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REPORT FROM STAFF SURVEY ASSUMPTIONS, ANALYSIS AND CONCLUSIONS

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1. Introduction

Tertiary education plays a crucial role in economic growth and social progress. Higher education drives research and development (R&D) that fosters positive economic change and social progress at all levels. As indicated by United Nations improved education accounts for about 50% of economic growth in OECD countries over the past five decades (*Women and Sustainable Development Goals*). There is also the widespread recognition that higher education sector is a main player of gender equality within the family and society (Dandan, Marquez, 2017). For instance according to Ferrant and Thim (2019) women with higher education are able to decrease their housework, due to opportunities to provide market services and increasing income.

The development of higher education institutions depends not only on the level of funding, but also on the effectiveness of the system itself. The latter is conditioned, among other things, by the relations prevailing among staff and the system of values which guides them. Many researchers complained that recruitment and evaluation procedures are not transparent and career support and human-management are very poor, so many females discover the rules of the game too late (Godfroy-Genin, 2009).

“To better understand the complex processes involved in increasing female and minorities’ participation in science and technology (S&T), one can distinguish three political approaches to gender equality in these areas. The first of these approaches focuses on programs targeting females themselves in an effort to increase their participation in S&T. The second approach seeks to increase females’ participation by reforming research institutions. The third focuses on overcoming gender bias by mainstreaming gender analysis into basic and applied research. These three approaches are interrelated: increasing females’ participation in S&T will not be successful without restructuring institutions and mainstreaming gender analysis into knowledge production” (Schiebinger, 2008).

Research on gender and science has developed steadily through the 1990s and 2000s, and shows that family and career tensions play an important role in explaining the low rates of females embarking on a scientific career. Many studies show that the family-or-science dilemma is not only gendered, but exacerbated by institutional constraints and implicit academic norms, values and expectations that take the traditional male life-course as the norm. Recent results point out an increase in the number of females leaving academia in order to take up careers in other science and technology-related professions, which provide not only new career paths, but also more favourable working conditions (*Meta-analysis of gender and science ...*, 2012).

Females in Africa, like their counterparts elsewhere, are very resourceful economic agents whose full participation in the economy’s labour force can contribute greatly to economic growth (Iheonu et al., 2020). In this context, the issue of equal treatment of females and men is extremely important. Research indicates that the higher education sectors in South Africa are still struggling with gender inequalities (Loots and Walker, 2015). At the same time, their results confirm that societies that increase females’ access to employment and narrow differences between men and women in economic opportunities increase the pace of economic development, greater macroeconomic stability and reduce poverty (Stotsky, 2006, p.5). One of the obstacles of an efficient gender policy, also in the higher education sector, is occupational segregation that may channel females into certain occupations characterized by lower wages, resulting in losses of productivity and output (Tzannatos, 1999). While females are more represented in the workforce, also in the formerly male-dominated professional fields in Science, Technology, Engineering and Mathematics (STEM) (Costa et al., 2014), gender inequality still persists and African women account for only 12% of both humanities and

science researchers (Mustapha *et al.*, 2017) and are largely absent in managerial positions including within the science field (Mustapha *et al.*, 2019; *Women in Science*, 2019).

Local and cultural factors, along with the “glass ceiling” effect, impact more significantly on female scholars in developing countries (Mabokela, Mlambo, 2017). Frances (2017) highlighted that in the period 1987-2011 the share of females employed in universities in the US increased from 30 to 50%. This advance in employment have not been accompanied with gains in their salaries and in access to funding in comparison to faculty men. A higher percentage of women than men were employed at lower-paying colleges and universities and a few females were moving into executive positions. These tendencies were also confirmed by Huang (2017), Chinese universities by Zhong and Guo (2017) where females constituted the minority in the medium to senior ranks of academic professionals, while the majority of females were employed in the junior ranks of assistant and instructor without titles, as well as for Italian and Swiss academia (Goastellec, Vaira, 2017).

Although the gender composition varies across African countries, the consistent pattern is that only a few females are employed in senior administrative and leadership positions, especially in senior and middle management, even in South Africa where women represent about 50% of research and academic staff in higher education and were are realized many programs and initiatives targeting women wishing to boost the participation in STEM and develop their scientific career like e.g. The International Centre for Genetic Engineering and Biotechnology, EQUALS Global Partnership, the For Women in Science and STEM and Gender Advancement (Mabokela, Mlambo, 2017; *2017 HLPF Thematic review of SDG 5...*, 2017; *Gender + Science...*, 2020).

Also, in the European higher education sector female academics form a disadvantaged group since they are underrepresented in senior academic positions, and tend to be more involved in teaching than in research or leadership than their male counterparts, which seems to inhibit career progression of female academics (Leišytė, Hosch-Dayican, 2017). Goastellec and Vaira (2017) found additionally that female academic career possibilities are strongly dependent on the scientific discipline and that the gender salary gap increases over job seniority. They also expressed more general conclusion that “the representation of females in academia closely reflects a women’s place in society”. Vertical segregation as a common trend in all EU countries and scientific disciplines, accompanied by high variation in terms national contexts was proved also by other studies (e. g. *Meta-analysis of gender and science ...*, 2012). Above observations were verified by Witkowska (2016) who concluded that existence of gender pay gap intensity depends on economic branches, job contracts, age, occupations and may generate many negative social and economic consequences, by Landmesser (2020) which using data from EU-SILC project, based on Oaxaca-Blinder decomposition and regression additionally analysis found that there exists large diversity in the size of the gender pay gap across members of the European Union, and also by Batóg and Batóg (2018) who using gender segregation index, measure of similarity of time series as well as some classification methods have further indicated that gender wage gap is highly business-cycle-sensitive (see also *From promises to action...*, 2019).

During last two decades policy analyses at European level indicated more frequent indirect discrimination against females in the academic profession and that the barriers to gender equality in higher education have become indirectly, more sophisticated and comprehensive (*Meta-analysis of gender and science ...*, 2012). There are also evidenced differences in type of academic contract, with more women than men on ‘teaching-only’ contracts and fewer on the traditional academic ‘teaching and research’ contracts (Leathwood, 2017).

Some authors point out that leaders and practitioners in academic science are still unaware of and poorly educated about the nature and impact of barriers to full participation of women in science around the world. This lack of awareness and education results in failures to fully utilize the human capital and limits technological advancements (Coe, Wiley, Bekker, 2019). To counteract this several action in higher education may be implemented to overcome gender inequalities, like: female scientific networks, quotas and targets, role models and mentoring, as well as earmarked resources (*National Policies on Women and Science ...*, 2002).

At the same time, it is worth bearing in mind that even significant progress in the implementation of these and many other solutions may lead to the full elimination of gender inequalities in a perspective that, depending on the geographical location, ranges from 50 to almost 200 years (*Global Gender Gap Report 2021 ...*, 2021).

Research addressing the evaluation of gender equality policies in science and research is scarce. There is a relative abundance of position statements, conceptual clarifications and recommendations dealing with gender issues in science across most countries. While policy action is needed for raising gender awareness and removing institutional constraints and biases, empirical research is required in order to provide a sound basis for policy making. The systematic collection of personal and career data is of utmost importance for monitoring progress towards both family and career balance and gender equality in scientific institutions (*Meta-analysis of gender and science ...*, 2012). In this context, the present report is based on a staff survey which aims to identify the relationships existing in the above-mentioned areas at key technical universities in South Africa and thereafter propose some recommendations.

2. Survey objectives and limitations

According to the Organisation for Economic Co-operation and Development (OECD) (OECD, 2017) OECD members should adopt practices that promote gender equality in education. However, we should be aware that diversity of education without providing clear definitions and policy goals to achieve gender equality, increases the risk for diminishing the transformative intent of broader social justice goals and overlooking gender equality completely (Forbes, Öhrn, Weiner 2011; Loots, Walker, 2015). That's why many studies still report on the persistence of deeper inequalities between the genders in all spheres of higher education (e.g. Francis, Burke, and Read 2014). This situation is not being improved by shocks to the economy, including the one recently caused by COVID-19 (*United Nations Entity for Gender Equality ...*, 2021).

