A PICTURE OF THE ENGINEERING OCCUPATION IN EUROPE

Diana Mariana POPA[1]

ABSTRACT:
DRAWING ON DATA FROM THE 7TH WAVE OF THE EUROPEAN SOCIAL SURVEY, THE PRESENT ARTICLE LOOKS AT THE CHARACTERISTICS, WORK PATTERNS AND OTHER VALUES OF INDIVIDUALS WITH AN OCCUPATION IN THE ENGINEERING FIELD. BASED ON A SAMPLE OF 335 SELECTED CASES FROM 15 PARTICIPATING COUNTRIES, A PICTURE OF THE PRESENT-DAY WORK SITUATION OF AN ENGINEER IS PRESENTED. FINDINGS ARE PRESENTED REGARDING WORK PATTERNS: TYPE OF CONTRACT, SUPERVISION ATTRIBUTES, NUMBER OF HOURS WORKED, INCOME, TYPE OF ORGANISATION WORKED FOR, DEGREE OF CONTROL AT WORK. OTHER VALUES SUCH AS CIVIC ENGAGEMENT, RESPECT FOR NATURE, RELIGIOUS BELIEFS ETC. ARE ALSO PRESENTED.

KEY WORDS: ENGINEERING, EUROPEAN SOCIAL SURVEY, VALUES

INTRODUCTION

Being part of the teaching body of a technical university, I am often confronted with the situation of speaking to students about their career prospects as future engineers. This is why I am interested in the answer to the question "What's it like to be an engineer?". Universities, national agencies for quality assurance in education and other actors involved in the educational system regularly conduct qualitative and quantitative studies in order to find out what the job market trends are in numerous professional domains and how educational programs could be tailored to meet both national and international job market requirements. In addition to these reports and other information from alumni, statistical data about the working engineering professionals can bring useful and interesting details about the career prospects in this domain. Such a useful source of comprehensive, standardized, reliable information is the European Social Survey (ESS), conducted regularly in European countries. Drawing on data from the European Social Survey, the present article looks at the characteristics, work patterns and other values of individuals with an occupation in the engineering field.

In the following sections the methodology used for selecting the investigated cases is presented, the resulted sample is described, and the identified working patterns and other values of engineers from 15 European countries are presented. Based on what we find out from this aggregated data, how could we better prepare engineering students for their future careers?

[1] Lecturer PhD, University POLITEHNICA of Bucharest, Romania, dianapopa.upb@gmail.com.

METHODOLOGY AND SAMPLE DESCRIPTION

This article is based on secondary data analysis using the European Social Survey database, the 7th wave, conducted in 2014 in 15 European countries. Data from the file was analyzed using the IBM SPSS software. From the entire datafile containing 28221 cases, the cases analyzed in this article were selected using two filters: the variable entitled "Occupation" and the control filter variable entitled "Highest educational level". For the "Occupation" variable those cases containing the "engineer" or "engineering" keywords were selected, resulting a first sample of 447 respondents. From all possible education level options, the 5 highest educational levels needed for an engineering occupation were selected:

- "ISCED 5A medium, bachelor/equivalent from lower tier tertiary",
- "ISCED 5A medium, bachelor/equivalent from upper/single tier tertiary",
- "ISCED 5A long, master/equivalent from lower tier tertiary",
- "ISCED 5A long, master/equivalent from upper/single tier tertiary"
- "ISCED 6, doctoral degree".

After filtering for the educational level, of the 447 initial cases 335 remained in the study sample. Non-responses and the "other" option for the "highest educational level" were also eliminated from the sample. These two variables assured the selection of those respondents with a similar education with today's requirements for the engineering profession.

