



Engineers for Europe Monitoring Report 1

Do We Know Our Engineers?

A detailed analysis of data needs and data availability concerning engineering professionals in six pilot countries (Edition 2020)

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Editor

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ENGINEERS *for* EUROPE (E4E)

Preface

The Engineers Europe Advisory Group (EEAG) was launched in Brussels on 11 September 2018 with the aim to promote the engineering profession. The EEAG consists of signatories which are professional organisations of engineers, employer associations and institutions of higher education in engineering. A list of signatories is added to this report.

The EEAG immediately launched an initiative to deepen the knowledge on the engineering profession, to improve the engineering education, to bridge the skills gap and enhance engineering careers. The project is called “Engineers for Europe” or E4E. A list of partners is added to this report.

One of the three main outcomes of the project¹ will be the Engineers Europe Monitor (EEM), a data platform set up to keep track of the engineering profession. The EEM will be piloted in six countries.²

Work on the EEM is preceded by a detailed analysis (mapping) of data availability and resulting data needs in the six countries, described in the current report. The report lists available sources and data sets still lacking. The mapping has focussed on five key aspects of the life of an engineering professional:

- Engineering population
- Personal background
- Initial and continuing education
- Career development and mobility
- Labour conditions

The report contains first findings on these five aspects for the six pilot countries. A more complete picture will be provided in the 2022 edition. The mapping in the report will help to design country specific surveys in conjunction with existing surveys organised by member organisations. Four types of the Engineers Europe Survey (EES) are scheduled to be organised, when needed, in six pilot countries:

1. Students Surveys (BEST)
2. Graduates Surveys (EYE)
3. Employers Surveys (CECIMO)
4. Active Engineers Surveys (FEANI)

The report is the result of desk research, partner- and expert hearings, analyses, writing and editing, carried out by the Editing Team, supported by Partner Correspondents. Desk research will be done in June-September 2019. Hearings were held in September-November 2019. Analyses, writing and editing is to take place in December 2019 and January 2020. The report will be published in February.

¹ The other two outcomes are the Engineers Europe Education Reform Accelerator (ERA) and the Engineers Europe Career Development Service (CDS).

² France, Germany, Ireland, Italy, Portugal and Sweden.

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2. Methodology

3. Personal background

What is known about the personal background of engineers? What about age and gender? Do we know the educational attainment level of their parents?

4. Initial and continuing education

What data do we have on type and level of engineering studies among the various cohorts (age groups) in the upcoming and active engineering population? What is known about the uptake and potential of continuing education?

5. Career development and mobility

What information do we have on the professional trajectories of the various categories of engineering professionals? Do we know whether they spend part of their career in other sectors (public, private, research, education) or in other countries, in Europe and elsewhere?

6. Labour conditions

Do we have information on the employment status of engineers? Are average salary levels known? What about work life balance issues? Is their social security guaranteed?

7. Conclusions

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- I. Country Chapters: France, Germany, Ireland, Italy, Portugal, Sweden
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Do We Know Our engineers?

France

Population of Engineers

Provide the numbers of engineers per category (civil, mechanical etc.) and age group (students, graduates up to 35, active engineers up to 50 and older) for the latest year that data are available. Indicate trends (upwards, downwards, stable). Mention sources and gaps in data. Suggest ways to overcome the gaps (e.g. E4E partner surveys).

1) Total population

All engineers – 2018:

1 060 000 engineers

850 000 active engineers

40 000 new graduates

10 000 retiring

Source: IESF - 29e enquête nationale sur les ingénieurs 2018

2) Number of diplomas delivered:

1997: 25 000

2002: 30 000

2012: 35 000

2017: 40 000

Most diplomas of high engineering schools are generalist, without indicating a potential specialty. That explains the lack of data regarding students and graduates.

Source: IESF - 29e enquête nationale sur les ingénieurs 2018

3) Engineering learners

Academic year 2017-2018:

- 158 774 learners in engineering education (Bac - Bac +5): a trend upwards with +4.1% comparing to the year before
- 141 966 in engineering cycle (Bac +3 - Bac +5)

Source : Chiffre du mois n°85-CDEFI

4) Categories the most represented:

- Industrial engineer: 324 250
- Electrical/Gas/Water/Waste management engineer: 54 297
- Construction and civil engineer: 50 900

Trends upwards: Agricultural engineer and Industrial engineer.