To construct effective evidence-based policy tools and support strategic planning in order to reduce gender inequalities we need to provide detailed and reliable statistics on the current state of gender equity and sex-ethnicity-income-disaggregated data in the educational sector (*United Nations Entity for Gender Equality ...*, 2021; *2017 HLPF Thematic review of SDG 5 ...*, 2017).

This is one reason why the topic of gender equality was raised in the PEESA III project, as it is very important for Partner Universities in South Africa, and is related to the study of the potential of the capabilities approach in shaping, developing and strengthening policy for higher education institutions. The current report plays a complementary role to parallel surveys of students at key South African technical universities. We hope that presented results will help to identify and remove some barriers of gender equality amongst students and staff.

One of the tools used in the PEESA III project to collect the necessary data is a survey conducted among staff members. The survey is related to activities undertaken within the scope

of the project *Personalised Engineering Education in Southern Africa* (PEESA III – reference number 585966-EPP-1-2017-1-DE-EPPKA2-CBHE-JP), financed by the European Union programme Erasmus+ Capacity Building in Higher Education and realised by South African (Cape Peninsula University of Technology, Durban University of Technology, Vaal University of Technology, Tshwane University of Technology) and European universities from Germany, Poland and Romania. The PEESA III project members are seeking to understand chosen aspects of gender inequality (if such phenomenon is present) among academic staff involved in engineering teaching and research. They also try to develop recommendations for university management and policymakers on how to remove identified inequalities.

The main goals of the survey were dedicated to academic staff only and conducted during 2020 and was evaluated if:

- there existed different treatment related to gender, ethnicity or race among staff,
- academic workers were aware of a gender equality policy at their university,
- academic staff is satisfied with its decision regarding teaching/conducting research within engineering studies.

The experience gained from the first student survey was used, including: evaluation of the correctness of the questionnaire design and the comprehensibility of the questions. The survey was preceded by the process of obtaining of ethical clearances. Ethical approvals are presented in Appendix 4, while application letters can be found in the Appendices 2 and 3.

During the survey, some limitations and barriers appeared. Among the most important were:

- limited possibilities to draw general conclusions for the population of South African engineering academic staff (number of answers was equal to 73),
- a long time to obtain ethical clearances,
- unbalanced sample: males (73,97%) vs. females (26,03%).

3. Questionnaire development and implementation

The staff questionnaire was developed and survey was conducted by the University of Szczecin team and South African partners, represented by:

- Lesley Cooke (DUT),
- Hester Jackson (DUT),
- Zakheeya Armoed (DUT),
- Maureen Ramaube (TUT),
- Trudy Sutherland (VUT),
- Luclaire Airey (CPUT).

All tasks and possible problems were consulted on the regular basis with members of Project Board.

The process of staff's surveying was realised in the following steps:

- Analysis of literature related to the female role and gender equality within tertiary education, on a regular basis.
- Preparation of first version of the gender equality questionnaire dedicated to staff presented during project meeting in Sibiu (Romania) in October 2019, July 2019.
- Preparing application letters for ethical approvals, September 2019.
- The beginning of the procedure of ethical clearance required by ethical committees at all partner universities in South Africa, October 2019.

- Consultations and improvement of the gender equality questionnaire based on feedback and comments of SA partners, January 2020.
- Elaboration and consulting the final version of questionnaire with partner universities, January 2020 (questionnaire form is presented in Appendix 1).
- Creation of the on-line survey questionnaire using Microsoft Form, January 2020.
- Providing a link to the on-line version and request for conducting the gender equality survey dedicated to staff at all partner’s universities in South Africa (DUT, CPUT, TUT, VAL), January 2020.
- Data collection, February-October 2020.
- Preparation of answer’s database, November 2021.
- Empirical analysis and writing the final version of survey’s report, July-August 2021.

4. Sample structure and results

Sample structure

In this report 73 full responses were analysed in detail. Figure 1 presents the structure of the sample according to the name of the university where the respondents are employed.

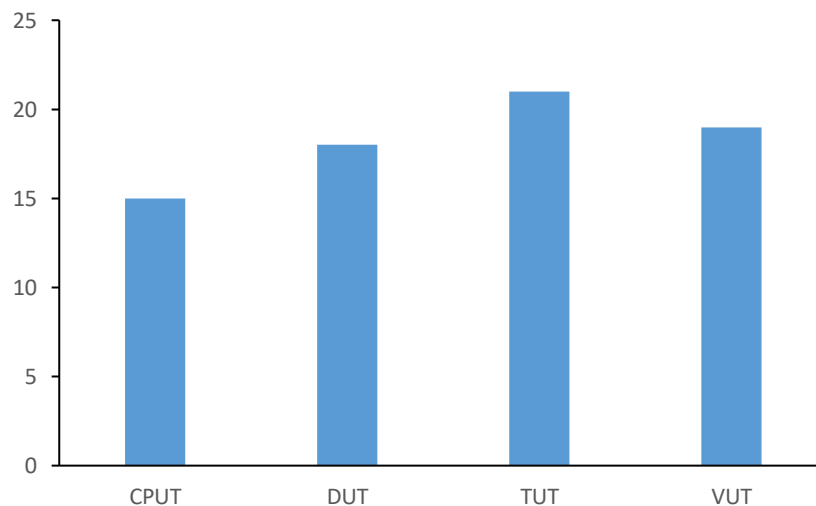


Fig. 1. Sample structure according to the name of the South African partner

Source: own elaboration.

The distribution of answers according to the kind of SA partner’s university is almost uniform. The vast majority of staff members who responded were 46 or older, representing 52.05% of all respondents. Almost all respondents are full-time employed.

Table 1 presents the sample structure according two staff features: *Gender* and *Ethnicity*. We can observe that the dominant share of staff members ethnicity was African (41.10%) and males (73.97%).

Table 1. Sample structure according to *Gender* and *Ethnicity*

		Ethnicity						
		Gender	African	Coloured	White	Indian	Other	Total
Count	Males		20	6	15	10	3	54
Row Percent			37.04	11.11	27.78	18.52	5.56	100.00
Count	Females		10	3	3	3	0	19
Row Percent			52.63	15.79	15.79	15.79	0.00	100.00
Count	All Groups		30	9	18	13	3	73
Column Percent			41.10	12.33	24.66	17.81	4.11	100.00

Source: own calculations.

The sample structure according to the type of department was shown in the Table 2. The two most representative departments are Electrical Engineering (10 persons) and Industrial Engineering (9 persons).

Table 2. Sample structure according to the type of Department

Department name	No. of respondents
Building Sciences	1
Chemical Engineering	2
Chemical, Metallurgical and Materials Engineering	5
Civil Engineering	5
Civil Engineering and Geomatics	5
Civil Engineering and Surveying	4
Construction Management and Quantity Surveying	4
Electrical Engineering	10
Electrical, Electronic and Computer Engineering	5
Electronic and Computer Engineering	4
Electronic Engineering	2
Industrial and Systems Engineering	2
Industrial Engineering	9
Maritime Studies	1
Mechanical and Automation Engineering	4
Mechanical Engineering	5
Metallurgical Engineering	2
Power Engineering	1
Process Control & Computer Systems	2
Total	73

Source: own calculations.

4.1. Quantitative analysis

The contingency table for two variables: *Position at the university* and *The length of service as an employee at university level* was presented as Table 3. We noticed that the dominant share of staff members who have completed the questionnaire were these at lecturer position (69.86%) and characterised by the work seniority at the university level from 11 to 20 years.

Table 3. Sample structure according to *Position* and *The length of service*

	Length of service	Position						Total
		Lecturer	Technician	Associate Professor	Professor	Assistant	Other	
Count	5 or less	7	3	0	0	1	0	11
Row Percent		63.64	27.27	0.00	0.00	9.09	0.00	100.00
Count	6-10	14	1	1	0	0	1	17
Row Percent		63.64	27.27	0.00	0.00	9.09	0.00	100.00
Count	11-20	22	2	0	3	0	2	29
Row Percent		75.86	6.90	0.00	10.34	0.00	6.90	100.00
Count	21 or more	8	1	1	5	0	1	16
Row Percent		50.00	6.25	6.25	31.25	0.00	6.25	100.00
Count	Total	51	7	2	8	1	4	73
Column Percent		69.86	9.59	2.74	10.96	1.37	5.48	100.00

Source: own calculations.

