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## Document title:

# Engineering topics attractive to female researchers

## Abstract:

The presented report investigates the gender issues connected with the engineering fields with a specific aim to suggest measurements that would make these university areas more attractive to women. To address this goal the research has focused on the alleged existence and potential role of gender stereotypes that presumably influence women's decisions to pursue engineering studies and affect the general environment there. After summarizing the existing research on this topic the report offers an interpretation of its own research based on questionnaire investigation that addressed three groups of respondents – Czech high and grammar school students, students of the Brno University of Technology and students of the Vienna University of Technology. Based on the existing knowledge, research results and implicit comments from the respondents the study concludes with the set of recommendations aiming at increasing attractiveness of technical education for women.

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# 1 Introduction

Technical education has traditionally been understood as a male domain. These areas require abilities that have been habitually associated with men. Similarly, electrotechnical engineer or computer expert almost automatically imply male gender while female representatives of these areas could be perceived as an oddity and even approached with distrust. This all would suggest that various gender patterns or even prejudices resonate both in society as well as technical schools themselves and thus influence women's decision to enter engineering programmes.

Nevertheless, with a growing societal emancipation the number, strength, and impact of the gender prejudices generally decreases potentially shifting the context of the female participation in technical degrees. The crucial question is not whether gender patterns and prejudices do exist but if and in what ways they influence the motivations of young women to enter technical faculties. To state the obvious the numbers of the female students and researchers at the engineering departments determines the number of female professionals in the field. Indeed, there are many practical implications connected with the lack of the gender-rich perspective when it comes to the development and design of modern technologies. With the growing spread of these technologies and subsequent societal dependence on them women naturally become essential users. Hence, if the gender stereotypes still resonate in the field they are likely to become translated into the developed technologies and products, which subsequently do not effectively match interests and needs of an essential demand group.

Therefore there are good normative as well as pragmatic reasons for why technical universities should promote their programmes among women. Based on the literature review summarizing the experience from the region as well as from outer areas and original research performed at Brno University of Technology and Vienna University of Technology the report will aim at suggesting ways in which the promotion of the technical degrees as well as the environment at the technical schools could be improved. It should be emphasized that this would a timely endeavour given the numbers of students at the technical and potential benefits the entire sector could get from a stronger involvement of women.

## 1.1 Structure and goals of the study

The study will be structured in the following way. The first part will introduce the existing research on gender issues linked with technical education. This section will show what gender stereotypes and even prejudices have been associated with this area and in what ways they affect the numbers and performance of women in technical schools. After reviewing the existing knowledge the report will look at the shares of women in ICT and technical schools in Austria, the Czech Republic, and other Central European states. The idea is to show whether the figures are comparable and hence suggesting the same contextual conditions related to women's interests and performance in technical degrees.

Before turning to the original investigation performed in Austria and the Czech Republic the report will also review the existing initiatives supporting women's participation in technical sciences operating at national as well as international levels. Together with the conceptual

discussion this review will open the analytical space for the interpretation of the data acquired through the questionnaire investigation.

The interpretation of the data will focus on the effects of gender stereotypes and their roles in shaping women's decisions regarding their potential studies and careers in the engineering sector. The data resulting from the empirical investigation complemented by contextual information coming from the existing resources will allow for solid analytical conclusions and recommendation. The latter will be also based on the explicit answers provided by the respondents in Austria and the Czech Republic.

That said, the main goal of the study lies in the evaluation of gender stereotypes connected with the technical/ICT sectors providing better understanding of the sectoral as well as societal hurdles that lead to a lower participation of women in this area. This analysis combined with explicit comments coming through the questionnaire will serve as a foundation for the analytical conclusions and recommendations aiming at approximating the field to female students and researchers.

## **1.2 Methodology**

As outlined above the methodology will combine qualitative assessment of the existing research and utilization of the questionnaire investigation providing the quantitative data about the stereotypical patterns. The first group has involved the representative sample of the Czech high/grammar school and university students across specialisations. The dataset has included 255 grammar/high school students and 254 university students. The sample was created on the basis of the online panel which is constructed to offer a high degree of representativeness in terms of gender, regional distribution, age or specialisations. As such the dataset of 509 respondents can be used to interpret gender positions in the context of the society as well as technical education.

The second group of respondents were the students of the Vienna University of Technology, where 51 students filled in the questionnaire offering their views on societal gender issues as well as gender prejudices associated with the technical schools. Finally, the third group has come from Brno University of Technology, where 97 respondents joined the investigation. In total the sample involved 657 respondents.

The questionnaire has been structured into several sections. The first section has focused on the general perception of men and women in Czech/Austrian societies. The next sections have investigated educational skills, attitudes towards math, and potential role of women in science. Finally, the sociodemographic section has offered the data enabling various cross-calculations.

It should be emphasized that the study does not aim at comparing the situation in Austria and the Czech Republic. Due to the regional and cultural proximity the investigation performed in both countries together with other contextual information serve as a foundation for analysis-based conclusions suggesting the measurements to be taken making the technical/ICT education and career more appealing to women.

## 2 Literature and data review

### 2.1 Gender in technical sciences / ICT

Despite the general majority of women at the universities in the developed world, the share of women in technical sciences is relatively low. The literature generally argues that the gender stereotype according to which men are biologically better equipped for technical areas belongs among one of the strongest patterns settled within societies as well as educational system (Brasseur 1993; Evetts 1996; Hajek 1997; Henryksen, Dillon, Ryder 2015; Hill 2010; Powell 2012; Renzetti, Curran 2003; Tong, Klecun 204;). As proofed by several studies (Cf. Hasmanova and Svatosova 2011; Hill, Corbet, Rose 2010: 4-7) this biological determination seems to prevail even when confronted with the contrary empirical results showing better assessments among the female parts of the classes. More specifically, this structural gender pattern have been connected with the actual results of boys and girls in math, which has been considered as a crucial subject determining decisions for a potential technical education and career.

Biological or better cognitive determination has also been perceived through another generalized notion - rationality. As the field is understood as a purely rational domain, the male dominance is viewed as natural and necessary while reflecting the bipolar gender assumption linking rationality with man and emotionality with women. Rationality and emotionality belong among the most sedimented gender stereotypes that affect many societal domains. When addressing specifically the gender gap in Science, Technology, Engineering, and Math (STEM) the literature tends to links these alleged characteristics with other general gender stereotypes. "[T]he persistence of the gender gap in STEM and educational choices might be considered the result of this long-lasting idea that science – and more specifically some science – is male-gendered. Nowadays it is still the case that the idea of male-gendered science might be transferred through polarized gender associations, which connect initiative, strengths, rationality, and autonomy with men, and other traditional female aspects, such as dependence, emotionality, and subjectivity with women." (Allegrini: 55).

Quite interestingly, the gender stereotypes seem to be strongly rooted particularly among women who actually pursue careers in technical areas. Powell's research (2012) has shown that even female students of the technical university degrees and researchers and professionals in technical sectors actually believe that men are better cognitively equipped for technical sciences. According to Powell's results, these women dominantly view themselves as exceptions and even tend to extend their gender stereotype-based scepticism to other women in the field (Powell 2012: 550-55).

One of the most influential organizations promoting women issues and agendas related to university education American Association of University Women (AAUW) has conducted a comprehensive study searching for answers why there is a low share of women in Science, Technology, Engineering, and Math (STEM) (Hill, Corbet, Rose 2010). Although the conclusions do not fully refuse the biological gender differences (yet to be better understood), it views the cultural and societal factors as essential since the SAT math exams reveal a growing number of high scores among girls, essentially changing the gender ratio among the best students – 13:1 to 3:1 during the last three decades (Cf. Hill, Corbet, Rose xiv).

Further results presented in the study (*Ibid.*) further confirm the hypothesis based on the role of the societal and educational environment. "One finding shows that when teachers and parents tell girls that their intelligence can expand with experience and learning, girls do better on math tests and are more likely to say they want to continue to study math in the future. That is, believing in the potential for intellectual growth, in and of itself, improves outcomes." (*Ibid.* xiv). This strongly suggests that the sedimented stereotypes may affect girls' results and aspirations. One more conclusion offered by the study is rather interesting particularly when confronted with the figures of the female students at the technical schools in the Czech Republic. As will be presented below the Czech technical programmes are dominated by men with the exception of biomedical engineering, chemistry, and architecture. The issue of spatial skills could be viewed as cognitively determined; however Hill, Corbet and Rose (p.56) show that this gap can be quickly mitigated by specific training. Although the faculties of architecture offer variety of programmes (not necessarily only related to building construction) the spatial skill could be thought as important for this technical specialization.

Very similar results have also been presented by the Czech researchers investigating gender issue at the Czech technical/ICT schools. The idea of biological determination has been observed as strongly presented within the Czech society and educational structures by Hasmanova (2011) along with the demotivating tendency to put forward a prejudice regarding the math gender predisposition (Hasmanova and Svatosova 2011: 9). Based on the comparative analysis Hasmanova and Svatosova (2011) have further showed that boys have better results in technical subjects while girls tend to be better in humanities. However, these Czech result do not correspond with the results from other developed countries, which would again suggest that the stereotypes play role in the Czech educational structure.

