Employers

EMPLOYABILITY AND UNIVERSITY EDUCATION IN THE FIELD OF PRODUCTION ENGINEERING

AQU CATALUNYA

EMPLOYABILITY AND UNIVERSITY EDUCATION IN THE FIELD OF PRODUCTION ENGINEERING

Barcelona, 2023

Generalitat de Catalunya

enqa. eqar/// ISO 9001 ISO 27001

C. d'Enric Granados, 33
08007 Barcelona

Drafted by: José Luis Mateos González

In collaboration with: Anna Prades Nebot and Jaume Valls Pasola

First edition: March 2023

With the cooperation from the sector of

With the cooperation of

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This report analyses the employability of graduates in the field of **Production Engineering** from a cross-sector perspective. This degree set, in the subfields of **Naval Engineering**, **Aeronautical Engineering**, **Automation and Industrial Electronic Engineering**, **Mechanical Engineering and Industrial Design**, **Chemical Engineering and Materials Science**, and **Industrial Engineering and Organisation**,[1] leads on to career paths that require "education and experience as is necessary to understand and apply engineering procedures in manufacturing processes and methods of production of industrial products" (MATISOFF, 1986, 1). The data analysed includes the perspective of stakeholders – alumni and companies and organisations that recruit graduates – on the employability of graduates: surveys on **satisfaction**, **employment outcomes** and **employers' opinions**. It also includes basic data on the degree programmes analysed: supply and demand, and breakdown of enrolments by biological sex.

The main findings of this report are set out below.

The key facts regarding the degree programmes are:

- **Demand** for Production Engineering degrees **tends to match the supply**. Pre-registration data for the 2020-2021 academic year indicate that the number of places requested as a first option was 6% higher than the total number of places offered by public universities. This excess demand was significantly lower than for the Catalan higher education system as a whole (SUC), which was 39%.
- Only 44.4% of Production Engineering students **graduated within the theoretical time required**, 35% below the SUC percentage (79.4%).
- Production Engineering degrees are **much more male dominated** than SUC degrees overall: **8 out of 10 people** who enrolled in the 2020-2021 academic year were men.

In terms of satisfaction with the training and employment outcomes for graduates of the degree programmes:

- Almost **30%** of Production Engineering students chose the degree for its **career opportunities**, nearly 17% more than the overall percentage for the SUC. This figure rises to 47% for those enrolled in Industrial Engineering and Organisation.
- Overall **satisfaction** with the degree (**6.9**) was 0.4 points **lower** than the overall figure for the **SUC** (**7.3**). All the degree programmes analysed had an overall satisfaction rate similar to that of the SUC as a whole, with the exception of Industrial Engineering and Organisation (6.4), Aeronautical Engineering (6.1) and Naval Engineering (6.2).

[1] This classification of degrees by discipline is based on the AQU Catalunya *Programme Catalogue*, which is explained in more detail in the introduction to this report.

- **Satisfaction with the improvements** in **personal** and **professional skills** provided by the degree was **notable** in most cases, with figures close to those of the SUC. However, with the exception of Chemical and Materials Engineering, graduates of the remaining degrees tended to give a **lower score** to **communication skills** acquisition than SUC students as a whole (6.1 vs. 7.1).
- Graduates gave a **rating similar to or higher** than the SUC as a whole for the capacity of the **bachelor's degree final project** to consolidate skills from the degree programme (around 7). However, with the exception of Electronic and Automation Engineering and Chemical and Materials Engineering, all the degree programmes tended to **rate less highly** the likelihood of applying knowledge from the degrees in **external work placements** (6.2 vs. 7).
- The vast majority of people (93.2%) were working three years after graduating, slightly higher than the overall rate for the SUC. **The employment rate for all degree programmes exceeded 90%**, except for Naval Engineering (84.9%).
- Among these, 73.2% were carrying out degree-specific tasks (similar to the SUC) and 19.3% university tasks, 7% more than for the SUC overall. All degree programmes had a better university suitability rate than that of the SUC, with the exception of Naval Engineering, which had values similar to the SUC.
- Graduates' **gross monthly salary** three years after graduation was **significantly higher** than the SUC average (**2,688 euros vs. 2,186 euros**). The field of Production Engineering includes degree programmes with the highest average salaries in the SUC.
- Contractual **stability** is also a characteristic of Production Engineering graduates: **76.1%** had a **permanent employment contract**, almost 20% more than the SUC overall (56.3%).
- The results suggest that graduates in Production Engineering have **higher quality employment outcomes** than SUC graduates overall. This is confirmed by the occupational quality index,[2] which aims to measure this factor: the field of Production Engineering obtained 74.2 out of 100, 8 points more than the SUC as a whole (66.6).
- **Language proficiency** and, to a lesser extent, **decision making**, **leadership** and **management** were the cross-disciplinary skills with the **largest educational shortcomings in relation to their application in the workplace**, according to graduates working in university functions. The opposite is true for theoretical and practical knowledge.