Table 4 consists data describing an awareness for the need for a gender equality policy in the university (Question 12) according to respondent's gender.

Table 4. Sample structure according to *Gender* and awareness of the need for a gender equality policy in the university

	Gender	Yes	No	I don't know	Total
Count	Males	40	2	12	54
Row Percent		74.07	3.70	22.22	100.00
Count	Females	12	2	5	19
Row Percent		63.16	10.53	26.32	100.00
Count	All Groups	52	4	17	73
Column Percent		71.23	5.48	23.29	100.00

Source: own calculations.

It may be somewhat surprising that men are more aware of the implementation of gender equality policies in the university. It is worth noting that the general level of knowledge of this type of policy among academic staff is quite high.

Knowledge about a need for the existence of an organizational unit / position related to generate a gender equality policy in the university (Question 13) is evenly possessed by both females and males in relative sense, but more that the half of respondents have no idea of this issue (see table 5).

Table 5. Sample structure according to *Gender* and awareness of a need for the existence of organizational unit / position related to generate a gender equality policy in the university

	Gender	Yes	No	I don't know	Total
Count	Males	24	0	30	54
Row Percent		44.44	0.00	55.56	100.00
Count	Females	8	4	7	19
Row Percent		42.11	21.05	36.84	100.00
Count	All Groups	32	4	37	73
Column Percent		43.84	5.48	50.68	100.00

Source: own calculations.

Table 6 represents information related to the assessment of the level of activities / tools for developing a gender equality policy carried out in the university (Question 14).

Table 6. The assessment of the level of activities / tools for developing a gender equality policy carried out in the university

		Grade level (1 – not at all; 5 – to a large degree)					
		Activity/tool of gender equality policy	1	2	3	4	5
Count	14.1. Curriculum reforms		23	11	20	14	5
Row Percent			31.51	15.07	27.40	19.18	6.85
Count	14.2. Conducting research on a variety of gender issues		18	13	28	9	5
Row Percent			24.66	17.81	38.36	12.33	6.85
Count	14.3. Organizational policies and programmes		22	16	24	4	7
Row Percent			30.14	21.92	32.88	5.48	9.59
Count	14.4. Support on return from maternity leave		21	13	23	7	9
Row Percent			28.77	17.81	31.51	9.59	12.33
Count	14.5. Female staff in grant review or journal editorial boards		20	9	24	14	6
Row Percent			27.40	12.33	32.88	19.18	8.22
Count	14.6. Gender diversity awareness training		27	12	19	9	6
Row Percent			36.99	16.44	26.03	12.33	8.22
Count	14.7. School websites have images that represent women		12	13	22	14	12
Row Percent			16.44	17.81	30.14	19.18	16.44

Source: own calculations.

It is visible for almost all the categories of the activities / tools regarding the gender equality policy that less 30% of academic staff gives them a relatively high rating of 4 or 5. Only in case of recognition of school websites that have images representing women carrying out a range of roles including teaching and research as an effective kind (element) of such policy.

Almost 81% of total number of respondents are satisfied with the decision regarding teaching or / and conducting research at engineering studies, while 9.6% stated that it is too early to make such a statement (Question 15).

Dependency analysis

The relationships of all issues pointed out in the questionnaire points 10.1-11.7 with chosen staff's features: gender, length of service, ethnicity, place of work (university) and position was analysed using statistical package STATISTICA 13.3 and the correspondence analysis (CA).

Methodological note on the correspondence analysis

In a classical correspondence analysis¹ we begin the formulation of contingency table which elements n_{ij} reflect simultaneous occurrence of categories i and j with two variables X and Y ($i = 1, 2, \dots, I; j = 1, 2, \dots, J$), where marginal numbers of rows and columns are denoted respectively by $n_{i\cdot}$ i $n_{\cdot j}$:

$$n_{i\cdot} = \sum_{j=1}^J n_{ij}, \quad n_{\cdot j} = \sum_{i=1}^I n_{ij}. \quad (1)$$

Then we derive a matrix of relative frequencies P called the correspondence matrix with elements p_{ij} , which contains among others marginal frequencies of rows and columns denoted respectively by $p_{i\cdot}$ i $p_{\cdot j}$:

$$p_{i\cdot} = \sum_{j=1}^J p_{ij} = \sum_{j=1}^J \frac{n_{ij}}{n} = \frac{n_{i\cdot}}{n}, \quad p_{\cdot j} = \sum_{i=1}^I p_{ij} = \sum_{i=1}^I \frac{n_{ij}}{n} = \frac{n_{\cdot j}}{n} \quad (2)$$

In the next step we construct matrices of profiles of rows and columns:

$$\begin{bmatrix} n_{ij} \\ n_{i\cdot} \end{bmatrix} = \begin{bmatrix} p_{ij} \\ p_{i\cdot} \end{bmatrix} = D_r^{-1} P, \quad \begin{bmatrix} n_{ij} \\ n_{\cdot j} \end{bmatrix} = \begin{bmatrix} p_{ij} \\ p_{\cdot j} \end{bmatrix} = D_c^{-1} P, \quad (3)$$

where D_r and D_c are diagonal matrices with elements respectively $p_{i\cdot}$ i $p_{\cdot j}$.

Marginal frequencies respectively of rows and columns in profile matrices D_r and D_c are called average row and column profiles, and represent centroids. Distances between row profiles (column profiles) are calculated as weighted Euclidean distances:

$$d(i, i') = \sum_{j=1}^J \frac{1}{p_{\cdot j}} \left(\frac{p_{ij}}{p_{i\cdot}} - \frac{p_{i'j}}{p_{i'\cdot}} \right), \quad d(j, j') = \sum_{i=1}^I \frac{1}{p_{i\cdot}} \left(\frac{p_{ij}}{p_{\cdot j}} - \frac{p_{ij'}}{p_{\cdot j'}} \right), \quad (4)$$

where as weights we use respectively marginal frequencies of columns and rows.

¹ See for example (Stanimir, 2005).

Above distances are also χ^2 distances, which can be used for calculation of inertia – a measure of differentiation of elements in data matrix. Total inertia enables to assess the dispersion level of row (column) profiles around their centroids, and shows the differences between particular row (column) profiles and their average profiles:

$$\lambda_i = \sum_{i=1}^I \chi_i^2 \cdot p_{i\bullet} \text{ (for rows), } \lambda_j = \sum_{j=1}^J \chi_j^2 \cdot p_{\bullet j} \text{ (for columns),} \quad (5)$$

where:

χ_i^2 – chi-square distance between row i and respective centroid,

χ_j^2 – chi-square distance between column j and respective centroid.

Higher values of total inertia indicate higher dispersion of points which represent profiles around the centre of coordinated axis. If we are going to analyse row and column profiles in the same time, we have to transform matrix P into matrix A called the matrix of standardized differences:

$$A = [a_{ij}], \quad (6)$$

where:

$$a_{ij} = \frac{p_{ij} - p_{i\bullet} p_{\bullet j}}{\sqrt{p_{i\bullet} p_{\bullet j}}}.$$

To calculate coordinates of points representing categories of variables in chosen dimension we have to provide a decomposition of matrix A :

$$A = D_r^{-1/2} (P - rc^T) D_c^{-1/2} = U \Gamma V^T, \quad (7)$$

where:

Γ – diagonal matrix of non-zero singular values of matrices AA^T and $A^T A$ composed in descending order,

$U(V)$ – matrix of singular vectors which correspond with square roots of eigenvalues of matrix $A^T A (AA^T)$.

A close position of points representing row profiles and column profiles is interpreted as their co-dependence, although the correspondence analysis method does not provide a direct measure of the strength of such a relationship.

Figure 2 presents a part of database and the STATISTICA workspace. The following figures show the relationships that exist between the characteristics of the respondents and selected areas of potential unequal treatment taking place while working at the university. Only those relationships that were characterised by a significant degree of association are presented.