The resulting sample included the following occupational categories:

- Science and engineering professionals - 20 (6%),
- Engineering professionals (excluding electrotechnology) – 4 (1.2%),
- Industrial and production engineers – 37 (11%),
- Civil engineers – 57 (17%),
- Environmental engineers – 6 (1.8%),
- Mechanical engineers – 65 (19.4%),
- Chemical engineers – 11 (3.3%),
- Mining engineers, metallurgists and related professionals – 8 (2.4%),
- Engineering professionals not elsewhere classified – 61 (18.2%),
- Electrotechnology engineers – 2 (0.6%),
- Electrical engineers – 33 (9.9%),
- Electronics engineers – 20 (6%),
- Telecommunications engineers – 11 (3.3%).

The values of the "Occupation" variable are based on self definition given by respondents. Categories such as engineering technicians, mechanics were not included. Management positions in the IT&C or manufacturing domains, for example, were not included in the study sample, even though these positions are very often occupied by people with a diploma in engineering. This is a research limitation of the present study, as managers with a possible engineering background were not included, given the fact that they identified themselves first of all as managers and not as engineers. Regarding the education level, 41.8% (120) of respondents in the sample had a ISCED 5A long, master/equivalent from upper/single tier tertiary.

Of the 335 respondents, 81.5% (273) were males and 18.5% (62) were females, with ages between 21 and 92, the most often mentioned age being 27. In terms of the respondents' country, from the 15 participating countries, the resulting sample has the following structure of respondents:

- Austria 6 (1.8%),
- Belgium 8 (2.4%),

- Switzerland 11 (3.3%),
- Czech Republic 6 (1.8%),
- Germany 77 (23%),
- Denmark 25 (7.5%),
- Estonia 26 (7.8%),
- Finland 37 (11%),
- France 49 (14.6%%),
- Ireland 13 (3.9%),
- Netherlands 14 (4.2%),
- Norway 26 (7.8%),
- Poland 18 (5.4%),
- Sweden 13 (3.9%),
- Slovenia 6 (1.8%).

Only 14.9% (50) of respondents live in another country that that of their birth, the largest number originating from the Russian Federation.

WORK PATTERNS

Engineers tend to work in large and very large companies: 31% (104) work in companies with more than 500 employees and 26.6 % (89) in companies with 100 to 499 employees. Most engineers work in the private sector, as shown in Table 1 and most have a 40 hour work week.

77.6% of respondents have an unlimited work contract, supporting the idea that the engineering profession provides job security. Entrepreneurial status is however rare, only 32 of respondents saying that they are self-employed. Correlated with the information that most engineers work for large companies, this rather low entrepreneurial rate could be explained by the high costs of starting a business in this domain (with the possible exception of consultancy firms). Acquiring the latest technologies and equipment requires substantial budgets that only large companies have. The engineering degree also gives one access to the public sector at central or local level but also to the educational and health sectors.

Table 1. What type of organization work/worked for

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Central or local government	25	7.5	7.5	7.5
	Other public sector (such as education and health)	23	6.9	6.9	14.3
	A state owned enterprise	25	7.5	7.5	21.8
	A private firm	237	70.7	70.7	92.5
	Self employed	18	5.4	5.4	97.9
	Other	7	2.1	2.1	100.0
	Total	335	100.0	100.0	

Engineers are rather satisfied with their income: 58.8% (197) of respondents say they live comfortably on their present income and 34.6 % (116) say they are coping on their present income. Only 6.3% of respondents say they have difficulties living on their present income. For 73.4% of respondents the main source of their household income is represented

by wages or salaries and only 6.3% state income from self-employment as their main household income. Only 13.1% of respondents have had paid work in another country for more than 6 months in the last 10 years. This is in accordance with other surveys showing that engineers' incomes keep increasing and engineers' job satisfaction is high[2].

Almost half of the respondents in the study sample - 48.1% (161) - say they are responsible for supervising other employees. This is an interesting aspect also to take into consideration when designing the university curriculum for future engineers, which should also include subjects such as leadership or communication in order to prepare future engineers for the task of supervision or coordination of other people. A positive correlation was found between the age of respondent and the degree in which he is allowed to decide how work is organized. A positive correlation was also found between the age of respondent and the degree in which he is allowed to influence policy decisions about the activities of the organization he forks for.