With regard to employers:

- The vast majority of the Production Engineering graduate employers surveyed (90%) required a **specific university degree**, being the fifth ranking sector in the employers study, together with Economy and Business, in demanding **English proficiency**.

[2] The occupational quality index (IQO) is based on different indicators: contract (*C*), job satisfaction (*S*), pay (*R*) and suitability (*A*). The value range is from 0 to 100 and the higher the rating the better the occupational quality experienced. The formula is: IQO = *f*[(*C* + *R* + *A*) * *S*]. For further details, see COROMINAS et al. (2012).

- A total of **55%** of employer organisations had **hiring difficulties**, in line with the average for all companies answering the AQU Catalunya employer survey.
- The lack of graduates with the necessary skills for the job is the main reason for these recruitment difficulties (61% of cases).
- Almost 5 out of 10 employing organisations (48.9%) thought the **ability to apply acquired knowledge and solve problems in new or unfamiliar environments** was the skill Production Engineering graduates most needed to improve. The **ability to manage technical actions** (46.1%) and **integrating knowledge and making judgements from incomplete information** (31.1%) were the other two skills most employers thought **needed improving**.
- However, **employers rated recent graduates' skills positively** (7.5).
- As far as work placement students are concerned, it is noteworthy that the skills most worked on during work placement were those graduates needed to improve. The exception to this is use of specific software, which stands out as one of the skills most worked on during work placement (47.5%).

INTRODUCTION

The expansion of university systems in Catalonia and elsewhere has intensified the diversification of the functions performed by universities, which have become institutions that go beyond their historical role associated with teaching and research. Today we usually refer to four missions: teaching, research, innovation and service to society (EUROPEAN COMMISSION, 2022). The emergence of the so-called "knowledge society", associated with this expansion, has emphasised the role of universities in the **employability of graduates**, understood not only as obtaining work – which may depend more on the economic situation and employment policies – but also as the capacity of universities to design "training with a profile that responds to the skills and qualifications requested in the labour market" (RODRÍGUEZ ESPINAR et al, 2007, 338).

The emphasis on analysing graduate employability profiles also coincides with the emergence of demands for accountability for expansive university systems that require increased public spending. It therefore makes sense for university quality agencies to make available to the university community a set of resources to assess the quality and impact of higher education from an employability perspective (BRENNAN, 2018). In this regard, one of the strategic courses of action of AQU Catalunya that enables this objective to be achieved is that of "facilitating access to quantitative and qualitative data, in an integrated way, to improve the quality of the Catalan Higher Education System" (AQU CATALUNYA, 2022).