Source IESF - 29e enquête nationale sur les ingénieurs 2018

Personal background

Indicate what is known about the personal background of the engineer per category and age group. Socio-economic status. Gender. First, second or third generation migrants. List the highest education level of parents. Indicate trends (more, less or no social mobility). Mention sources and gaps in data. Suggest ways to overcome the gaps (e.g. E4E partner surveys).

1) Gender

Students :

2012: around 25% women

2017: around 28-29% women

Very few women in NTIC, electronics, aerospace. More in agriculture, chemistry, life sciences.

➔ 60% in chemistry and life sciences; 58% in agronomy and agri-food.

Source : IESF - 29e enquête nationale sur les ingénieurs 2018

2) Origins

Graduates: 5 355 engineering diplomas delivered to foreigners - 14,8%.

Source : Chiffres du mois n°83 : Les ingénieurs diplômés de 1990 à nos jours – CDEFI

3) Socio-economic origins

Active engineers:

61% of engineers have fathers from high social classes (CIO, liberal and superior intellectual professions, executive positions).

More chances to become an engineer when a parent was one as well: one engineer out of 6 in the last 2 school years has a father working as an engineer (more than the % of engineers in society)

Source: IESF Enquête 2014

4) Personal situation

Active engineers:

30-34: 23% of engineers in a relationship with another engineer.

High proportion of women over 45 without a conjoint partner (20%).

1/3 of men engineers from 55-59 have partners without professional activity. High proportion in general for men.

Source : IESF Enquête 2014

5) Data lacks

- Highest education level of parents
- Trends in social mobility
- Very few data on origins and socio-economic status

Initial and continuing education

Indicate what is known about the highest level of education of the engineer per category and age group. Use EQF levels, bachelor-master-doctorate plus the local nomenclature. Explain the status of the higher education institution. Indicate take-up and type of continuing education (if known). Indicate trends (shifts between categories and levels). Mention sources and gaps in data. Suggest ways to overcome the gaps (e.g. E4E partner surveys).

1) Level of education

Graduates: $\frac{1}{3}$ of graduates with at least another diploma bac+5. 80% consider that this extra diploma is an asset in their career.

Source: IESF Enquête 2014

Active engineers: 38% of all engineers with a 2nd diploma - level Bac + 5 and beyond.

Source : IESF - 29e enquête nationale sur les ingénieurs 2018

2) Status of HEIs

Pre-eminence of preparatory classes for access to engineering schools : 47,6% (69,8% if we include preparatory classes integrated to engineering schools).

Source: IESF Enquête 2014

Total in public schools: 108 685 (in engineering cycle: 101 765)

Total in private schools: 50 089 (in engineering cycle: 40 201)

Source: Chiffre du mois n°85-CDEFI

3) Apprenticeships/Internships

Students : 14.6% in apprenticeship for initial training (mostly in private schools).

Source: Les effectifs en cycle ingénieur 2017-2018 MESRI-SIES

4) Data lacks :

- Continuing education
- Training for professional and soft skills

Career development and mobility

Indicate what is known about career- development and mobility per category and age group. How long do engineers stay in the same position? Do they move between the public and private sector? Do they move between countries? Indicate trends (more or less specialisation, more or less mobility). Mention sources and gaps in data. Suggest ways to overcome the gaps.

1) Unemployment

Active engineers: 3.4% (including graduates seeking 1st job) // 2,5% (without the inclusion of the graduates).

Source: IESF - 29e enquête nationale sur les ingénieurs 2018

More period of unemployment for women when changing jobs, especially after 50.

Source : IESF Enquête 2014

2) Time in the same position

Active engineers : 75% with 3 types of activity at the end of their career.

Source: IESF - 29e enquête nationale sur les ingénieurs 2018

3) Work abroad

Active engineers:
Total : 15-16% (CH, USA, DE, UK)
Progression towards Asia, now stable
Weak trends towards Africa

Source : IESF - 29e enquête nationale sur les ingénieurs 2018

4) Professional insertion

Graduates: improvement of the professional insertion : 18% of graduates in job search at the end of 2016 against 14% at the end of 2017.