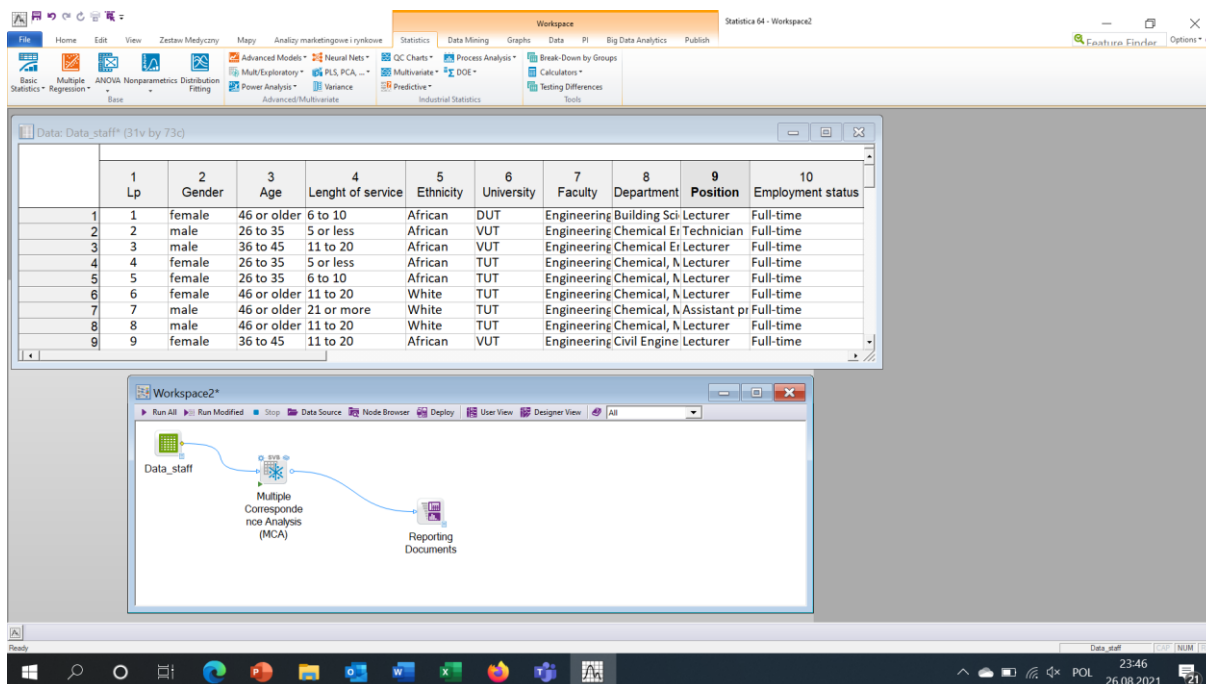


Fig. 2. Sample part of the database and the calculation workspace
Source: own elaboration.

Question 10.1: During your work did you encounter any different treatment related to gender concerning: assessment system of work?

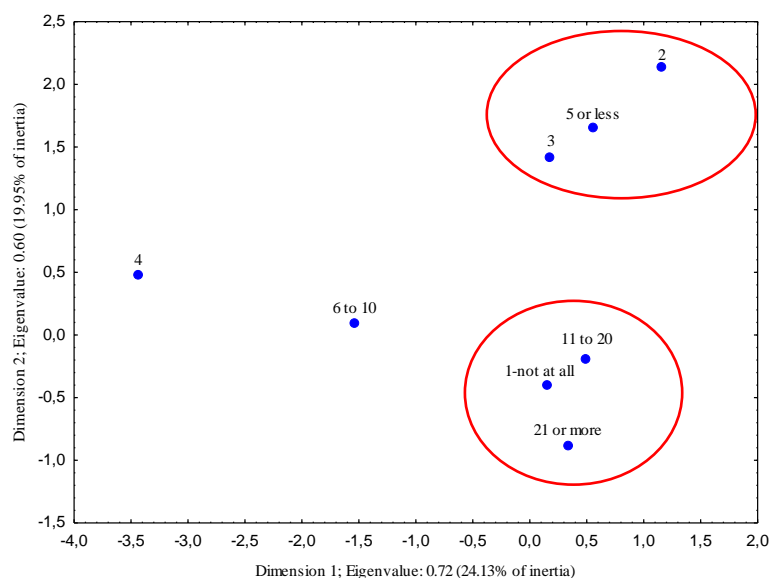


Fig. 3. The relationship between length of service at the university and different treatment related to assessment system of work
Source: own elaboration.

Interpretation: the feeling of unequal treatment related to gender in the area of assessment system of work was expressed practically only by employees with a length of service at the university of 5 years or less and to some degree with this length from 6 to 10 years.

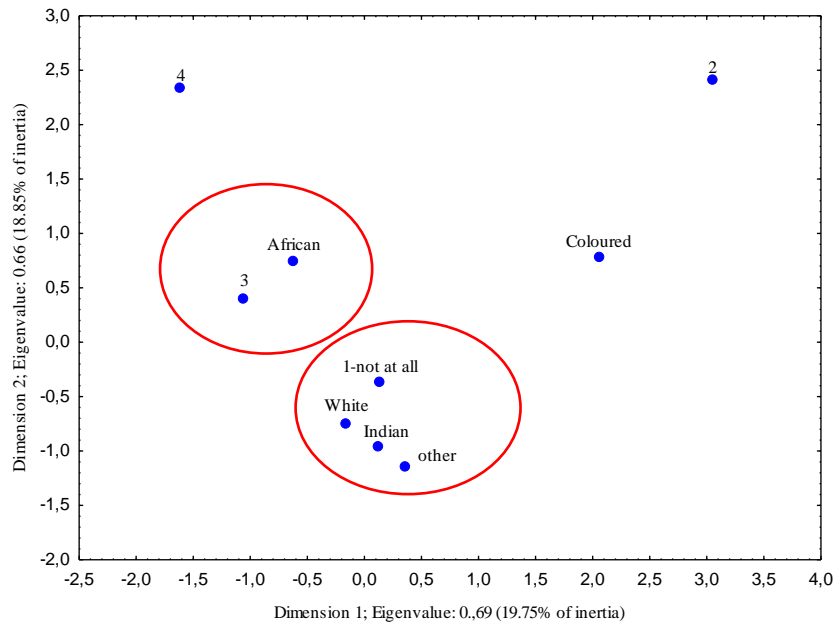


Fig. 4. The relationship between ethnicity and different treatment related to assessment system of work

Source: own elaboration.

Interpretation: the feeling of unequal treatment related to gender in the area of assessment system of work was indicated by respondents of African ethnicity and to a lesser extent by respondents of Coloured ethnicity.

Question 10.3: During your work did you encounter any different treatment related to gender concerning: financial support?

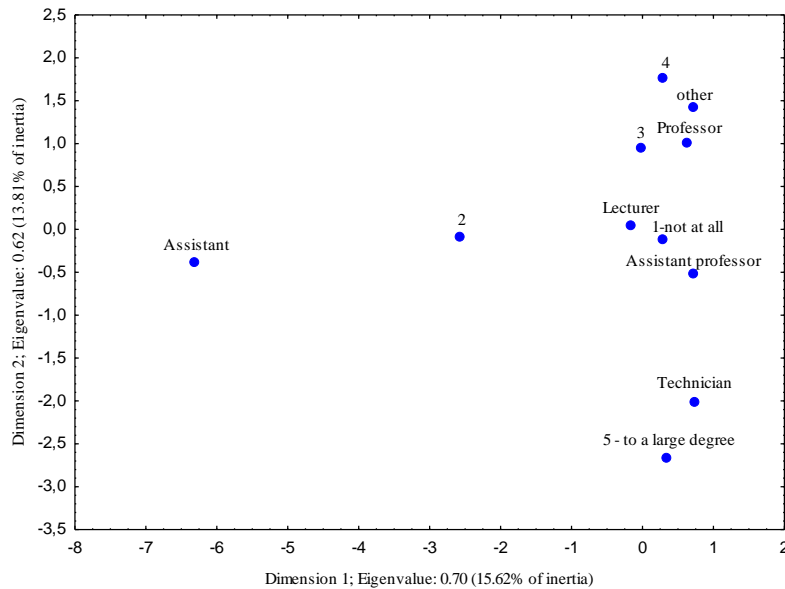


Fig. 5. The relationship between position and different treatment related to financial support

Source: own elaboration.