Similarly Sloboda (2004) has emphasized a role of the social environment effectively forming children to accept settled gender roles that essentially influence their choices regarding education and future careers. Curiously, based on the official statistics Sloboda shows that the numbers of women at technical schools in the Czech Republic and developing world are comparable and sometimes even favor the developing countries (Sloboda 2004: 6-7). His explanation is interestingly based on the distribution of power, particularly economic power, within developed and developing societies. Whereas in developed capitalist societies the economic power essential for governing the society has been accumulated in the economic and industrial sectors, the power in non-capitalist states is still centered in politics (ideological groups) and/or army. This notion makes the gender issue in technological sector less sensitive for the latter states. However, following this logic Sloboda came to the conclusion that the well-paid sectors such as engineering, ICT, or law and medicine will be highly masculinized while women will only rarely pursue successful careers in these areas (Sloboda 2004: 7). Reflecting this it should be noted that the latter two areas show an increasing dominance of women, at least measured by the gender shares of students (Czech Statistical Office 2014).

From a more general perspective the Czech experience appears to confirm the idea that gender stereotypes or even prejudices tend to pervade through all career developmental stages. In a study of gender aspects of the Czech educational structure Hajek (1997) has argued that reproduction or even strengthening of the gender segregation does not result from a fear of female competition evolving along the masculine rules but rather from concerns envisioning the change of the shifts in the field leading to a loss of exceptionality

and societal prestige. Masculinity has still been perceived as more prestigious, connected with qualities like independence, professional determination, or ambitiousness (Hajek 1997: 9).

## **2.2 Motivational factors for women's participation in technical/ICT education**

The reflections presented above revealed several counter-motivational issues that have informed our investigation. Nevertheless, the existing research offers also some insights into potential motivational factors leading women to enter technical schools. Despite various gender stereotypes and prejudices there are women who pursue successful studies and careers in technical sectors. The research shows (Cf. Powell 2012) that these women tend to see their performance as overcoming the structural barriers leading to strengthening of their self-consciousness and reinforcement of their ambitions in the masculine area. Vast majority of their female respondents also did not express any affinities to feminist ideas (Powell 2012: 543-44). More specifically, the motivational factors revealed by female technical specialists included issues such as an opportunity to do an interesting and perspective work, success in a challenging area, value of the engineering degree, or diverse work. Most of the respondents were very successful in technical subjects during their primary and secondary education and many of them grew up in male-dominated environment stimulating interest in technically-oriented hobbies. Additionally, female engineers have a tendency to mention the positive impact of their teachers. Following the note mentioned above their self-perception as exceptions, the female respondents tend to appreciate male social environment (Powell 2012: 546-50).

## **2.3 Shares of the women in the ICT programmes in selected Central European countries**

The previous part of the study has revealed several motivational as well as counter-motivational issues that should be followed when investigating the issue of gender diversity at technical/ICT schools. Even if the study has no comparative goals the figures showing the actual shares of women at various technical faculties across the region of Central Europe (Austria, the Czech Republic, Poland, and Slovakia) would provide a relevant context for the analysis aiming at formulating several recommendations.

The data that will be presented bellow have resulted from the research structured in the following way:

- Due to the variety of engineering areas the topics have been grouped in to the following categories:
  - Theoretical and supporting disciplines
  - Electrotechnology and microelectronics
  - Electronics and radio electronics
  - Telecommunications and networks
  - Automation, measurement and controlling
  - Biomedical engineering
  
- For the Czech Academy of Sciences the following categories have been used:

- Physics of materials
  - Photonics, electronics, instrumentation
  - Informatics and automation
- The structure of academic positions reflected the following national specifics
- Austrian institutions:
    - professor, associated professor, doctor (Ph.D.), Ing/MSc equivalent, other specialists; there is no category of Ph.D. students – they are included into Ing/MSc group
  - Czech and Slovak institutions:
    - professor, docent, doctor (Ph.D.), Ing/MSc equivalent, and Ph.D. student
  - Polish institutions:
    - professor, doctor (Ph.D.), Ing/MSc equivalent; there is no category of Ph.D. students – they are included into Ing/MSc group
- The following institutions (universities and research institutes) have been included in the statistics:
- Austria
    - Technische Universität Wien
    - Technische Universität Linz
    - Technische Universität Graz
  - Czech Republic
    - České vysoké učení technické
    - Vysoké učení technické v Brně
    - Vysoká škola báňská – Technická univerzita Ostrava
    - Univerzita Pardubice
    - Západočeská univerzita
    - Univerzita Tomáše Bati
    - Akademie věd České republiky
  - Poland
    - Akademia Górniczo-Hutnicza im. St. Staszica
    - Politechnika Częstochowska
    - Politechnika Gdańska
    - Politechnika Koszalińska
    - Politechnika Krakowska
    - Politechnika Lubelska
    - Politechnika Łódzka
    - Politechnika Opolska
    - Politechnika Poznańska
    - Politechnika Rzeszowska im. Ignacego Łukasiewicza
    - Politechnika Śląska
    - Politechnika Świętokrzyska
    - Politechnika Warszawska
  - Slovakia
    - Slovenská technická univerzita v Bratislave
    - Technická univerzita v Košiciach
    - Žilinská univerzita v Žiline



The tables presented bellow show the overall results allowing general interpretation. The specific tables for each category can be found in the annex of this study.

### ***Austria***

**Tab. 1 Total number/% of women in Austrian technical universities**

Total AT			
	women	all	% of women
Prof.	3	74	4,1
Assoc. Prof.	1	67	1,4
Doctor (Ph.D.)	43	370	11,6
Master	85	545	15,6
total	132	1056	12,5

### ***Czech Republic***

**Tab. 2 Total number/% of women in Czech technical universities**

Total CZ (Universities)			
	women	all	% of women
Prof.	7	121	5,8
Assoc. Prof.	9	202	4,5
Doctor (Ph.D.)	36	404	8,9
Master	45	198	22,7
Ph.D. stud	105	886	11,9
total	202	1811	11,2

**Tab. 3 Total number/% of women in the Czech Academy of Science (technical institutes)**

Total CAS			
	women	all	% of women
Prof.	2	38	5,3
Assoc. Prof.	1	30	3,3
Doctor (Ph.D.)	48	269	17,8
Master	49	166	29,5
total	100	503	19,9

## **Poland**

**Tab. 4 Total number/% of women in Polish institutions**

Total PL			
	women	all	% of women
Prof.	10	201	5
Doctor (Ph.D.)	94	978	9,6
Master	123	628	19,6
total	227	1807	12,6

## **Slovakia**

**Tab. 5 Total number/% of women in Slovak institutions**

Total SK			
	women	all	% of women
Prof.	11	85	12,9
Assoc. Prof.	25	118	21,2
Doctor (Ph.D.)	44	230	19,1
Master	11	40	27,5
Ph.D. stud	22	230	9,6
total	113	703	16,1

The overall results show a large degree of similarity among the countries. The share of women among university professionals is slightly above 10 percent with the exception of Slovakia where the total share is higher (16 percent). Apparently this figure is not random since the Slovak technical academia seems to be the most feminized among the investigated countries. A convincing interpretation of this fact would need a substantial research but the plausible explanation might be connected with several waves of expert exodus that Slovakia was experiencing during the federation times as well as in the 1990s. Since it is generally easier for men to move to pursue their careers the female specialists could benefit from this in terms earning contracts and positions. Additionally Slovakia has the lowest number of female Ph.D. students across the region (this could again signal specific gender dynamics in the past).

However, the detailed sets of the data that have been gathered have revealed several other interesting issues. The qualitative reading of the Czech data has shown that the Czech technical academia includes not inconsiderable amount of female doctoral students from Eastern Europe. This corresponds with several cooperative and supporting schemes that exist in this area. Quite interestingly, Polish universities where the students coming from Eastern Europe could be expected as well do not seem to recognize this group of students

(or foreign students on general). Rather consistently, there is a recognizable group of Polish and Slovak female Ph.D. students present at the Austrian institutions. In comparison with other regional academia the Austrian one seems to be the most nationally diverse.

The qualitative reading of the data has also revealed that women working in the institutions are often married to their colleagues. Furthermore, women rather often do not finish their doctoral studies during/after their maternity leave and if they get the degree they very often leave the institution or remain at lower academic positions. This would obviously support the idea that it is difficult to combine professional career with family care in this male-dominated area. Finally, women with higher rankings tend to have other organisational and managerial functions, thus investing part of their professional commitment to administration rather than research.

In a nutshell, apart from slightly higher share of women particularly in the higher positions in Slovakia, the data did not reveal any unexpected results. Moreover, the qualitative reading seems to support the existence of the projected gender issues and barriers. These issues will be further examined based on the data provided by our questionnaire investigation.

As regards the specific areas that tend to be appealing for women the following have been identified as prevailing - Biomedical engineering – imaging, therapeutic technique, biosignals, drug delivery to tissues; Engineering physics – semiconductors, nanostructures, electrochemistry, thin films, superconductors; Electromagnetic field – propagation, measurement, simulation, antennas; Optical engineering – fiber optics, photonics, optical communications, optical sensors; Cybernetics and automation – biomedicine, robotics, control systems; Measurement – microscopy, diagnostics, magnetic resonance, sensors; Electrotechnology – semiconductors, photovoltaics, material engineering, energy storage, materials theory; Microelectronics – nanosensors, nanotechnology, thin films, graphene.