Engineers have a great degree of autonomy in their work. About three quarters or respondents (Figure 2) have a large or complete control over how they organize their daily work. This can be correlated with the high percent of respondents (75.3%) who say it is important to them to be able to make own decisions and be free.

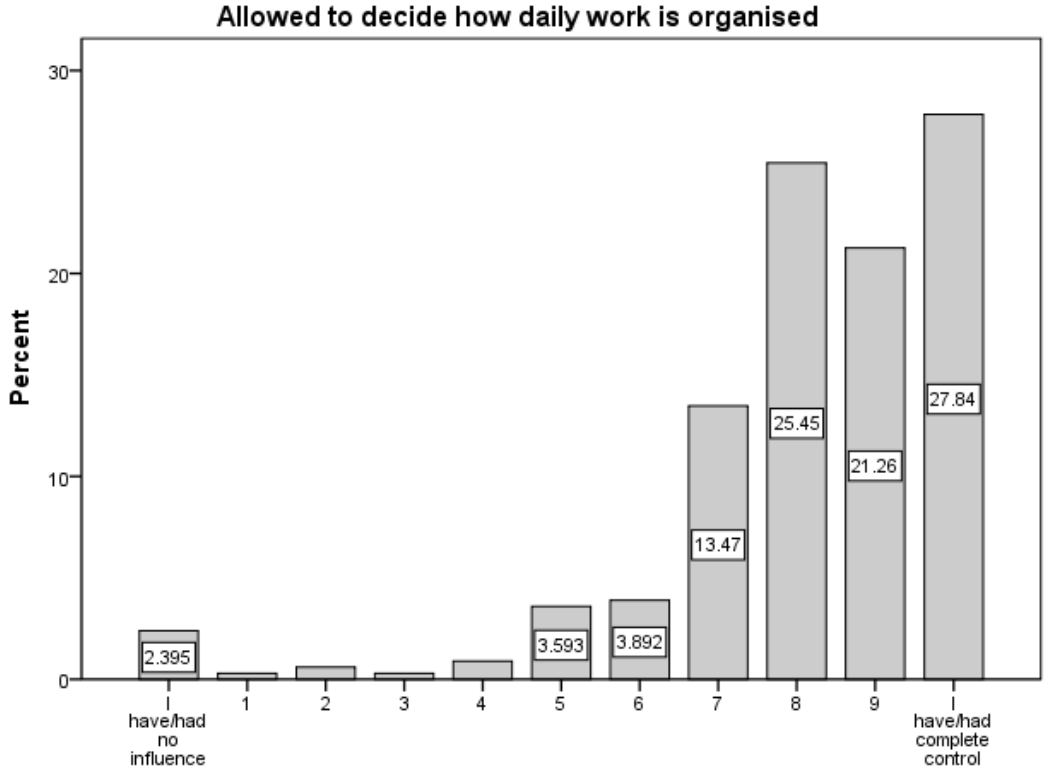

Figure 1. Degree of control at work

Another interesting observation is that a little over half (52.2%) of respondents went to a course/lecture or conference in the last 12 months in order to improve their skills. This is in accordance with principles stated in the codes of ethics of the engineering profession. For example, in the Statement of Ethical Principles of the Engineering Council and the Royal Academy of Engineering of the United Kingdom[3] one such principle is that engineers should

[2] American Society of Civil Engineers; The Engineering Income and Salary Survey Standard Report Trends Analysis, Policies, and Practices, 2012. https://www.asme.org

[3] Engineering Council of the UK. *Statement of Ethical Principles of the Engineering Council and the Royal Academy of Engineering of the United Kingdom*, 2014. www.engc.org.uk/professional-ethics

"Keep their knowledge and skills up to date and assist the development of engineering knowledge and skills in others".