Interpretation: the feeling of unequal treatment related to position in the area of financial support was observed mostly for “Technician”, “Professor” and “others”. In addition technicians reported also some kinds of vertical/hierarchical discrimination.

Question 10.4: During your work did you encounter any different treatment related to gender concerning: professional or scientific advancement?

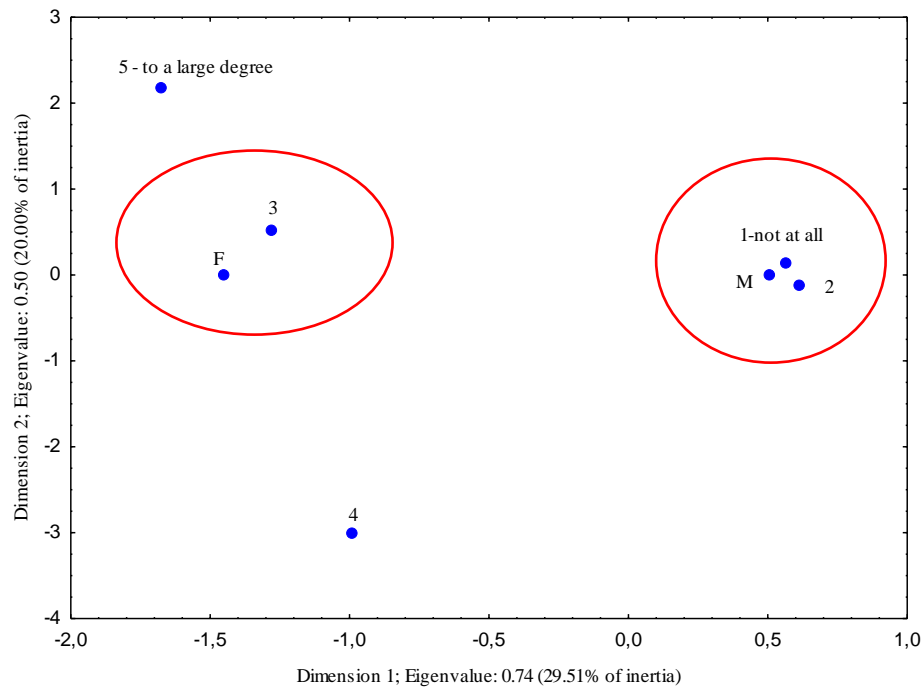


Fig. 6. The relationship between gender and different treatment related to professional or scientific advancement

Source: own elaboration.

Interpretation: unlike men, women experience a certain degree of unequal treatment in the area of professional and scientific advancement (Figure 6) as well as in other areas contained in the questions 10.1-10.3.

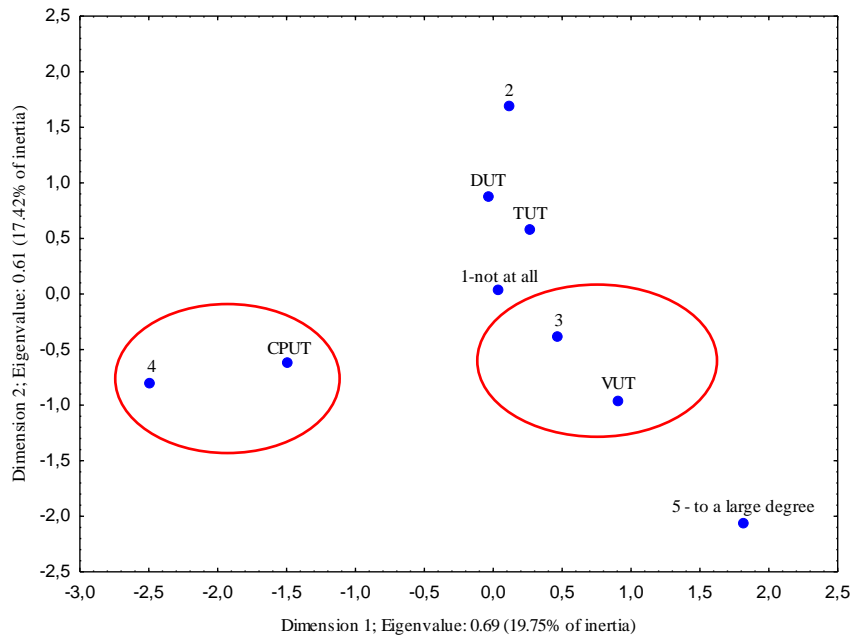


Fig. 7. The relationship between place of work (university) and different treatment related to professional or scientific advancement

Source: own elaboration.

Interpretation: the feeling of some unequal treatment related to gender in the area of assessment system of work was indicated by respondents from two universities: VUT and CPUT.

Question 11.2: Evaluation of discriminations related to gender or ethnicity/race you encounter during your job/duties concerning: vertical/hierarchical discrimination.

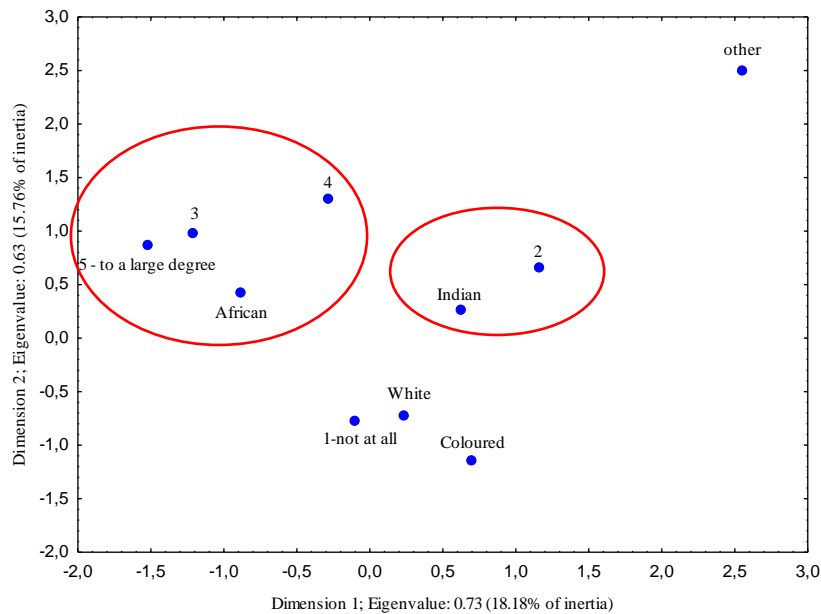


Fig. 8. The relationship between ethnicity and different treatment related to vertical/hierarchical discrimination

Source: own elaboration.

Interpretation: unequal treatment related to ethnicity in the area of vertical/hierarchical discrimination was reported only by African and partially by Indian staff members.

Question 11.3: Evaluation of discriminations related to gender or ethnicity/race you encounter during your job/duties concerning: the wage gap.

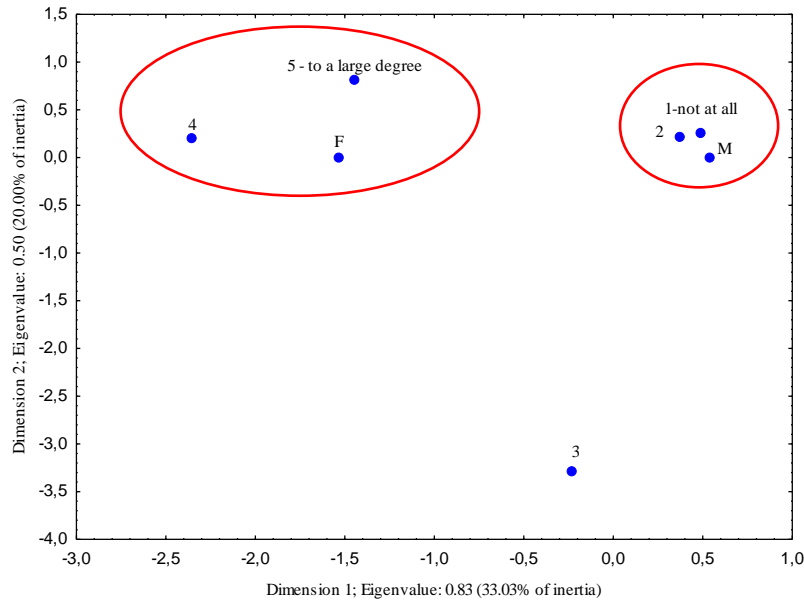


Fig. 9. The relationship between gender and different treatment related to wage
Source: own elaboration.