Apart from biomedical engineering this list does not seem to reveal an explicit gender dimension. However, when expanding the list of the engineering programmes to all technical faculties some of the more feminized sectors become obvious (Czech Statistical Office 2014, see table below). Both major faculties of architecture (Czech Technical University in Prague and Brno University of Technology) show a majority of female students. Interestingly, getting back to the cognitive determinations architecture apparently requires certain spatial skills that tend to be associated with men. On the other hand faculties of architecture involve several programmes focusing on design or applied art where the alleged female qualities should become essential.

**Tab. 6 total number/% of women in the Czech technical faculties**

Faculty/University	women	men	% women	% men
F. of Mathematics and Physics Charles Uni	623	2002	24	76
F. of Informatics Masaryk Uni	294	2233	12	88
F. of Civil Engineering Czech Technical Uni (CTU)	1993	3434	37	63
F. of Mechanical Engineering CTU	227	2276	9	91
F. of Electrical Engineering CTU	285	3317	8	92
F. of Information Technologies CTU	170	1953	8	92

F. of Transportation Sciences CTU	431	1422	23	67
F. of Nuclear Sciences and Physical Engineering CTU	473	1192	28	72
F. of Architecture CTU	906	813	53	47
F. of Biomedical Engineering CTU	852	530	62	38
F. of Mechanical Engineering Pilsen	181	1197	13	87
F. of Electrical Engineering Pilsen	168	1612	9	91
F. of Mechanical Engineering Liberec	120	1258	9	91
F. of Mechatronics, Informatics and Interdisciplinary Studies Liberec	59	732	8	92
Jan Perner Transport faculty Pardubice	512	1606	24	76
F. of Electrotechnical Engineering and Computer Science Pardubice	48	1068	4	96
F. of Civil Engineering Brno Uni of Technology (BUT)	2113	4340	33	77
F. of Mechanical Engineering BUT	373	3955	9	91
F. of Electrical Engineering and Communication BUT	314	3392	9	91
F. of Informatin Technology BUT	139	2187	6	94
F. of Chemical Engineering BUT	698	371	65	35
F. of Architecture BUT	349	285	55	45
F. of Civil Engineering Ostrava	763	1411	35	65
F. of Security Engineering Ostrava	416	1124	27	73
F. of Mechanical Engineering Ostrava	148	1990	7	93
F. of Electrical Engineering and Computer Science Ostrava	279	3138	8	92
F. of Mining and Geology Ostrava	1521	1880	45	55
F. of Metallurgy and Material Engineering Ostrava	875	1319	40	60
F. of Informatics and Statistics University of Economics Prague	892	2171	30	70
F. of Engineering Czech Uni of Life Sciences (CULS)	181	1719	10	90
F. of Forestry and Wood Sciences CULS	864	1647	34	66
F. of Forestry and Wood Technology Mendel Uni Brno	612	1218	33	67

The most striking figures coming out from this statistics concern a large proportion of female students at the Faculties of Mining and Geology (45 percent) and Metallurgy and Material Engineering of the Technical University in Ostrava (40 percent). Additionally, the Faculty of Electrical Engineering and Computer Science of the same university has one of the lowest shares of female students (8 percent). These figures suggest that the potentially most masculinized faculties (mining and heavy industrial technologies) are extremely successful in presenting themselves as environments accommodating female scientific interests and offering prospective careers for women.



### **3 Review of the programmes supporting women participation in sciences**

#### **3.1 National and International Policy Initiatives**

Recognizing both the normative as well as pragmatic reasons for attracting more women to technical education and more generally to STEM areas there are several initiatives promoting this agenda on national as well as international levels.

Essentially for the areas relevant in this project there is the Women in Engineering Group (WIE) within the Institute of Electrical and Electronics Engineers (IEEE) being the largest international professional organization dedicated to promoting women engineers and scientists and inspiring girls around the world to follow their academic interests to a career in engineering. The group aims at facilitating the recruitment and retention of women in technical disciplines and stimulating creation of vibrant innovative environments based on trans-gender cooperation. The organization promotes exceptional women achievements in the area and supports women career developments.

Traditionally, the U.S academia is (as well as the entire society) very sensitive towards gender issues. The Office of Science and Technology under the President Obama's Administration has run a specific programme promoting women participation in STEM (Office of Science and Technology Policy). As the programme emphasizes "Supporting women STEM students and researchers is not only an essential part of America's strategy to out-innovate, out-educate, and out-build the rest of the world; it is also important to women themselves. Women in STEM jobs earn 33 percent more than those in non-STEM occupations and experience a smaller wage gap relative to men" (Office of Science and Technology Policy 2015). By its extensive nature and impact the U.S. academia has a global reach particularly when it comes to scientific excellence.

In the UK the initiatives comes rather through the universities. Most prominently it is the Women in Science, Engineering, and Technology (WiSET) scheme that is organized by the Sheffield Hallam University and the Women in Science, Technology and Engineering (WISE) campaign. While providing a rich variety of information and supporting mechanisms they both share a goal of getting one more million women to the UK STEM workforce. Reflecting the U.S. and UK initiatives it should be also noted that one can find numerous women associations operating in single academic institutions supporting women performances in technical/ICT sciences.

Several initiatives also function on the EU level. The European Commission under the Digital Agenda for Europe has run a programme called Women in ICT (Women in ICT). Summarising many issues that have already mentioned by this report a recent study published under this framework has shown that bringing more women into EU digital sector would bring €9 billion annual GDP boost (Women Active in the ICT Sector 2013). Other initiatives are also connected with the specialized scientific organizations and bodies. Apart from the WIE IEEE group mentioned above we can also mention Women in ICST Research and Education (Women in ICTS Research and Education), which a working group of Informatics Europe uniting leading European educational and research institutions in the ICT area (incl. Vienna University of Technology, or Czech Technical University).

Last but not least several corporations run their own initiatives supporting women participation in areas where gender issue appears to be marginalized. To mention at least

two - Microsoft generously funds the Women Fellowship Scheme or cosmetic giant L'ORÉAL supports the Women in Science programme in cooperation with UNESCO. This initiative has a national branch in the Czech Republic awarding excellent Czech female scientists ([www.prozenyvevede.cz](http://www.prozenyvevede.cz)).

Although they do not seem to be widely recognized within society also several Czech technical universities have joined the campaigns promoting technical education among girls and women. The largest institutions - Czech Technical University as well as Brno University of Technology – have both supported the web portal [www.zkusit.cz](http://www.zkusit.cz) (“tryIT”) trying to attract women to ICT sector. The CTU also runs a much more vibrant web portal [www.holkypozor.cz](http://www.holkypozor.cz) (“attentiongirls”) that informs about the interesting events happening at the CTU while often including perceptions of the current female students. The initiative also tries to build on the reputation of excellent female scientists and highly successful and recognized alumnae.

## **4 Sociological investigation**

### **4.1 Research Design**

The research has been based on the questionnaire investigation targeting three distinct social clusters – high/grammar school and university students (Czech Republic), and technical university students in Brno and Vienna. After the data collection the following operations were performed and will be presented and interpreted below.

First, the representative sample of the Czech high/grammar and university students was statistically cross-calculated to reveal results concerning societal prejudices and views of the women’s professional orientations along the gender and educational cleavages. The data will be summarized in the general Table 7 and subsequent tables that will only present the views of high school students.

Second, the group of the Czech university students from the general representative sample (254 members) was included into the analysis of the samples gathered at the universities in Brno and Vienna. The tables 11 and 12 will present the data with and without gender cleavage looking at the general societal gender prejudices as well as prejudices related to technical education. Finally, the tables 9 and 10 will offer the datasets focusing on the prejudices related to women’s professional capabilities and performance.