Source : IESF - 29e enquête nationale sur les ingénieurs 2018

82% of the 2017 graduates found work 2 months after graduation.

Source : Chiffre du mois n°85-CDEFI

5) Data lacks

Trends in specialisation

Labour conditions

Indicate what is known about the labour conditions per category and age group. Average

salaries. Social security. Indicate the percentage working as an independent. Indicate the percentage working part-time. Child-care facilities. Indicate trends (more of less flexibility). Mention sources and gaps in data. Suggest ways to overcome the gaps (e.g. E4E partner surveys).

1) Average salaries

20-25: 34 800 (m.) / 33 000 (f.)

25-30: 39 300 (m.) / 37 200 (f.)

30-35: 48 700 (m.) / 45 000 (f.)

More remuneration for those with diplomas in administration/management.

Source : IESF - 29e enquête nationale sur les ingénieurs 2018

2) Time of work/week

45h/week: 55%

Source : IESF - 29e enquête nationale sur les ingénieurs 2018

3) Flexibility in work time organization

Free organization: 48%

Telework: around 20%

Source : IESF - 29e enquête nationale sur les ingénieurs 2018

4) Types of contracts

93% with CDI or civil servants.

Source : Chiffre du mois n°85-CDEFI

5) Data lacks

- Social security/pension
- Work-life balance

Ireland

Population of Engineers

Provide the numbers of engineers per category (civil, mechanical etc.) and age group (students, graduates up to 35, active engineers up to 50 and older) for the latest year that data are available. Indicate trends (upwards, downwards, stable). Mention sources and gaps in data. Suggest ways to overcome the gaps (e.g. E4E partner surveys).

1) Total population

“According to Census 2016, there are 42,771 engineers in the Republic of Ireland and Table 1 shows the breakdown for each of the broad disciplines of engineering. This total number of engineers is certainly a significant underestimate (our survey work suggests there could be up to 95,000) and is a result of many engineers filling in job titles which do not include the term ‘engineer’ or a related term.”

Source: Engineering 2018 - Engineers Ireland

2) Number of new entrants in engineering courses

“For the 2017/18 academic year, there were 3,884 new entrants to engineering courses in higher education, an increase of 2% since 2012, but down 4% in the past year. As a proportion of all new entrants to higher education, engineering has remained relatively stable at 9%. The analysis of discipline-specific trends is complicated by the common/general entry route.”

Source : Engineering 2019 - Engineers Ireland

3) Categories the most represented

- Civil engineer: 11.000
- Mechanical engineer: 8.333
- Electrical engineer: 7.143

Trends upwards: Civil engineer, Mechanical engineer, Electrical engineer, Chemical engineer

Source : Engineering 2018 - Engineers Ireland ; Engineering 2019 - Engineers Ireland

Personal background

Indicate what is known about the personal background of the engineer per category and age group. Socio-economic status. Gender. First, second or third generation migrants. List the highest education level of parents. Indicate trends (more, less or no social mobility). Mention sources and gaps in data. Suggest ways to overcome the gaps (e.g. E4E partner surveys).

1) Gender

Women comprise 13% of new entrants and graduates (undergraduate and postgraduate), just one in eight.

Larger gap: Civil & Building, Electrical & Electronic, Mechanical & Manufacturing

Source : Engineering 2019 - Engineers Ireland

2) Origins

Active engineers: 86% are Irish nationals (2016)

Source: Engineering occupations - CareersPortal

3) Data lacks

- Highest education level of parents
- Socio-economic status
- Trends in social mobility
- Personal situation

Initial and continuing education

Indicate what is known about the highest level of education of the engineer per category and age group. Use EQF levels, bachelor-master-doctorate plus the local nomenclature. Explain the status of the higher education institution. Indicate take-up and type of continuing education (if known). Indicate trends (shifts between categories and levels). Mention sources and gaps in data. Suggest ways to overcome the gaps (e.g. E4E partner surveys).

1) Level of education

Graduates: 3,865 Graduates from Level 7 and Level 8 courses. A 1% increase since 2016, but a 15% decrease over the past five years. (2017)

1,031 Graduates from Level 9 and Level 10 courses. A steady increase in this postgraduate level in recent years, up 9% in the past year and 40% in the past five years. (2017)

Source: Engineering 2019 - Engineers Ireland

2) Apprenticeships/Internships

The total population of apprentices has increased by 9% in the past year and by 81% in the past five years. There are now 11,273 apprentices.