Interpretation: unequal treatment related to gender in the area of wage was reported only by women.

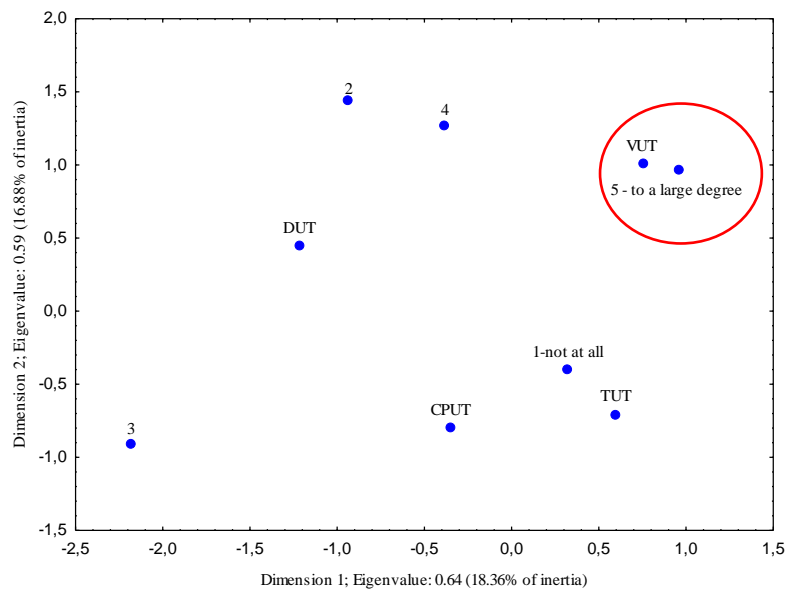


Fig. 10. The relationship between place of work (university) and different treatment related to wage
Source: own elaboration.

Interpretation: unequal treatment related to gender in the area of wage was reported only by VUT staff.

Question 11.6: Evaluation of discriminations related to gender or ethnicity/race you encounter during your job/duties concerning: preferences of social contacts. friendly work environment. good interpersonal relationships and opportunities for social awards.

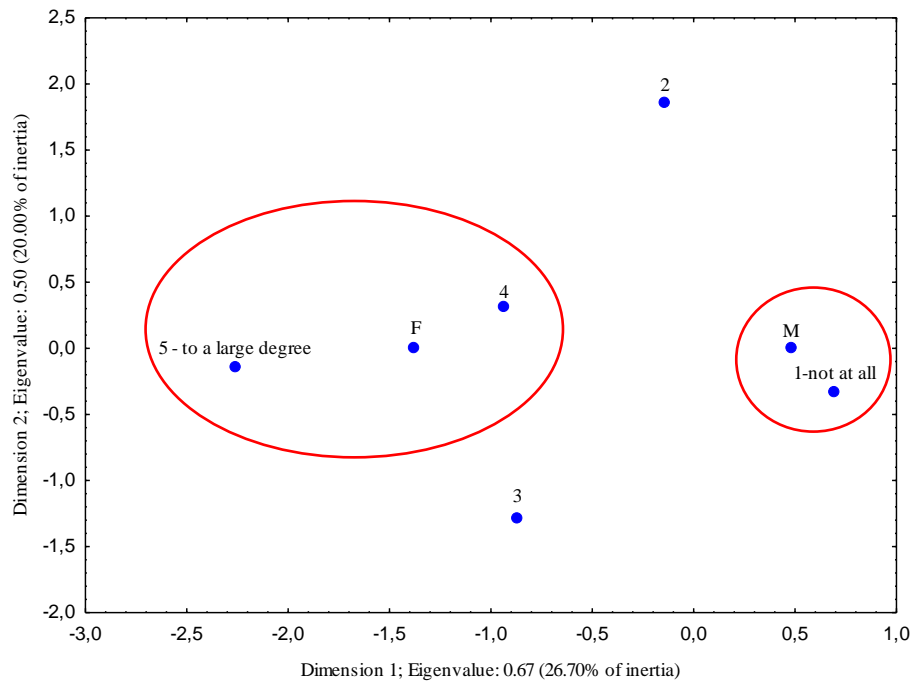


Fig. 11. The relationship between gender and different treatment related to preferences of social contacts, friendly work environment, good interpersonal relationships and opportunities for social awards

Source: own elaboration.

Interpretation: unequal treatment related to gender in the area of preferences of social contacts, friendly work environment, good interpersonal relationships and opportunities for social awards was noticed only by women.

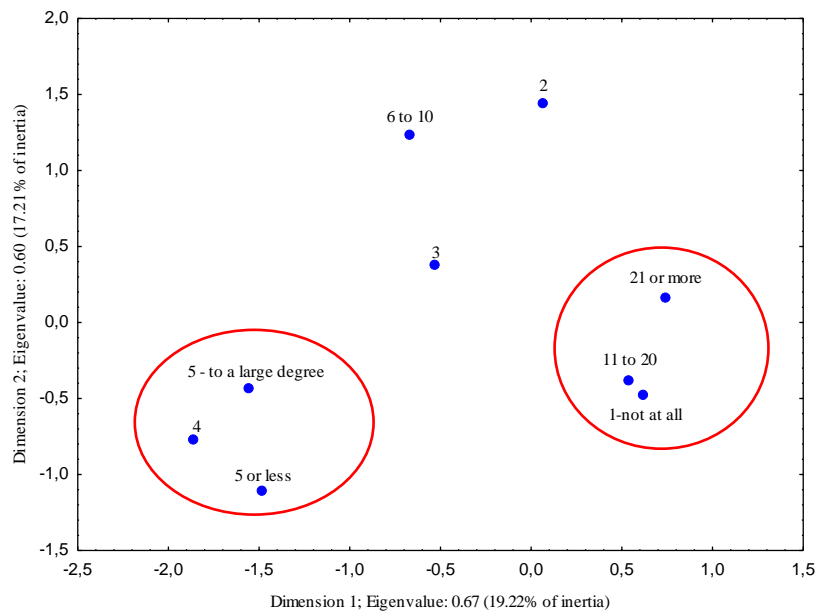


Fig. 12. The relationship between length of service at the university and different treatment related to preferences of social contacts, friendly work environment, good interpersonal relationships and opportunities for social awards

Source: own elaboration.

Interpretation: unequal treatment related to length of service at the university in the area of preferences of social contacts, friendly work environment, good interpersonal relationships and opportunities for social awards was observed among staff with this kind of length equal to 5 or less years and to some extent among workers with academic seniority between 6 and 11 years.

To assess the meaning of specific factors included in questions 10 and 11 for some kind of different treatment related to the gender or ethnicity during work at the university the aggregated percentage of two answers „4” and “5 – to a large degree” were calculated. In none of the cases considered did the total percentage exceed 18%, ranging from 5.48 to 17.81 percent.

This confirms the results of correspondence analysis, that there are no significantly negative phenomena in the area of equality by gender and nationality among academic staff at the researched universities. If they do occur, it is to a very limited extent in terms of gender pay gap and colleagues' attitude.

4.2. Qualitative analysis – open question

In the survey addressed to academic staff, one open question was asked, in which employees could enter their opinion regarding the survey, university activities related to gender equality policy, gender balance in the university and clarify their feelings in relation to the questions raised in the questionnaire. Over 38% of the survey participants used the additional opportunity to write an additional comment, while more than 32% of the statements concerned the gender balance policy (see Table 7). The answer to the open-ended question was voluntary, so each statement was treated with great attention, and the conclusions constitute additional added value.