**Tab. 7 Czech Representative sample – high school/university students\_gender**

	Currently studying high school/university																			
	high school										university									
	Gender										Gender									
	Male					Female					Male					Female				
	strongly agree	rather agree	Do not agree, nor disagree	rather disagree	strongly disagree	strongly agree	rather agree	Do not agree, nor disagree	rather disagree	strongly disagree	strongly agree	rather agree	Do not agree, nor disagree	rather disagree	strongly disagree	strongly agree	rather agree	Do not agree, nor disagree	rather disagree	strongly disagree
Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %
Society does not support women	5.2%	15.6%	21.5%	35.6%	22.2%	2.5%	17.5%	27.5%	38.3%	14.2%	1.0%	13.5%	22.1%	37.5%	26.0%	0.7%	24.7%	30.0%	34.7%	10.0%
Women are not interested in professional advancement and career	1.5%	2.2%	14.8%	48.1%	33.3%	0.8%	4.2%	5.0%	26.7%	63.3%	1.0%	1.9%	10.6%	35.6%	51.0%	1.3%	0.7%	6.0%	33.3%	58.7%
Men dominate the jobs and do not give women a chance	3.0%	28.1%	34.8%	22.2%	11.9%	3.3%	28.3%	28.3%	25.8%	14.2%	1.9%	19.2%	31.7%	32.7%	14.4%	1.3%	30.0%	38.0%	21.3%	9.3%
Men can do a lot of things better than women	13.3%	23.0%	37.8%	18.5%	7.4%	5.0%	12.5%	30.8%	34.2%	17.5%	8.7%	30.8%	35.6%	17.3%	7.7%	3.3%	8.0%	29.3%	33.3%	26.0%
Men have a higher chance to become successful than women having the same potential	8.1%	42.2%	25.9%	17.0%	6.7%	9.2%	38.3%	17.5%	24.2%	10.8%	2.9%	47.1%	19.2%	22.1%	8.7%	10.7%	51.3%	13.3%	12.7%	12.0%
On the elementary school boys are better at maths than girls	6.7%	21.5%	35.6%	26.7%	9.6%	6.7%	22.5%	30.0%	21.7%	19.2%	6.7%	27.9%	30.8%	20.2%	14.4%	2.7%	16.0%	32.0%	28.0%	21.3%
On the elementary school girls are better at Czech/German than boys	9.6%	34.8%	34.1%	13.3%	8.1%	12.5%	38.3%	30.0%	12.5%	6.7%	7.7%	44.2%	24.0%	12.5%	11.5%	8.7%	34.7%	34.0%	12.0%	10.7%
For a boy, who does want to go at university, is technical school the best option	7.4%	35.6%	27.4%	17.8%	11.9%	5.8%	30.8%	25.8%	24.2%	13.3%	5.8%	34.6%	28.8%	19.2%	11.5%	3.3%	26.7%	26.7%	22.0%	21.3%
For a girl, who does want to go at university, is economic or health care school the best option	6.7%	33.3%	31.9%	15.6%	12.6%	2.5%	24.2%	27.5%	22.5%	23.3%	4.8%	25.0%	34.6%	21.2%	14.4%	4.0%	24.0%	22.0%	28.7%	21.3%
It is more difficult for girls to get at the technical university (electro technical, building construction, or mechanical engineering faculty)	14.1%	45.2%	19.3%	14.1%	7.4%	10.0%	46.7%	15.8%	20.8%	6.7%	10.6%	40.4%	18.3%	22.1%	8.7%	9.3%	36.0%	22.7%	18.7%	13.3%



Technical university is less attractive for girls than for boys	22.2%	55.6%	14.1%	5.9%	2.2%	15.8%	47.5%	16.7%	15.0%	5.0%	26.0%	51.9%	13.5%	6.7%	1.9%	14.7%	56.7%	12.0%	12.0%	4.7%
Humanities, social sciences, or economics are less attractive for boys than for girls	7.4%	34.8%	29.6%	19.3%	8.9%	3.3%	28.3%	32.5%	23.3%	12.5%	7.7%	31.7%	19.2%	28.8%	12.5%	4.7%	36.0%	24.0%	21.3%	14.0%
It is more difficult for boys than for girls to get at humanities or economic university	5.2%	25.9%	27.4%	26.7%	14.8%	0.8%	15.8%	31.7%	34.2%	17.5%	1.0%	16.3%	22.1%	34.6%	26.0%	0.7%	6.7%	28.0%	30.0%	34.7%
As in the past girls should not go to universities	0.7%	2.2%	7.4%	16.3%	73.3%	2.5%	2.5%	2.5%	5.8%	86.7%	0.0%	1.0%	4.8%	9.6%	84.6%	1.3%	1.3%	2.0%	1.3%	94.0%
I enjoy/ed studying maths at elementary and high schools	20.0%	33.3%	11.9%	17.0%	17.8%	24.2%	25.8%	13.3%	20.8%	15.8%	32.7%	36.5%	11.5%	9.6%	9.6%	24.7%	32.0%	13.3%	16.0%	14.0%
Lessons of math are/were one of the worst for me at elementary and high schools	17.0%	18.5%	10.4%	21.5%	32.6%	17.5%	18.3%	10.8%	19.2%	34.2%	4.8%	8.7%	10.6%	32.7%	43.3%	11.3%	11.3%	11.3%	23.3%	42.7%
Women can be similarly or even more successful in humanities or social sciences	31.1%	46.7%	19.3%	3.0%	0.0%	49.2%	37.5%	9.2%	3.3%	0.8%	33.7%	47.1%	15.4%	2.9%	1.0%	42.7%	39.3%	16.0%	0.7%	1.3%
Women can be similarly or even more successful in technical sciences	17.0%	26.7%	27.4%	25.2%	3.7%	26.7%	35.0%	22.5%	13.3%	2.5%	26.9%	29.8%	24.0%	18.3%	1.0%	28.7%	28.0%	28.7%	14.0%	0.7%
Women can be similarly or even more successful in natural sciences	26.7%	39.3%	25.9%	5.2%	3.0%	39.2%	45.0%	12.5%	2.5%	0.8%	29.8%	38.5%	25.0%	5.8%	1.0%	36.7%	36.7%	22.0%	3.3%	1.3%
Women can combine scientific career with family care	12.6%	37.8%	31.1%	15.6%	3.0%	20.0%	45.0%	20.8%	12.5%	1.7%	8.7%	48.1%	28.8%	13.5%	1.0%	19.3%	45.3%	20.0%	13.3%	2.0%
Women are similarly talented at technical subjects as men	8.1%	23.0%	31.1%	37.0%	0.7%	10.0%	28.3%	38.3%	20.8%	2.5%	7.7%	27.9%	21.2%	37.5%	5.8%	13.3%	22.7%	34.0%	28.0%	2.0%

## **4.2 Sample:**

### **4.2.1 Czech societal views on gender and women careers**

In terms of general societal prejudices the results reveal only decent differences between the high school and university students while the latter generally believe more that women are interested in professional careers advancement. In general, educational level does not seem to play essential role in students' views of the societal gender issues.

The gender cleavages show basically the same values when it comes to general gender issues but some specifics become visible when looking at cognitive abilities. Most strikingly, only less than 19% of female university students agree that boys are better at maths on elementary schools. This view is however shared by almost 35% male university students. Quite interestingly, high school students view this issue similarly (around 28% agree with the statement). Correspondingly, only about 43% of female university students agree that girls are better at languages while this view is shared by 53% of male university students. Both, high school as well as university male students believe that technical education is a good option for boys (43/41%) while only 29% of female university students support this idea. Additionally, female high school students believe (40%) that economic or health care programmes are more suitable for women/girls while the other groups do not show such a strong position on this. This group also views technical programmes as difficult (59%) and non-attractive (77%) for women. On the other side only 45% of female university students view technical programmes as more difficult for women. When it comes to attractiveness of technical programmes both groups of university students are rather sceptical (77% men, 70% women).

The table above summarizes the data related to women's professional paths. The representatives of the young generation seem to be more sceptical about women's potential to become successful Electro Engineer (52% men, 48% women). This table also reveals one of the strongest cases gender cleavages when only 60% of male high school students believe women can become successful programmers while four fifths of the remaining researched groups view this option as highly possible.

### **4.2.2 Potential technical/ICT students (Grammar/High School students)**

From a general perspective the results show rather coherent picture of the gender-oriented views vis-à-vis technical education among the Czech young population. The female university students seem to be self-conscious when it comes to cognitive capabilities associated with technical degrees but similarly to their younger colleagues they do not find them attractive. These results are also confirmed by the following figures which have filtered only high school students.

### Tab. 8.1-9 Potential students' answers\_gender crosstabulation

It is more difficult for girls to get at the technical university (electro technical, building construction, or mechanical engineering faculty) \* Gender Crosstabulation

% within Gender

		Gender		Total
		Male	Female	
It is more difficult for girls to get at the technical university (electro technical, building construction, or mechanical engineering faculty)	strongly agree	14.1%	10.0%	12.2%
	rather agree	45.2%	46.7%	45.9%
	Do not agree, nor disagree	19.3%	15.8%	17.6%
	rather disagree	14.1%	20.8%	17.3%
	strongly disagree	7.4%	6.7%	7.1%
Total		100.0%	100.0%	100.0%

Lessons of math are/were one of the worst for me at elementary and high schools \* Gender Crosstabulation

% within Gender

		Gender		Total
		Male	Female	
Lessons of math are/were one of the worst for me at elementary and high schools	strongly agree	17.0%	17.5%	17.3%
	rather agree	18.5%	18.3%	18.4%
	Do not agree, nor disagree	10.4%	10.8%	10.6%
	rather disagree	21.5%	19.2%	20.4%
	strongly disagree	32.6%	34.2%	33.3%
Total		100.0%	100.0%	100.0%

I enjoy/ed studying maths at elementary and high schools \* Gender Crosstabulation

% within Gender

		Gender		Total
		Male	Female	
I enjoy/ed studying maths at elementary and high schools	strongly agree	20.0%	24.2%	22.0%
	rather agree	33.3%	25.8%	29.8%
	Do not agree, nor disagree	11.9%	13.3%	12.5%
	rather disagree	17.0%	20.8%	18.8%
	strongly disagree	17.8%	15.8%	16.9%
Total		100.0%	100.0%	100.0%

Technical university is less attractive for girls than for boys \* Gender Crosstabulation