Source: Engineering 2018 - Engineers Ireland

3) Continuing education

“Engineering organizations have been investing in upskilling/reskilling current employees (66%) and collaborating with education institutions (64%). However, comparatively few have been offering apprenticeships (26%) or specifically targeting female talent (23%).”

Source: Engineering 2019 - Engineers Ireland

4) Data lacks

- Status of HEIs
- Course of specialisation
- Training for professional and soft skills

Career development and mobility

Indicate what is known about career- development and mobility per category and age group. How long do engineers stay in the same position? Do they move between the public and private sector? Do they move between countries? Indicate trends (more or less specialisation, more or less mobility). Mention sources and gaps in data. Suggest ways to overcome the gaps.

1) Unemployment

Employment rate in 2016: 95% (comparing to 89% in 2011) in all broad disciplines.

Source: Engineering 2018 - Engineers Ireland

2) Work abroad

Foreign workers are more likely than Irish workers to migrate again in the future.

Source : Engineering occupations - CareersPortal

3) Professional insertion

Enormous demand for engineers across the economy. More than 6,000 job openings for engineers will be created in 2019.

Source : Engineering 2019 - Engineers Ireland

4) Data lacks

- Time in the same position
- Trends in specialisation

Labour conditions

Indicate what is known about the labour conditions per category and age group. Average salaries. Social security. Indicate the percentage working as an independent. Indicate the percentage working part-time. Child-care facilities. Indicate trends (more of less flexibility). Mention sources and gaps in data. Suggest ways to overcome the gaps (e.g. E4E partner surveys).

1) Average salaries

1-2 years' experience: 33,750 EUR

6-10 years' experience: 50,000 EUR

More than 30 years' experience: more than 89,000 EUR

Increase of salaries since 2014, particularly for younger engineers.

Source : Engineering 2019 - Engineers Ireland

2) Social security/pension

19% benefit from health insurance by their employer

Source : Engineering 2019 - Engineers Ireland

5% is the typical contribution by the employer to the pension scheme of an engineer with 11-15 years' experience.

Source: Salary survey 2019 - Engineers Ireland

3) Flexibility in work time organization

The vast majority of employed engineering professionals and technicians works full-time (96%) – 2016.

Source : Engineering occupations - CareersPortal

4) Work-life balance

69% engineers receive full pay for at least 26 weeks of maternity leave

63% engineers receive full pay for at least 2 weeks of paternity leave

Big variations according to the engineering sector.

Source: Salary survey 2019 - Engineers Ireland

5) Data lacks

- Time of work/week
- Types of contracts

Portugal

Population of Engineers

Provide the numbers of engineers per category (civil, mechanical etc.) and age group (students, graduates up to 35, active engineers up to 50 and older) for the latest year that data are available. Indicate trends (upwards, downwards, stable). Mention sources and gaps in data. Suggest ways to overcome the gaps (e.g. E4E partner surveys).

1) Total population

154.1 engineers

Source: Database PORDATA

2) Categories the most represented

- Computer engineer: 36.1 – Sharp increase
- Civil engineer: 34.4 – Sharp decrease
- Electrical engineer: 28.1 – Maintenance
- Mechanical engineer: 22.3 – Maintenance

Source: Database PORDATA

3) Students

Computer engineering: 16.7

Electrical engineering: 12.4

Mechanical engineering: 10.5

Source: Database DGEEC

4) Comments

Lack of useful sources for non-active graduates data.

Personal background

Indicate what is known about the personal background of the engineer per category and age group. Socio-economic status. Gender. First, second or third generation migrants. List the highest education level of parents. Indicate trends (more, less or no social mobility). Mention sources and gaps in data. Suggest ways to overcome the gaps (e.g. E4E partner surveys).