Table 7. Characteristics of comments on open question (Question 16)

	Females	Males	Total
No. of respondents	19 (26%)	54 (74%)	73 (100%)
Staff that add extra comment	10 (52,6% of females)	18 (33,3% of males)	28 (38,4% of total)
Comments on gender balance	9 (47,4% of females)	14 (26% of males)	23 (32,5% of total)

Source: own calculations.

The importance of gender balance in research and implementation of special tools at SA universities has been emphasized in many statements by women, for example:

- „Would appreciate if this gender equality issue is taken seriously” (age 26-35),
- „Engineering is still dominated by males in the industry. Women have to work harder to prove their worth in the industry” (age 46 or older),
- „There are few female staff in engineering but that might be because they are sought after in industry and get better pay there” (age 46 or older),
- „For a woman to be recognised or even listened to at the workplace, she has to be performing exceptionally e.g. publishing multiple papers in year, should be a professor” (age 26-35).

In the statements of women, one can notice the emphasis on discrimination against women, and favouring men in the awarding of positions (“Men still get preferential treatment in terms of positions”), discrimination against women among older workers over 45 (“Senior men are taken more seriously”), in employment of foreigners (“Engineering faculty prefers hiring of more foreign nationals than SA men and women”) and racial discrimination (“discriminating against white females”).

Women aged 26-35 and 46 or older emphasized in their statements the need to focus on: the role and importance of women in Engineering, both in science and industry, the professional competences of women related to Engineering and the competition with men based on skills, knowledge and professionalism.

Only 18 men entered an additional comment, which constitutes 33.3% of the total number of men. Their statements were more balanced, but still consist some emphasis on the limitations of implementation of the equality policy at the university.

Among the chosen statements, we can note:

- „When I was a younger staff member I was shifted to the corner of discussions because of my age” (age 26-35),
- „The department of Electronic Engineering has created a fair and just environment for all staff members regardless of gender, race or any other forms of division. While I was at a previous department with the institution, I did witness injustice in gender equality along with many other forms” (age 36-45),
- „Women in the workplace are treated the same, or even in most cases better than male staff members” (age 46 or older),
- „This topic on gender equality is getting politically too good. The problem now is that gender balance organizational goal is putting merit, fitness-for-purpose, and competence second behind being a woman. Down to high school, girl child are being

treated encouraged and motivated. The boy child is left in many places to their fate. No one is discriminating against women anymore” (age 46 or older).

Strong support for the equality policies at the university level was found in the following statements of men:

- „The university can do more for women empowerment” (age 26-35),
- „Encouraging women to conduct more research related to women in engineering” (age 36-45),
- „Work life balance is very important especially for women and the work environment needs to be customised” (age 36-45),
- „Generally, departments are sensitive to the fact the females are underrepresented in the engineering profession, and consequently are aware of the need to employ more women in the faculty” (age 46 or older),
- „More can be done for gender equality. Changes are noted” (age 46 or older),
- „In the over 20 years I have noticed changes and more can be done” (age 46 or older),
- „I think the gender policy implementation is on the right course” (age 46 or older).

Academic staff members with more than 21 years of seniority work at the university level, notice changes in the gender balance policy at the university. They also often indicate that more can be done in this matter, because there are still unfair situations in which employees may feel be discriminated against gender, age, race, origin, etc. According to them universities are sensitive to the underrepresentation of women in the engineering profession, and thus are aware of the need to employ more women in the faculty.

On the other hand, employees with the length of academic work up to 5 years (5 or less) noticed tools supporting women in the profession of engineers and at universities, the need for knowledge and professional competences in competing in the profession, regardless of gender. Employees with short work experience also emphasize the increasing role of women in managerial positions in engineering departments. They also indicate the need to introduce new measures to support the position of women in technology universities and as an engineer in industry, and to avoid any discrimination on the basis of race, origin, age, etc.

5. Conclusions

When conducting a survey, we should take care to obtaining precise answers from respondents. The experience gained during first students’ survey has allowed to develop vocabularies (fixed options) that secure against different answers related to the same notion, e.g. name of the faculty. It should also be noted that although there has been some improvement in this area, a relatively significant obstacle to surveying is still the long time needed to obtain approval from the relevant ethics committee.

On the basis of the received results and main conclusions presented below the universities may formulate recommendations and take actions aimed at increasing the awareness of the existence of discrimination on grounds of gender or ethnicity and the effective reduction of such discrimination.

Conclusions:

- Female respondents reported discrimination in some work-related areas,
- A similar situation occurred in the case of young academics,

- African staff members expressed different treatment related to assessment system of work and the existence of “glass ceiling”, but this conclusion should be treated with some caution due to the sample bias – this ethnicity represented more than 40% of the total sample,
- Academic workers from VUT have noticed some incidence of discriminant situations related to professional or scientific advancement as well as to gender wage gap.

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Appendix 1. Questionnaire form



Co-funded by the
Erasmus+ Programme
of the European Union

DISCLAIMER

Dear Madame/Sir.

We kindly ask you to complete the following survey related to activities undertaken within the scope of the project *Personalised Engineering Education in Southern Africa* (PEESA III) – (reference number 585966-EPP-1-2017-1-DE-EPPKA2-CBHE-JP). financed by the European Union programme Erasmus+ Capacity Building in Higher Education. The project is realised by several South African and European universities. The PEESA III project members are seeking to understand selected issues related to gender equality in engineering study and related disciplines. The PEESA III Team will ultimately seek to advise decision makers on how best to encourage women to work in engineering.

Please note that this is a voluntary survey and you do not have to complete it. You can also withdraw from the survey at any stage without any consequences. and may choose to respond only to selected questions. The survey is completely anonymous and the results will be used only for purposes of PEESA III. The questionnaire should take no more than 10 min to complete. Members of the project will analyse answers. draw general conclusions and discuss these during their dissemination meetings. Some results after generalization could also account for scientific considerations. We would like to express our understanding and respect for spending your time on this questionnaire.

I understand terms and conditions and want to participate

- Yes (please continue the survey)
- No (please leave the survey)

STAFF SURVEY

1. Gender:

- female
- male
- other

2. Age:

- 25 or younger
- 26 to 35
- 36 to 45
- 46 or older

3. The length of service as an employee at university level (years):

- 5 or less
- 6 to 10
- 11 to 20
- 21 or more

4. Ethnicity/Race:

- African
- Coloured
- Indian
- White
- Other _____ (please define)

5. University name:

- Cape Peninsula University of Technology
- Durban University of Technology
- Tshwane University of Technology
- Vaal University of Technology

6. Faculty name:

- Faculty of Engineering and the Built Environment
- Faculty of Engineering and Technology

7. Department name:

- Architecture and Industrial Design
- Building Sciences
- Chemical Engineering
- Chemical, Metallurgical and Materials Engineering
- Civil Engineering

- Civil Engineering and Geomatics
- Civil Engineering and Surveying
- Clothing and Textile Technology
- Construction Management and Quantity Surveying
- Electrical Engineering
- Electrical, Electronic and Computer Engineering
- Electronic and Computer Engineering
- Geomatics
- Industrial Engineering
- Industrial Engineering & Operations Management
- Industrial and Systems Engineering
- Maritime Studies
- Mechanical Engineering
- Mechanical and Automation Engineering
- Metallurgical Engineering

8. Position at the university:

- Assistant
- Assistant professor
- Professor
- Lecturer

- Technician
- Administrative officer
- Other _____ (please define)

9. Employment dimension (status):

- Full-time
- Part-time
- Visiting professor
- Other _____ (please define)

10. During your work. did you encounter any different treatment related to gender concerning:

Subject	1-not at all	2	3	4	5 - to a large degree
10.1. Assessment system of work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10.2. Colleagues attitude	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10.3. Financial support	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10.4. Professional or scientific advancement	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

11. Please provide your evaluation of the following discriminations related to your gender or ethnicity/race you encounter during your job/duties:

Subject	1-not at all	2	3	4	5 - to a large degree
11.1. Horizontal occupational (women still channeled to a specific engineering professions)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