% within Gender

		Gender		Total
		Male	Female	
Technical university is less attractive for girls than for boys	strongly agree	22.2%	15.8%	19.2%
	rather agree	55.6%	47.5%	51.8%
	Do not agree, nor disagree	14.1%	16.7%	15.3%
	rather disagree	5.9%	15.0%	10.2%
	strongly disagree	2.2%	5.0%	3.5%
Total		100.0%	100.0%	100.0%

**Women can be similarly or even more successful in technical sciences \* Gender Crosstabulation**

% within Gender

		Gender		Total
		Male	Female	
Women can be similarly or even more successful in technical sciences	strongly agree	17.0%	26.7%	21.6%
	rather agree	26.7%	35.0%	30.6%
	Do not agree, nor disagree	27.4%	22.5%	25.1%
	rather disagree	25.2%	13.3%	19.6%
	strongly disagree	3.7%	2.5%	3.1%
<b>Total</b>		100.0%	100.0%	100.0%

**Humanities, social sciences, or economics are less attractive for boys than for girls \* Gender Crosstabulation**

% within Gender

		Gender		Total
		Male	Female	
Humanities, social sciences, or economics are less attractive for boys than for girls	strongly agree	7.4%	3.3%	5.5%
	rather agree	34.8%	28.3%	31.8%
	Do not agree, nor disagree	29.6%	32.5%	31.0%
	rather disagree	19.3%	23.3%	21.2%
	strongly disagree	8.9%	12.5%	10.6%
<b>Total</b>		100.0%	100.0%	100.0%

**Women can be similarly or even more successful in natural sciences \* Gender Crosstabulation**

% within Gender

		Gender		Total
		Male	Female	
Women can be similarly or even more successful in natural sciences	strongly agree	26.7%	39.2%	32.5%
	rather agree	39.3%	45.0%	42.0%
	Do not agree, nor disagree	25.9%	12.5%	19.6%
	rather disagree	5.2%	2.5%	3.9%
	strongly disagree	3.0%	0.8%	2.0%
<b>Total</b>		100.0%	100.0%	100.0%

**Women can combine scientific career with family care \* Gender Crosstabulation**

% within Gender

		Gender		Total
		Male	Female	
Women can combine scientific career with family care	strongly agree	12.6%	20.0%	16.1%
	rather agree	37.8%	45.0%	41.2%
	Do not agree, nor disagree	31.1%	20.8%	26.3%
	rather disagree	15.6%	12.5%	14.1%
	strongly disagree	3.0%	1.7%	2.4%
<b>Total</b>		100.0%	100.0%	100.0%

**Women are similarly talented at technical subjects as men \* Gender Crosstabulation**

% within Gender

		Gender		Total
		Male	Female	
Women are similarly talented at technical subjects as men	strongly agree	8.1%	10.0%	9.0%
	rather agree	23.0%	28.3%	25.5%
	Do not agree, nor disagree	31.1%	38.3%	34.5%
	rather disagree	37.0%	20.8%	29.4%
	strongly disagree	0.7%	2.5%	1.6%
<b>Total</b>		100.0%	100.0%	100.0%

Reviewing these figures provided by high school (hence potential university) students it is again apparent that the perceived cognitive capabilities do not seem to be decisive as girls believe in their abilities in math and basically deny any (biological/societal) predispositions for humanities, social or health sciences. Similarly, they do not see a combination of family and career in technical/natural sciences as problematic. The crucial issue seems to be the attractiveness of technical education, where both genders view the gender problem similarly (e.g. technical subjects not being attractive for women).

#### 4.2.3 University/Technical university students' view of general gender issues and gender issues connected with technical field

The data obtained from the university students (254 general Czech university students, 97 Brno students, and 51 Vienna students) provide statement about the environment at the universities in general and more specifically at the technical universities. Comparing the three groups of respondents based on the data touching the general societal gender issues, we see major gender and national cleavages. Most strikingly when responding the question if men can do a lot of things better than women the results of the shares showing agreement (rather + strong) were the following – Czech male (39 %), Czech female (11 %), Vienna male (19 %), Vienna female (0 %), Brno male (38 %), Brno female (10 %). These figures were chosen as illustrative but virtually all responses follow this pattern showing a great discrepancy between Austrian female students and Czech male students (particularly Brno students; for details see table 11 below).

When it comes to technical education the Czech students agree much more than Austrians that this type of education is more difficult for women. This view was only supported by 3 % of Austrian male students and 0% of Austrian female students. Brno technical students (both female and male 34/38 %) agree with this statement slightly less than the Czech mixed university students 51/45 %. Additionally, the Austrian representatives believe much more (60/60 % – only *strong* agreement on the part of female student) than their Czech colleagues (Cze – 36/36 %; Brno – 37/57 %) that women can be similarly or even more talented for technical subjects than men.

**Tab. 9 University/technical university students\_women professional paths**

	ide					
	general CZE		Wien		Brno	
	yes	no	yes	no	yes	no
	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %
Woman can be successful as: Medical Doctor	99,2%	,8%	100,0%	0,0%	91,8%	8,2%
Woman can be successful as: Teacher	98,4%	1,6%	98,0%	2,0%	90,7%	9,3%
Woman can be successful as: Economist	98,8%	1,2%	96,1%	3,9%	85,6%	14,4%
Woman can be successful as: Electro Engineer	73,2%	26,8%	92,2%	7,8%	69,1%	30,9%
Woman can be successful as: Programmer	79,5%	20,5%	90,2%	9,8%	70,1%	29,9%

**Tab. 10 University/technical university students\_women professional paths\_gender cleavage**

	ide											
	general CZE				Wien				Brno			
	Gender				Gender				Gender			
	Male		Female		Male		Female		Male		Female	
	yes	no	yes	no	yes	no	yes	no	yes	no	yes	no
	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %
Woman can be successful as: Medical Doctor	98,1%	1,9%	100,0%	0,0%	100,0%	0,0%	100,0%	0,0%	90,8%	9,2%	95,2%	4,8%
Woman can be successful as: Teacher	97,1%	2,9%	99,3%	,7%	96,9%	3,1%	100,0%	0,0%	88,2%	11,8%	100,0%	0,0%
Woman can be successful as: Economist	97,1%	2,9%	100,0%	0,0%	96,9%	3,1%	100,0%	0,0%	84,2%	15,8%	90,5%	9,5%
Woman can be successful as: Electro Engineer	72,1%	27,9%	74,0%	26,0%	93,8%	6,3%	100,0%	0,0%	67,1%	32,9%	76,2%	23,8%
Woman can be successful as: Programmer	80,8%	19,2%	78,7%	21,3%	93,8%	6,3%	100,0%	0,0%	68,4%	31,6%	76,2%	23,8%

The tables summarizing the views on the potential women professional paths only underline major gender and national discrepancies. Austrian female students unanimously responded in a way that women can be successful in all areas offered in the questionnaire and the figures from Austrian male students also reveal almost unanimous consent. The prejudices based on assumptions of cognitive preconditions appeared in both Czech groups roughly a third of Brno male students is sceptical regarding women's prospects in electro engineering and programming.

**Tab. 11 University students – CZE\_Vienna\_Brno\_gender**

	ide									
	general CZE									
	Gender									
	Male					Female				
	strongly agree	rather agree	Do not agree, nor disagree	rather disagree	strongly disagree	strongly agree	rather agree	Do not agree, nor disagree	rather disagree	strongly disagree
Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %
Society does not support women	1,0%	13,5%	22,1%	37,5%	26,0%	,7%	24,7%	30,0%	34,7%	10,0%
Women are not interested in professional advancement and career	1,0%	1,9%	10,6%	35,6%	51,0%	1,3%	,7%	6,0%	33,3%	58,7%
Men dominate the jobs and do not give women a chance	1,9%	19,2%	31,7%	32,7%	14,4%	1,3%	30,0%	38,0%	21,3%	9,3%
Men can do a lot of things better than women	8,7%	30,8%	35,6%	17,3%	7,7%	3,3%	8,0%	29,3%	33,3%	26,0%
Men have a higher chance to become successful than women having the same potential	2,9%	47,1%	19,2%	22,1%	8,7%	10,7%	51,3%	13,3%	12,7%	12,0%
On the elementary school boys are better at maths than girls	6,7%	27,9%	30,8%	20,2%	14,4%	2,7%	16,0%	32,0%	28,0%	21,3%
On the elementary school girls are better at Czech/German than boys	7,7%	44,2%	24,0%	12,5%	11,5%	8,7%	34,7%	34,0%	12,0%	10,7%
For a boy, who does want to go at university, is technical school the best option	5,8%	34,6%	28,8%	19,2%	11,5%	3,3%	26,7%	26,7%	22,0%	21,3%
For a girl, who does want to go at university, is economic or health care school the best option	4,8%	25,0%	34,6%	21,2%	14,4%	4,0%	24,0%	22,0%	28,7%	21,3%
It is more difficult for girls to get at the technical university (electro technical, building construction, or mechanical engineering faculty)	10,6%	40,4%	18,3%	22,1%	8,7%	9,3%	36,0%	22,7%	18,7%	13,3%
Technical university is less attractive for girls than for boys	26,0%	51,9%	13,5%	6,7%	1,9%	14,7%	56,7%	12,0%	12,0%	4,7%
Humanities, social sciences, or economics are less attractive for boys than for girls	7,7%	31,7%	19,2%	28,8%	12,5%	4,7%	36,0%	24,0%	21,3%	14,0%
It is more difficult for boys than for girls to get at humanities or economic university	1,0%	16,3%	22,1%	34,6%	26,0%	,7%	6,7%	28,0%	30,0%	34,7%
As in the past girls should not go to universities	0,0%	1,0%	4,8%	9,6%	84,6%	1,3%	1,3%	2,0%	1,3%	94,0%

