for better working conditions and formalization of the job; reaching the highest possible position in the company as well as higher income and better positions. Furthermore, predominantly men employees are not willing to take advice, criticisms or commands by women regardless of their experience or position. The opinions regarding the gender pay gap in STEM are diverse due to different personal experience. However, women agree there is an existing gender pay gap in STEM. As reasons or justifications for this gender pay gap the interviewees have identified the flexibility and commitment of men i.e. "the possibility of staying at work longer (to finish their duties or to jump in if a problem arises) is greater in contrast to women who have children to take care of and other responsibilities at home which need to be balanced. Somehow it stems from the fact that we (women) are generationally predestined to take care of children while

men to pursue careers, maybe that's why the wage disparity exists."-32 y/o working in the bio-tech industry.

Generally, almost all companies indicate that both women and men, receive the same promotion prospects within their company, specifying that their employees are not subject to any form of gender promotional bias. The research shows that in the tech industry men are usually paid and promoted more than women, based on their performance and loyalty to the company. In the biotech industry, 100% of companies have indicated that there are no differences in promoting opportunities between men and women. All six light manufacturing companies stressed that promotions are based on internal references, evaluation of completed projects or annual performance reviews. Complementary, total of 15 interviewees were promoted vertically, two were promoted horizontally while eight have not been promoted yet. The women interviewed were promoted to low or middle-management positions in an average of three to five years of working in a STEM company. Total of nine interviewed women are general managers, while 10 have low or middle-management positions. However, interviewed women do believe climbing the career ladder would have been easier if they were men.

"If I were a man it would be easier for me during my career. I would definitely say yes. As a woman, I cannot complain, I have had opportunities to prove myself, but the road is much more difficult."-51 y/o manager in biotech company

A few large companies where the interviewees are employed, both national and international, are offering mentors to their employees who above all introduce the new employees to the work obligations and environment. Nonetheless, only a part of the mentors supports the employees in their further personal and professional development and career advancement. Overall, at least one company per

interviewed industry indicated that women tend to adapt easier to new challenges and are more curious in terms of expanding their skills, relative to men. More than half of the companies surveyed indicated that women are more curious, open to learning and gaining additional skills to advance their proficiency than men in the company. For eight interviewees, their company provides a mentor. Five of the interviewees whose company provides them with mentors are working in light manufacturing companies, two work in biotech companies while one in tech companies. Five interviewees have a mentor who is part of their family, mostly the father, while three have personal mentors. Five of the interviewees had mentors only during school, mainly during graduate school, and the same number of interviewees did not have a mentor while building their careers. Nevertheless, all 25 of the interviewees have agreed that mentorship is immensely important and beneficial for the career advancement of women in STEM.

Gender discrimination has been experienced the most during the job search in their younger years, while unmarried and childfree, regardless of the industry. 75% of the surveyed companies have a policy for dealing with discrimination and harassment in the workplace in place. Research data shows that job interview questions that involve employment discrimination are common experiences during the interview process.

The data show that women tend to have fewer years of industry experience, with a discrepancy between 1-2 years. In other contexts, and globally, the explanation for this gap between years of experience among men and women is explained by time out of the workforce due to maternity leave. However, the HR staff interviewed claim that maternity leave does not affect women advancement, nor their managerial position. Nevertheless, the interviewed women have opposite experiences and perceptions.

Women's pregnancy is the most critical moment in women's careers and often delayed the career development of women in STEM. The break women take when having children means that it slows down their career progress, impacts whether women are hired and when maternity leave is taken than it is likely that women return to work before the full completion of the maternity leave. The highlight is put on the tech industry companies, where being absent for nine months is considered to have an enormous negative impact on women's careers due to the rapid changes that occur in the IT sector. Due to this it is noticed that the interviewees working in tech, or the academic sector have not been using the maternity leave fully and have tried to balance it with their professional life. Most women attribute their career advancement and success to the support of

their family and their partners. Women that have children recognize the support of their parents (mothers), in laws and partners when it comes to building their careers and raising children. In addition, women whose children attended daycare, but were often sick, were frowned upon when they needed to be absent at work. Although women mentioned the support of partners not a single interviewee shared that her partner took the parental leave instead of her once children were born. Interviewed women recognized that they cannot compete with men colleagues when it comes to working longer hours as family and household responsibilities after work fall mainly on women. Collected data suggests that strong gender stereotypes still exist widely within Macedonian society

Recommendations

Summary: Aiming to narrow down the gender gap and increase women's participation in tech, biotech, and light manufacturing professions in North Macedonia the following recommendations were developed:

How to encourage girls to build a career in STEM? Support the educational system through:

- ✚ Implement a large-scale program for secondary school students (including curriculum reforms to further promote STEM careers, mentorship programs, after-school skills programs, advocacy and awareness campaigns, and cooperation with STEM professionals etc.), to raise aspirations of young girls to enroll in STEM fields;
- ✚ Implement programs for teachers such as professional development, internships, build a network of support and expertise that can be drawn upon to develop innovative teaching methods, network building (network of support and expertise within the STEM community), access to resources, incentives (financial rewards, professional recognition, and career advancement) etc.
- ✚ Organize promotional events to encourage and support young girls to study in STEM in collaboration with the private sector and the educational institutions;
- ✚ In collaboration with the Ministry of Education and science provide regular scholarships for women in the STEM fields;
- ✚ Support women mentorship opportunities for female students enrolled in STEM fields to pursue careers in tech fields
- ✚ Support internship opportunities through establishment of regular cooperation between the educational institutions and the STEM companies, both domestic and foreign regardless of the size.

How to engender HR policies in private companies? Encourage inclusive work culture through:

- ✚ Training of HR departments to develop gender-sensitive policies for health and safety at the workplace;
- ✚ Training of HR departments to raise awareness of workplace discrimination and harassment, and grievance systems;
- ✚ Education on workplace discrimination and harassment for all employees, including HR departments)
- ✚ Encourage companies to invest in women employees by offering executive development opportunities (with a focus on building the leadership competencies needed to thrive in the company)

How to create an enabling environment for women in STEM? Support change of harmful patriarchal practices through:

- ✚ Promote gender-balanced and gender-sensitive working lifestyle through development of training materials (for online and physical learning) to promote gender-sensitive working culture.
- ✚ Support the on-going change of the Labour Law of North Macedonia regarding the inclusion of parental leave and division of childcare among both parents; (example: Development of campaigns with storytelling of fathers that took parental leave).
- ✚ Support more and better childcare and elderly care facilities which correspond to the needs of women and men working in STEM areas;
- ✚ Support policies for post-maternity support for mothers returning to work, as well as benefits for working mothers and improving flexible working are all invaluable;
- ✚ Support the division of unpaid household work between men and woman

If this executive summary has sparked your interest, and you wish to access the full publication please do send an email to: kristina.plecic@undp.org and igor.izotov@undp.org