OTHER VALUES

Engineers are quite interested in the current political affairs (76.1% are very or quite interested in political affairs) and civically active: 37.3% signed a petition in the last 12 months (in comparison with 27.2% from all participants in the survey) and a little over 80% voted in the last national elections (in comparison with 69.8% from all participants in the survey). Compared to the whole sample for the general population, engineers are less inclined in agreeing with the statement that the government should reduce differences in income levels (52.5% of respondents in the engineering group agree with this statement in comparison with 68.6% of the respondents in the entire dataset).

Respect for nature is one important aspect of the engineering profession[4]. According to several professional codes of conduct for engineers, one of the professional duties is to care about sustainability and the environment. For example, the Statement of Ethical Principles of the Engineering Council and the Royal Academy of Engineering of the United Kingdom includes two such provisions for engineers: "Minimise and justify any adverse effect on society or on the natural environment for their own and succeeding generations" and "Take due account of the limited availability of natural and human resources."[5]. In relation with this, for the item „it is important to care for nature and the environment" of the total sample for the general population, 31.8% of respondents say it is „very much like" me and 40.9% say it is „like me". Only 2.6% of the total population says it is „not like me" or „not like me et all". For the engineers sample, 27.6% of respondents say it is „very muck like me" and 41.1% „like me" to care for nature and the environment. 9.6% of engineers say it is „a little or not like me" to care for the environment. None of the engineers say that it is not al all like them to care for the environment (as opposed to 0.5 of the general population).

62.7% of respondents describe themselves as people for whom thinking up new ideas and being creative is important. 41.4% of respondents say following traditions and customs are very little or not at all like them. In comparison, only 28.4% of the general population say following traditions and customs in very little or not at all like them. 50.1% of respondents declare themselves to belong to a certain religion or denomination. Of the 165 respondents who said they don't currently belong to a certain religion, 116 (70.3%) said they never did. The majority of respondents declared themselves to be not religious.

CONCLUSION

In conclusion, based on the present data, the following answer can be given to the question "What's it like to be an engineer in Europe?": he/she works in a large company in the private sector with a 40 hour work week, has an unlimited work contract with a satisfactory income and is likely responsible for supervising other employees. Based on data from the study sample the engineering field remains male dominated.

Engineers have a high degree of control in their work, they have jobs that allow freedom of organizing their daily activities and the power to take decisions. Because engineers in many cases also supervise other people, their communication, leadership and/or management skills should also be developed during their educational course. Engineers are free thinkers and value creative thinking, required characteristics for the advancement of science. For a large part following traditions and customs is unlike them.

---

[4] Harris, Charles; *The Good Engineer: Giving Virtue its Due in Engineering Ethics.* Science and Engineering Ethics, 2008, 14: 153. https://doi.org/10.1007/s11948-008-9068-3

[5] Engineering Council of the UK. *Statement of Ethical Principles of the Engineering Council and the Royal Academy of Engineering of the United Kingdom*, 2014. www.engc.org.uk/professional-ethics

This article presented findings based on data from the European Social Survey, the 7th wave, conducted in 2014 in 15 countries. Unfortunately, Romania hasn't been part of the surveyed countries since 2008, but given the fact that Romanian engineers have free access to the European job market, results presented here are also interesting for future Romanian engineers. The engineering occupation remains a rewording one and most engineers are extremely or very satisfied with life as a whole and declare themselves happy in a large majority.

REFERENCES

1. **American Society of Civil Engineers;** The Engineering Income and Salary Survey Standard Report Trends Analysis, Policies, and Practices, 2012. https://www.asme.org
2. **Engineering Council of the UK**. *Statement of Ethical Principles of the Engineering Council and the Royal Academy of Engineering of the United Kingdom*, 2014. www.engc.org.uk/professional-ethics
3. **ESS Round 7:** *European Social Survey Round 7 Data (2014).* Data file edition 2.1. NSD - Norwegian Centre for Research Data, Norway – Data Archive and distributor of ESS data for ESS ERIC
4. **Harris, Charles**; *The Good Engineer: Giving Virtue its Due in Engineering Ethics.* Science and Engineering Ethics, 2008, 14: 153. https://doi.org/10.1007/s11948-008-9068-3.