I enjoy/ed studying maths at elementary and high schools	32,7%	36,5%	11,5%	9,6%	9,6%	24,7%	32,0%	13,3%	16,0%	14,0%
Lessons of math are/were one of the worst for me at elementary and high schools	4,8%	8,7%	10,6%	32,7%	43,3%	11,3%	11,3%	11,3%	23,3%	42,7%
Women can be similarly or even more successful in humanities or social sciences	33,7%	47,1%	15,4%	2,9%	1,0%	42,7%	39,3%	16,0%	,7%	1,3%
Women can be similarly or even more successful in technical sciences	26,9%	29,8%	24,0%	18,3%	1,0%	28,7%	28,0%	28,7%	14,0%	,7%
Women can be similarly or even more successful in natural sciences	29,8%	38,5%	25,0%	5,8%	1,0%	36,7%	36,7%	22,0%	3,3%	1,3%
Women can combine scientific career with family care	8,7%	48,1%	28,8%	13,5%	1,0%	19,3%	45,3%	20,0%	13,3%	2,0%
Women are similarly talented at technical subjects as men	7,7%	27,9%	21,2%	37,5%	5,8%	13,3%	22,7%	34,0%	28,0%	2,0%
	ide									
	Wien									
	Gender									
	Male					Female				
	strongly agree	rather agree	Do not agree, nor disagree	rather disagree	strongly disagree	strongly agree	rather agree	Do not agree, nor disagree	rather disagree	strongly disagree
	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %
	Society does not support women	0,0%	3,1%	18,8%	34,4%	43,8%	0,0%	0,0%	20,0%	20,0%
Women are not interested in professional advancement and career	0,0%	6,3%	6,3%	25,0%	62,5%	0,0%	0,0%	0,0%	60,0%	40,0%
Men dominate the jobs and do not give women a chance	0,0%	9,4%	40,6%	28,1%	21,9%	20,0%	20,0%	40,0%	20,0%	0,0%
Men can do a lot of things better than women	3,1%	15,6%	21,9%	28,1%	31,3%	0,0%	0,0%	0,0%	40,0%	60,0%
Men have a higher chance to become successful than women having the same potential	15,6%	34,4%	18,8%	18,8%	12,5%	40,0%	40,0%	20,0%	0,0%	0,0%
On the elementary school boys are better at maths than girls	9,4%	9,4%	31,3%	9,4%	40,6%	0,0%	0,0%	0,0%	20,0%	80,0%
On the elementary school girls are better at Czech/German than boys	3,1%	15,6%	37,5%	12,5%	31,3%	0,0%	20,0%	20,0%	20,0%	40,0%
For a boy, who does want to go at university, is technical school the best option	6,3%	18,8%	25,0%	9,4%	40,6%	0,0%	0,0%	60,0%	0,0%	40,0%



For a girl, who does want to go at university, is economic or health care school the best option	0,0%	3,1%	40,6%	12,5%	43,8%	0,0%	0,0%	60,0%	0,0%	40,0%
It is more difficult for girls to get at the technical university (electro technical, building construction, or mechanical engineering faculty)	0,0%	3,1%	18,8%	15,6%	62,5%	0,0%	0,0%	0,0%	0,0%	100,0%
Technical university is less attractive for girls than for boys	3,1%	34,4%	18,8%	15,6%	28,1%	0,0%	40,0%	0,0%	20,0%	40,0%
Humanities, social sciences, or economics are less attractive for boys than for girls	3,1%	15,6%	28,1%	21,9%	31,3%	0,0%	0,0%	0,0%	20,0%	80,0%
It is more difficult for boys than for girls to get at humanities or economic university	0,0%	0,0%	28,1%	18,8%	53,1%	0,0%	0,0%	0,0%	0,0%	100,0%
As in the past girls should not go to universities	0,0%	0,0%	0,0%	0,0%	100,0%	0,0%	0,0%	0,0%	0,0%	100,0%
I enjoy/ed studying maths at elementary and high schools	53,1%	21,9%	12,5%	9,4%	3,1%	20,0%	40,0%	0,0%	20,0%	20,0%
Lessons of math are/were one of the worst for me at elementary and high schools	0,0%	6,3%	9,4%	28,1%	56,3%	0,0%	20,0%	0,0%	20,0%	60,0%
Women can be similarly or even more successful in humanities or social sciences	28,1%	28,1%	25,0%	6,3%	12,5%	80,0%	0,0%	20,0%	0,0%	0,0%
Women can be similarly or even more successful in technical sciences	28,1%	31,3%	18,8%	15,6%	6,3%	80,0%	0,0%	20,0%	0,0%	0,0%
Women can be similarly or even more successful in natural sciences	31,3%	28,1%	21,9%	12,5%	6,3%	80,0%	0,0%	20,0%	0,0%	0,0%
Women can combine scientific career with family care	25,0%	31,3%	28,1%	15,6%	0,0%	40,0%	40,0%	0,0%	20,0%	0,0%
Women are similarly talented at technical subjects as men	37,5%	21,9%	31,3%	6,3%	3,1%	60,0%	0,0%	20,0%	20,0%	0,0%
	ide									
	Brno									
	Gender									
	Male					Female				
	strongly agree	rather agree	Do not agree, nor disagree	rather disagree	strongly disagree	strongly agree	rather agree	Do not agree, nor disagree	rather disagree	strongly disagree
	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %
Society does not support women	2,6%	2,6%	15,8%	25,0%	53,9%	0,0%	14,3%	19,0%	52,4%	14,3%
Women are not interested in professional advancement and career	0,0%	5,3%	17,1%	26,3%	51,3%	0,0%	0,0%	0,0%	42,9%	57,1%

Men dominate the jobs and do not give women a chance	2,6%	7,9%	14,5%	39,5%	35,5%	0,0%	33,3%	23,8%	33,3%	9,5%
Men can do a lot of things better than women	18,4%	19,7%	30,3%	19,7%	11,8%	0,0%	9,5%	19,0%	42,9%	28,6%
Men have a higher chance to become successful than women having the same potential	7,9%	27,6%	18,4%	25,0%	21,1%	23,8%	42,9%	4,8%	23,8%	4,8%
On the elementary school boys are better at maths than girls	7,9%	26,3%	26,3%	18,4%	21,1%	4,8%	14,3%	23,8%	14,3%	42,9%
On the elementary school girls are better at Czech/German than boys	7,9%	35,5%	27,6%	17,1%	11,8%	14,3%	23,8%	33,3%	4,8%	23,8%
For a boy, who does want to go at university, is technical school the best option	19,7%	35,5%	19,7%	13,2%	11,8%	23,8%	38,1%	23,8%	4,8%	9,5%
For a girl, who does want to go at university, is economic or health care school the best option	6,6%	26,3%	38,2%	17,1%	11,8%	4,8%	33,3%	14,3%	33,3%	14,3%
It is more difficult for girls to get at the technical university (electro technical, building construction, or mechanical engineering faculty)	7,9%	26,3%	13,2%	26,3%	26,3%	19,0%	19,0%	9,5%	38,1%	14,3%
Technical university is less attractive for girls than for boys	21,1%	57,9%	9,2%	2,6%	9,2%	19,0%	38,1%	9,5%	23,8%	9,5%
Humanities, social sciences, or economics are less attractive for boys than for girls	13,2%	32,9%	27,6%	17,1%	9,2%	0,0%	38,1%	33,3%	19,0%	9,5%
It is more difficult for boys than for girls to get at humanities or economic university	2,6%	6,6%	34,2%	30,3%	26,3%	0,0%	0,0%	28,6%	47,6%	23,8%
As in the past girls should not go to universities	1,3%	0,0%	0,0%	6,6%	92,1%	0,0%	0,0%	0,0%	4,8%	95,2%
I enjoy/ed studying maths at elementary and high schools	42,1%	34,2%	3,9%	13,2%	6,6%	71,4%	14,3%	4,8%	9,5%	0,0%
Lessons of math are/were one of the worst for me at elementary and high schools	3,9%	6,6%	3,9%	34,2%	51,3%	4,8%	4,8%	4,8%	9,5%	76,2%
Women can be similarly or even more successful in humanities or social sciences	51,3%	36,8%	11,8%	0,0%	0,0%	33,3%	47,6%	9,5%	0,0%	9,5%
Women can be similarly or even more successful in technical sciences	39,5%	31,6%	18,4%	7,9%	2,6%	42,9%	38,1%	14,3%	4,8%	0,0%
Women can be similarly or even more successful in natural sciences	44,7%	35,5%	14,5%	5,3%	0,0%	42,9%	52,4%	4,8%	0,0%	0,0%
Women can combine scientific career with family care	19,7%	19,7%	27,6%	26,3%	6,6%	19,0%	38,1%	19,0%	23,8%	0,0%
Women are similarly talented at technical subjects as men	15,8%	21,1%	28,9%	26,3%	7,9%	14,3%	42,9%	28,6%	14,3%	0,0%