1) Gender

- Students:
Male: 45.8
Female: 14.0

- Active engineers;
Male: 119.0
Female: 35.1

Source : Database PORDATA, Database DGEEC

2) Data lacks

- Origins
- Highest education level of parents
- Socio-economic status
- Trends in social mobility
- Personal situation

Initial and continuing education

Indicate what is known about the highest level of education of the engineer per category and age group. Use EQF levels, bachelor-master-doctorate plus the local nomenclature. Explain the status of the higher education institution. Indicate take-up and type of continuing education (if known). Indicate trends (shifts between categories and levels). Mention sources and gaps in data. Suggest ways to overcome the gaps (e.g. E4E partner surveys).

1) Level of education

- Students:
EQF Level 6: 24.9
EQF Level 7: 32.4
EQF Level 8: 2.5
- Active engineers:
EQF Level 6: 80.3
EQF Level 7: 71.5
EQF Level 8: 2.2

Source: Database DGEEC

2) Statuts of HEIs

- Students:
Polytechnic School: 20.5
University School: 39.3
- Active engineers:
Polytechnic School: 84.1
University School : 70.0

Source: Database DGEEC

3) Data lacks

- Apprenticeships/Internships
- Continuing education

- Course of specialisation
- Training for professional and soft skills

Career development and mobility

Indicate what is known about career- development and mobility per category and age group. How long do engineers stay in the same position? Do they move between the public and private sector? Do they move between countries? Indicate trends (more or less specialisation, more or less mobility). Mention sources and gaps in data. Suggest ways to overcome the gaps.

1) Sector of employment

Graduates:

Employability in the training sector : 68,9% (2016)

Source: Técnico Lisboa

2) Work abroad

Graduates:

Internationalisation : 22,6% (2016)

Source : Técnico Lisboa

3) Professional insertion

Graduates:

2016: 96,8% for graduates with a second cycle diploma

Professional insertion at the end of the degree: 42,8%

Professional insertion after 6 months: 84,5%

Source : Técnico Lisboa

4) Data lacks

Lack of useful data for most categories and criteria, except for graduates.

Labour conditions

Indicate what is known about the labour conditions per category and age group. Average salaries. Social security. Indicate the percentage working as an independent. Indicate the percentage working part-time. Child-care facilities. Indicate trends (more of less flexibility). Mention sources and gaps in data. Suggest ways to overcome the gaps (e.g. E4E partner surveys).

5) Average salaries

Graduates :

EUR 1 834/month (2016)

Active engineers :

January 2019 : from 4,59/hour (unqualified civil engineering and construction worker) to 10,87/hour (building construction and engineering)

Source : Instituto Nacional de Estadística

6) Data lacks

Lack of useful data except on the average salaries.

Germany

Population of Engineers

Provide the numbers of engineers per category (civil, mechanical etc.) and age group (students, graduates up to 35, active engineers up to 50 and older) for the latest year that data are available. Indicate trends (upwards, downwards, stable). Mention sources and gaps in data. Suggest ways to overcome the gaps (e.g. E4E partner surveys).

1) Categories the most represented

- Civil engineer: 456.100
- Mechanical engineer: 451.600
- Computer engineer : 396.300
- Electrical engineer: 274.600

Trends upwards: Civil engineer, Environmental engineer, Chemical engineer, Computer engineer, Industrial engineer

Source : Mikrozensus (2016)

2) Students

- Computer engineer : 205.601
- Mechanical engineer: 191.763
- Electrical engineer: 84.751

Source: Statistisches Bundesamt (2018)

Personal background

Indicate what is known about the personal background of the engineer per category and age group. Socio-economic status. Gender. First, second or third generation migrants. List the highest education level of parents. Indicate trends (more, less or no social mobility). Mention sources and gaps in data. Suggest ways to overcome the gaps (e.g. E4E partner surveys).

1) Gender

Students: 177.575 female students (=23 %)

Source : Statistisches Bundesamt (2017)

Active engineers : 404.600 female engineers (= 17,7 %)

Source : Mikrozensus (2016)

2) Origins

Students: 140.337 foreign students (= 18,2 %)

Source : Statistisches Bundesamt (2017)

Active engineers: 325.200 foreign engineers (= 14,2 %)

Source : Mikrozensus (2016)

3) Data lacks

- Highest education level of parents
- Socio-economic status
- Trends in social mobility
- Personal situation

Initial and continuing education

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Lack of useful data

Career development and mobility

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Lack of useful data

Labour conditions

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Lack of useful data