11.2. Vertical/hierarchical (managerial positions are reserved for men – “glass ceiling”)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.3. Pay (the wage gap)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.4. Shorter or more flexible working hours	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.5. Career opportunities					
11.6. Preferences of social contacts. friendly work environment. good interpersonal relationships and opportunities for social awards					
11.7. Employer’s aversion to employ women	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other obstacles/barriers _____ (please define)

12. Are you aware gender equality policy at your university?

Yes No I do not know

13. Is there any organizational unit/position related to gender equality policy at your university?

Yes No I do not know

(please define)

14. Please assess activities/tools you recognize within gender equality policy realization at your university:

Subject	1-not at all	2	3	4	5 - to a large degree
14.1. Implementing curriculum reforms to achieve the goal of gender equality	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14.2. Conducting research on a variety of gender issues and presenting solutions that are valid for the community	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14.3. Organizational policies and programmes that enable work-life balance (e.g. flexible working arrangements. child care. career breaks)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14.4. Support on return from maternity leave	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14.5. Identify and recommend female staff to join grant review and journal editorial boards	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14.6. Gender diversity awareness training (includes all different gender)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14.7. Ensure all school websites have images that represent women carrying out a range of roles including teaching and research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other _____ (please define)

15. Generally speaking, are you satisfied with your decision regarding teaching/ conducting research at engineering studies?

Yes No It's too early to make a statement

16. Other comments:

Appendix 2. An introductory letter of ethical clearance (University of Szczecin)

Szczecin. 3rd of September 2019

To bodies and persons responsible for ethical clearance at:

Cape Peninsula University of Technology

Durban University of Technology

Tshwane University of Technology

Vaal University of Technology

ETHICAL CLEARANCE APPLICATION LETTER

Dear Sirs.

University of Szczecin is involved together with your University in the project *Personalised Engineering Education in Southern Africa (PEESA III – project reference number 585966-EPP-1-2017-1-DE-EPPKA2-CBHE-JP)* financed by the European Union programme Erasmus+ Capacity Building in Higher Education. One of the aim of our activity is identification of factors that may increase the gender equality among staff in engineering education at South African universities. To achieve this goal we have to conduct a survey among staff of your university (content of the survey you can find in the attachment).

We kindly ask you to provide the ethical clearance of the survey. From our side we declare that the content of the survey complies with the national and EU rules and practices on research ethics. The survey will be conducted anonymously and the respondents' answer is not obligatory. We also guarantee gathering and protection of data. as well as dissemination of survey results. consistent with well recognized ethical principles.

Obtained results of the survey will not only allow to realize the main goals of the project. but will also form the basis for joint presentations and publications of your university employees and employees of the University of Szczecin.

Appendix 3. Letter of ethical clearance (University of Szczecin)

Szczecin. 3rd of September 2019

To bodies and persons responsible for ethical clearance at:

Cape Peninsula University of Technology

Durban University of Technology

Tshwane University of Technology

Vaal University of Technology

ETHICAL CLEARANCE LETTER

I declare that the content of the survey aimed at identifying factors that may increase the gender equality among staff in engineering education in South Africa. to be carried out as part of the project *Personalised Engineering Education in Southern Africa (PEESA III – project reference number 585966-EPP-1-2017-1-DE-EPPKA2-CBHE-JP)* financed by the programme Erasmus+ Capacity Building in Higher Education. complies with the rules on research ethics in force at the University of Szczecin. as well as with the recognized ethical practices and fundamental ethical principles. The survey (content in the attachment) will be conducted anonymously and the respondents' response is voluntary. Planned survey is also characterized by ethical clearance with regards to the European Charter for Researchers. Project members – academic staff members of the University of Szczecin – ensure proper conducting, gathering and protection of data. as well as generating, sharing and disseminating results of the survey. in line with recognized ethical principles and practices. They are familiar with the national and international legal requirements regarding data protection and confidentiality protection requirements. and will undertake the necessary steps to fulfil them at all times.

Appendix 4. Ethical approval from Tshwane University of Technology



Research Ethics Committee

The TUT Research Ethics Committee is a registered Institutional Review Board (IRB 00005968) with the US Office for Human Research Protections (IORG# 0004997) (Expires 14 Jan 2023). Also, it has Federal Wide Assurance for the Protection of Human Subjects for International Institutions (FWA 00011501). In South Africa it is registered with the National Health Research Ethics Council (REC-160509-21).

June 3, 2020

REC Ref #: REC2019/05/001 Name: Ramaube M TUT Staff Member
--

Ms M Ramaube
Department of Mechanical and Automation Engineering
Faculty of Engineering

Dear Ms Ramaube,

Decision: Approved – Gatekeeper permission (Staff survey)
--

Name: Ramaube M
Project title: *PEESA III Staff Survey*
Qualification: Non-degree Project

Thank you for submitting the project documents for review by the Research Ethics Committee (REC), Tshwane University of Technology (TUT). In reviewing the documents, the comments and notes below are tabled for your consideration, attention and/or notification.

The Chairperson of the Research Ethics Committee, Tshwane University of Technology, reviewed the project documents on June 3, 2020. The application for **Gatekeeper Permission** is **Approved**. The proposed research project may now continue with the proviso that:

- 1) The researcher/s will conduct the study according to the procedures and methods indicated in the **approved proposal**, particularly in terms of any undertakings and/or assurances made regarding the confidentiality of the collected data.
- 2) The proposal will be submitted to the Committee for prospective ethical clearance if there are any substantial **deviations** and/or changes from the approved proposal.
- 3) The researcher/s will act within the parameters of any applicable **national legislation, professional codes of conduct**, institutional guidelines and scientific standards relevant to the specific field of study. Strict adherence to the following South African legislation, where applicable, is especially important: Protection of Personal Information Act (Act 4 of 2013), Children's Act (Act 38 of 2005) and the National Health Act (Act 61 of 2003).
- 4) The researcher will inform the REC as soon as possible of any **adverse events** involving research participants that may have occurred during the course of the study. It includes the actions and/or processes that were implemented to mitigate and/or prevent any further injuries and/or adverse outcomes.
- 5) The researcher will inform the REC of any **new or unexpected ethical issues** that may have emerged during the course of the study, as well as how these ethical issues were addressed. The researcher must consult with the REC for advice and/or guidance in any such event.
- 6) The current ethics approval expiry date for this project is **June 3, 2022**. No research activities may continue after the ethics approval expiry date. An application for the extension of ethics approval must be submitted for projects that need to continue beyond the expiry date.

Note:

The reference number [top right corner of this communiqué] should be clearly indicated on all forms of communication [e.g. Webmail, E-mail messages, letters] with the intended research participants.

Yours sincerely,

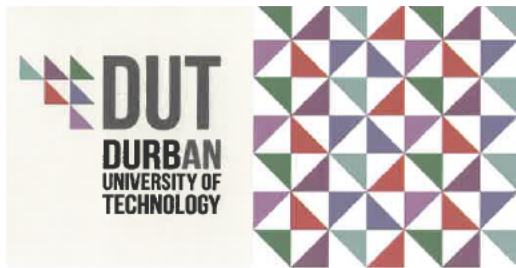


HD Mason (Dr)
Chairperson: Research Ethics Committee
[TUTRef#2019=05=001=RamaubeM]

We empower people

Tel. 0861 102 422, Tel. (012) 382-5911, Fax (012) 382-5114, www.tut.ac.za • The Registrar, Private Bag X680, Pretoria 0001

Appendix 5. Ethical approval from Durban University of Technology



Institutional Research Ethics Committee
Research and Postgraduate Support Directorate
2nd Floor, Berwyn Court
Gate I, Steve Biko Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2375
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

9 October 2019

Ms L A Cooke
P O Box 1334
Durban
4000

Dear Ms Cooke

Application for Amendment of Approved Research Proposal

Gender Equality in Engineering Education at Durban University of Technology

I am pleased to inform you that your application for the addition of an on-line survey of female staff (University of Szczecin) to your proposal has been approved.

Yours Sincerely

A handwritten signature in black ink, appearing to read 'J K Adam', is written over a horizontal line.

Professor J K Adam
Chairperson: IREC