**Tab. 12 University students\_CZE\_Vienna\_Brno\_general**

	ide														
	general CZE					Wien					Brno				
	strongly agree	rather agree	Do not agree, nor disagree	rather disagree	strongly disagree	strongly agree	rather agree	Do not agree, nor disagree	rather disagree	strongly disagree	strongly agree	rather agree	Do not agree, nor disagree	rather disagree	strongly disagree
	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %
Society does not support women	,8%	20,1%	26,8%	35,8%	16,5%	2,0%	5,9%	23,5%	25,5%	43,1%	2,1%	5,2%	16,5%	30,9%	45,4%
Women are not interested in professional advancement and career	1,2%	1,2%	7,9%	34,3%	55,5%	0,0%	7,8%	7,8%	29,4%	54,9%	0,0%	4,1%	13,4%	29,9%	52,6%
Men dominate the jobs and do not give women a chance	1,6%	25,6%	35,4%	26,0%	11,4%	3,9%	15,7%	33,3%	27,5%	19,6%	2,1%	13,4%	16,5%	38,1%	29,9%
Men can do a lot of things better than women	5,5%	17,3%	31,9%	26,8%	18,5%	2,0%	13,7%	19,6%	27,5%	37,3%	14,4%	17,5%	27,8%	24,7%	15,5%
Men have a higher chance to become successful than women having the same potential	7,5%	49,6%	15,7%	16,5%	10,6%	17,6%	35,3%	25,5%	13,7%	7,8%	11,3%	30,9%	15,5%	24,7%	17,5%
On the elementary school boys are better at maths than girls	4,3%	20,9%	31,5%	24,8%	18,5%	9,8%	11,8%	23,5%	9,8%	45,1%	7,2%	23,7%	25,8%	17,5%	25,8%
On the elementary school girls are better at Czech/German than boys	8,3%	38,6%	29,9%	12,2%	11,0%	7,8%	21,6%	29,4%	11,8%	29,4%	9,3%	33,0%	28,9%	14,4%	14,4%
For a boy, who does want to go at university, is technical school the best option	4,3%	29,9%	27,6%	20,9%	17,3%	3,9%	15,7%	35,3%	5,9%	39,2%	20,6%	36,1%	20,6%	11,3%	11,3%
For a girl, who does want to go at university, is economic or health care school the best option	4,3%	24,4%	27,2%	25,6%	18,5%	0,0%	5,9%	41,2%	9,8%	43,1%	6,2%	27,8%	33,0%	20,6%	12,4%
It is more difficult for girls to get at the technical university	9,8%	37,8%	20,9%	20,1%	11,4%	0,0%	2,0%	19,6%	15,7%	62,7%	10,3%	24,7%	12,4%	28,9%	23,7%

Technical university is less attractive for girls than for boys	19,3%	54,7%	12,6%	9,8%	3,5%	5,9%	41,2%	15,7%	11,8%	25,5%	20,6%	53,6%	9,3%	7,2%	9,3%
Humanities, social sciences, or economics are less attractive for boys than for girls	5,9%	34,3%	22,0%	24,4%	13,4%	3,9%	13,7%	25,5%	21,6%	35,3%	10,3%	34,0%	28,9%	17,5%	9,3%
It is more difficult for boys than for girls to get at humanities or economic university	,8%	10,6%	25,6%	31,9%	31,1%	0,0%	0,0%	25,5%	15,7%	58,8%	2,1%	5,2%	33,0%	34,0%	25,8%
As in the past girls should not go to universities	,8%	1,2%	3,1%	4,7%	90,2%	0,0%	0,0%	3,9%	0,0%	96,1%	1,0%	0,0%	0,0%	6,2%	92,8%
I enjoy/ed studying maths at elementary and high schools	28,0%	33,9%	12,6%	13,4%	12,2%	45,1%	33,3%	9,8%	7,8%	3,9%	48,5%	29,9%	4,1%	12,4%	5,2%
Lessons of math are/were one of the worst for me at elementary and high schools	8,7%	10,2%	11,0%	27,2%	42,9%	2,0%	5,9%	9,8%	25,5%	56,9%	4,1%	6,2%	4,1%	28,9%	56,7%
Women can be similarly or even more successful in humanities or social sciences	39,0%	42,5%	15,7%	1,6%	1,2%	33,3%	29,4%	25,5%	3,9%	7,8%	47,4%	39,2%	11,3%	0,0%	2,1%
Women can be similarly or even more successful in technical sciences	28,0%	28,7%	26,8%	15,7%	,8%	35,3%	21,6%	23,5%	13,7%	5,9%	40,2%	33,0%	17,5%	7,2%	2,1%
Women can be similarly or even more successful in natural sciences	33,9%	37,4%	23,2%	4,3%	1,2%	37,3%	21,6%	29,4%	7,8%	3,9%	44,3%	39,2%	12,4%	4,1%	0,0%
Women can combine scientific career with family care	15,0%	46,5%	23,6%	13,4%	1,6%	29,4%	29,4%	29,4%	11,8%	0,0%	19,6%	23,7%	25,8%	25,8%	5,2%
Women are similarly talented at technical subjects as men	11,0%	24,8%	28,7%	31,9%	3,5%	35,3%	23,5%	25,5%	11,8%	3,9%	15,5%	25,8%	28,9%	23,7%	6,2%

## 5 Analytical conclusions – motivational and counter-motivational factors

The study has approached the issue of women's participation in technical education from the perspective of gender stereotypes and prejudices that can be deeply rooted within society and essentially influence peoples' decisions. Moreover these stereotypical patterns inform the environments making them potentially less attractive for allegedly discriminated social groups. Therefore the study has reviewed the existing literature and research analysing gender issues in technical areas to identify important factors that should be included into the original investigation performed under this project. The research organized within this project generally targeted two groups of people – high school students representing the potential recruits for the technical programme and current students of the technical universities representing and evaluating the environment there. Apart from the gender aspect the investigation was also enriched by the cross national comparison providing useful external reflection.

The following results can be abstracted from the report pointing to several motivational and counter-motivational factors.

- Although there is a high demand for female technical researchers and professionals stimulated by both normative but also pragmatic reasons, women still remain underrepresented in this area.
- As revealed in the comparison with Austria gender stereotypes are still relatively strongly presented in the Czech society which might influence girl/women's decision to pursue careers in the male dominated area.
- The results of the investigation at Brno University of Technology revealed relatively strong presence of gender prejudices and cognitive preconditions in this environment. The general Czech sample acknowledged lower level of gender prejudices.
- The potential female recruits are relatively convinced about their cognitive abilities potentially utilised in technical sciences and view themselves in this area as capable as men.
- The crucial negative statement about the technical programmes strongly recalls their unattractiveness.

The conclusion must underline the issue of unattractiveness that seems to be strengthened by the existing cognitive structure of prejudices and preconditions. To make the concluding remark more specific the problem regarding low female participation does not seem to be a need to study maths or descriptive geometry but rather that the institutions either do not offer attractive programmes or are not able to promote them. This moment might strikingly contradict the reality where modern technologies are increasingly used by girls and women and where the alumnae from the technical schools (particularly ICT) have the highest chance to get a job in the field and highest salary compared to other graduates.

## 5.1 Recommendations

The following part is based on the research results as well as on the explicit comments made by the respondents in the questionnaire. It should be noted that several comments directly confirm the conclusions of the research.

Based on the data the recommendation will be structured into three major groups.

### I. Reflect the gender issues

*The comments made by the respondents surprisingly often mentioned gender issue as both problems they experienced and potential measurements making the field more attractive.*

- Create an environment sensitive to gender issues in terms of general attitudes to women and evaluation of their work
- Avoid gender-related insinuations and build a hospitable “girlfriendly” environment making women feel welcome
- Consider establishing of the mentors that could provide support and help to women particularly during the early stages of the studies. This institute should aim at mitigating stress resulting from the new and male dominated environment
- Put forward the institutional culture of readiness and responsiveness
- Become involved in the field-related societal discussions through professional institutions and groups

### II. Promote the programmes

- Promote the programmes through underlying the future career perspective that is generally very good for engineers
- Involve female scientists and teachers into PR activities
- Emphasize the gender aspect in PR activities intentionally preferring female objects
- Design creative and aesthetically-informed promoting materials (including faculty websites)
- Introduce and promote financial and material supporting schemes for female students
- Introduce and promote maternity services
- Organize pre-accession courses or workshops promoting the environment potentially outside of the faculties

### III. Improve the programmes

- Think about female-oriented courses

- Develop courses utilizing creativity
- Think about practical workshops or internship in places attractive for women
- Get out of the box and design interdisciplinary or interscientific courses and programmes
- Study and follow successful examples – technical institutions being attractive for women

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## Annex

### Research Questionnaire

We are turning to you with a request to fill in this 20-minute questionnaire, which focuses on the gender roles in the Czech/Austrian societies. We are interested in your opinions, so please fill in the anonymous questionnaire sincerely. Thank you very much.

#### *General Section – roles of men and women in the Czech/Austrian societies*

Let us start with some general statements about men and women. Please indicate to what extent you agree with the following proposition.

Fully agree	
Rather agree	
Do not agree, nor disagree	
Rather disagree	
Fully disagree	

- 1. Society does not support women**
- 2. Women are not interested in professional advancement and career**
- 3. Men dominate the jobs and do not give women a chance**
- 4. Men can do a lot of things better than women**
- 5. Men have a higher chance to become successful than women having the same potential**

#### *Section of Educational Skills*

Let us turn our attention to the gender roles in educational process. Please indicate to what extent you agree with the following proposition.

Fully agree	
Rather agree	
Do not agree, nor disagree	
Rather disagree	
Fully disagree	

- 6. On the elementary school boys are better at maths than girls
- 7. On the elementary school girls are better at Czech/German than boys
- 8. For a boy, who does want to go at university, is technical school the best option
- 9. For a girl, who does want to go at university, is economic or health care school the best option
- 10. It is more difficult for girls to get at the technical university (electro technical, building construction, or mechanical engineering faculty)
- 11. Technical university is less attractive for girls than for boys
- 12. Humanities, social sciences, or economics are less attractive for boys than for girls
- 13. It is more difficult for boys than for girls to get at humanities or economic university
- 14. As in the past girls should not go to universities

*Section of Attitudes towards Math*

Now, let us turn our attention to the attitudes towards maths. Please indicate to what extent you agree with the following proposition.

Fully agree	
Rather agree	
Do not agree, nor disagree	
Rather disagree	
Fully disagree	

- 15. I enjoy/ed studying maths at elementary and high schools
- 16. Lessons of math are/were one of the worst for me at elementary and high schools

*Section – Women in Science and Technical Science*

Now let us turn our attention to your opinions on women’s potentials and various areas. Please indicate to what extent you agree with the following proposition.

Fully agree	
-------------	--

Rather agree	
Do not agree, nor disagree	
Rather disagree	
Fully disagree	

**17. Women can be similarly or even more successful in humanities or social sciences (philosophy, law, sociology, ethics, psychology,...)**

**18. Women can be similarly or even more successful in technical sciences (electro technics, information technologies, wireless communication, building construction, mechanical engineering, ...)**

**19. Women can be similarly or even more successful in natural sciences (maths, physics, chemistry, biology,...)**

**20. Women can combine scientific career with family care**

**21. Women are similarly talented at technical subjects as men**

**22. Can women become successful in these careers? Please choose one answer for every profession.**

Yes
No

**A. Medical Doctor**

**B. Teacher**

**C. Economist**

**D. Electro Engineer**

**E. Computer Programmer**

*Sociodemographic Section*

**D1. Gender**

**D2. Age**

**D3. Currently studying high school/university?**

High school	
University	

*Information for the respondents studying the university. If you study more university programmes please respond to the questions reflecting the programme that you had started earlier. If you started more programmes contemporaneously please reflect the one that you consider more important in terms of your education.*

**D4.** (for high school students)

**What type of high school do you attend?**

General (grammar school/gymnasium)	
Economic	
Technical	
Other	

**D4.** (for university students)

**What type of programme do you study?**

Humanities/Social Sciences	
Economic	
Technical	
Natural Sciences/Medicine	
Arts	
Other	

**D5.** (for high school students)

**What is the share of girls on your class?**

0-25 %
26-50 %
51-75 %
76-100 %

**D5.** (for university students)

**What is the share of women in your programme/study year?**

0-25 %
26-50 %
51-75 %
76-100 %

**D6. What is the highest education achieved by your parents**

<b>Father</b>	<b>Mother</b>
Elementary	Elementary
High School	High School
High School SAT	High School SAT
University	University

**D7. (for high school students)**

**What was your math result/grade in last June?**

**D7. (for university students)**

**What was your last math result/grade at high school?**

**D8. (for university students)**

**How many semesters of compulsory math courses are required in your degree programme?**

**D9. (for high school students)**

**What is the current year of your study?**

**D9. (for university students)**

**What is the current year of your study?**

**D10. Do you know any woman that studies or graduated from a technical university programme?**

Yes
No

**D11: (Question for girls/women)**

**What would be your recommendation or suggestion for a technical university to attract attention of potential female students? We would appreciate a detailed answer.**

**This was the last question. Thank you very much for your interest and time.**

## Annex

### The specific tables for particular category

#### Czech Republic - Universities

	Theoretical and supporting disciplines			Electrotechnology and microelectronics			Electronics and radio electronics		
	women	all	% of women	women	all	% of women	women	all	% of women
Prof.	4	28	14,3	0	16	0,0	1	31	3,2
Assoc. Prof.	2	33	6,1	4	44	9,1	1	37	2,7
Dr.	12	89	13,5	6	55	10,9	2	81	2,5
Master	9	75	12,0	6	23	26,1	5	17	29,4
Ph.D. stud	11	109	10,1	24	143	16,8	12	142	8,5
total	38	334	11,4	40	281	14,2	21	308	6,8

	Telecommunications and networks			Automation, measurement and controlling			Biomedical engineering		
	women	all	% of women	women	all	% of women	women	all	% of women
Prof.	0	9	0,0	2	27	7,4	0	10	0,0
Assoc. Prof.	0	29	0,0	1	39	2,6	1	20	5,0
Dr.	4	76	5,3	6	70	8,6	6	33	18,2
Master	1	30	3,3	0	6	0,0	24	47	51,1
Ph.D. stud	5	167	3,0	11	210	5,2	42	115	36,5
total	10	311	3,2	20	352	5,7	73	225	32,4

#### Czech Republic – Czech Academy of Science

	Physics of materials			Photonics, electronics, instrumentation			Informatics and automation		
	women	all	% of women	women	all	% of women	women	all	% of women
Prof.	0	8	0,0	0	6	0,0	2	24	8,3
Assoc. Prof.	0	7	0,0	0	4	0,0	1	19	5,3
Dr.	13	46	28,3	13	95	13,7	22	128	17,2
Master	16	41	39,0	26	75	34,7	7	50	14,0
total	29	102	28,4	39	180	21,7	32	221	14,5

## Austria - Universities

	Theoretical and supporting disciplines			Electrotechnology and microelectronics			Electronics and radio electronics		
	women	all	% of women	women	all	% of women	women	all	% of women
Prof.	2	22	9,1	0	10	0	0	13	0,0
Assoc. Prof.	1	26	3,8	0	14	0,0	0	12	0,0
Dr.	18	124	14,5	5	71	7,0	9	64	14,1
Master	34	147	23,1	11	79	13,9	9	97	9,3
total	55	319	17,2	16	174	9,2	18	186	9,7

	Telecommunications and networks			Automation, measurement and controlling			Biomedical engineering		
	women	all	% of women	women	all	% of women	women	all	% of women
Prof.	1	11	9,1	0	9	0,0	0	9	0,0
Assoc. Prof.	0	7	0,0	0	3	0,0	0	5	0,0
Dr.	3	50	6,0	2	39	5,1	6	22	27,3
Master	17	88	19,3	5	90	5,6	9	44	20,5
total	21	156	13,5	7	141	5,0	15	80	18,8

## Poland - Universities

	Theoretical and supporting disciplines			Electrotechnology and microelectronics			Electronics and radio electronics		
	women	all	% of women	women	all	% of women	women	all	% of women
Prof.	0	21	0,0	2	29	6,9	2	61	3,3
Dr.	8	73	11,0	14	133	10,5	34	367	9,3
Master	4	35	11,4	9	96	9,4	41	253	16,2
total	12	129	9,3	25	258	9,7	77	681	11,3



Telecommunications and networks	Automation, measurement and controlling	Biomedical engineering
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	women	all	% of women	women	all	% of women	women	all	% of women
Prof.	1	34	2,9	4	45	8,9	1	11	9,1
Dr.	7	139	5,0	21	201	10,4	10	65	15,4
Master	20	80	25,0	32	128	25,0	17	36	47,2
total	28	253	11,1	57	374	15,2	28	112	25,0

### Slovakia - Universities

Theoretical and supporting disciplines	Electrotechnology and microelectronics	Electronics and radio electronics
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	women	all	% of women	women	all	% of women	women	all	% of women
Prof.	1	14	7,1	1	4	25,0	3	21	14,3
Assoc. Prof.	7	25	28,0	0	0		5	37	13,5
Dr.	13	44	29,5	0	7	0,0	9	60	15,0
Master	2	5	40,0	0	1	0,0	3	17	17,6
Ph.D. stud	5	28	17,9	0	5	0,0	1	57	1,8
total	28	116	24,1	1	17	5,9	21	192	10,9

Telecommunications and networks	Automation, measurement and controlling	Biomedical engineering
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	women	all	% of women	women	all	% of women	women	all	% of women
Prof.	2	19	10,5	3	24	12,5	1	3	33,3
Assoc. Prof.	2	18	11,1	10	35	28,6	1	3	33,3
Dr.	12	51	23,5	8	61	13,1	2	7	28,6
Master	3	9	33,3	3	8	37,5	0	0	
Ph.D. stud	4	47	8,5	9	88	10,2	3	5	60,0
total	23	144	16,0	33	216	15,3	7	18	38,9