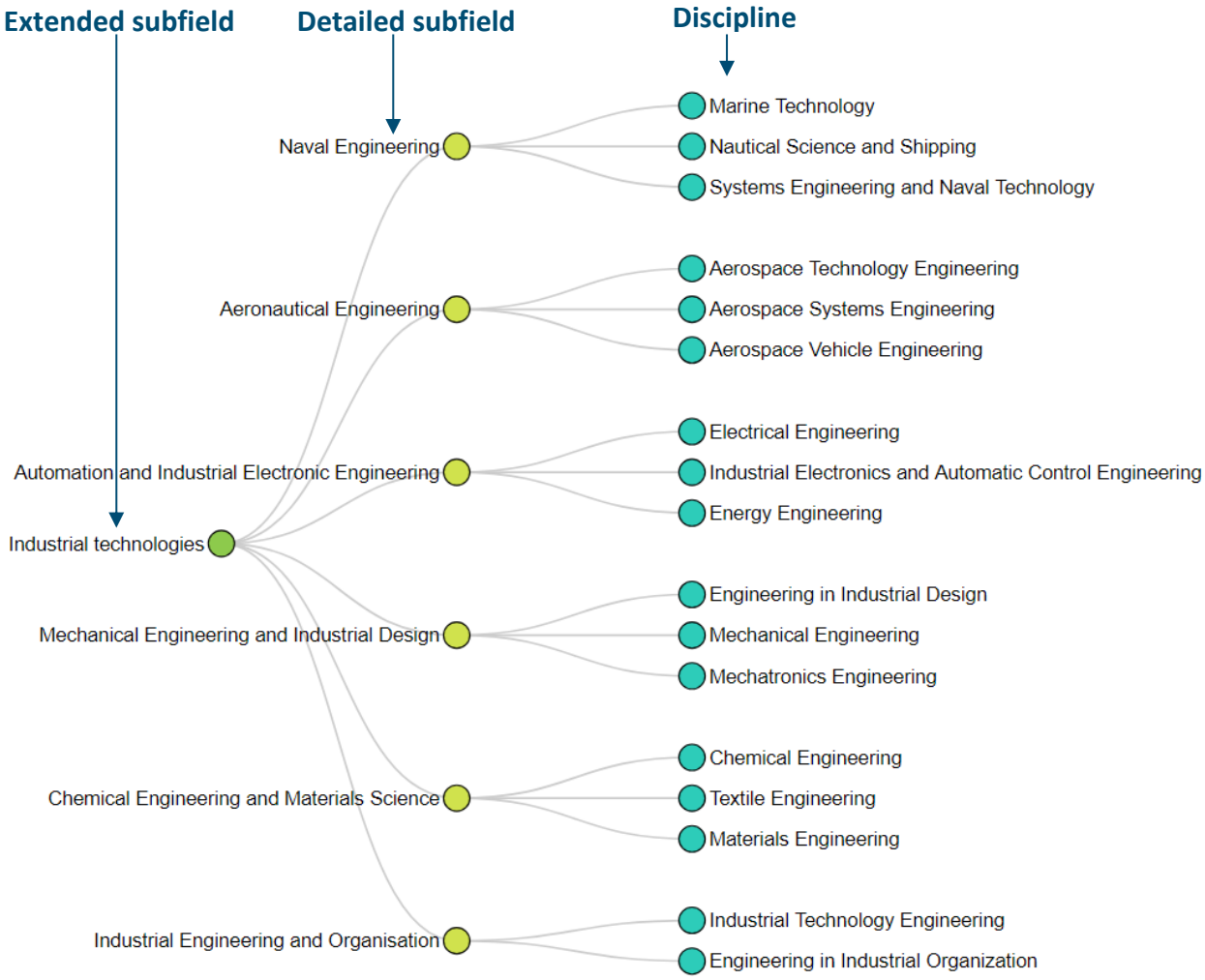
This report, part of a series of reports on the relationship between university and employability, aims to do this for Production Engineering degree programmes.[3] These degree programmes lead to career paths that require “education and experience as is necessary to understand and apply engineering procedures in manufacturing processes and methods of production of industrial products” (MATISOFF, 1986, 1). In this sense, data are analysed regarding degrees in the extended subfield of Industrial Technologies, based on the AQU Catalunya *Programme Catalogue* ,[4] which includes the detailed subfields and disciplines shown in figure 1.[5] For ease of reading and analysis, this report uses the “detailed subfield” aggregation level.

[3] In this report, the term *set of degree programmes* refers to both the *field* and *sector* of Production Engineering.

[4] The AQU Catalunya *Programme Catalogue* is a hierarchical classification system of degree programmes, based on the proximity of the disciplines. It has four grouping levels for the specific degrees taught in the SUC, from the most to the least broad: field, extended subfield, detailed subfield and discipline. Pilot and Aeronautical Management are excluded from the analysis because of their small sample sizes in the surveys analysed in this report and because they do not strictly fit the MATISOFF (1986) definition of Production Engineering.

[5] The “Related Degree Programmes” section in this report lists the bachelor’s degree programmes active in the SUC for the 2021-2022 academic year and the universities where they are taught.

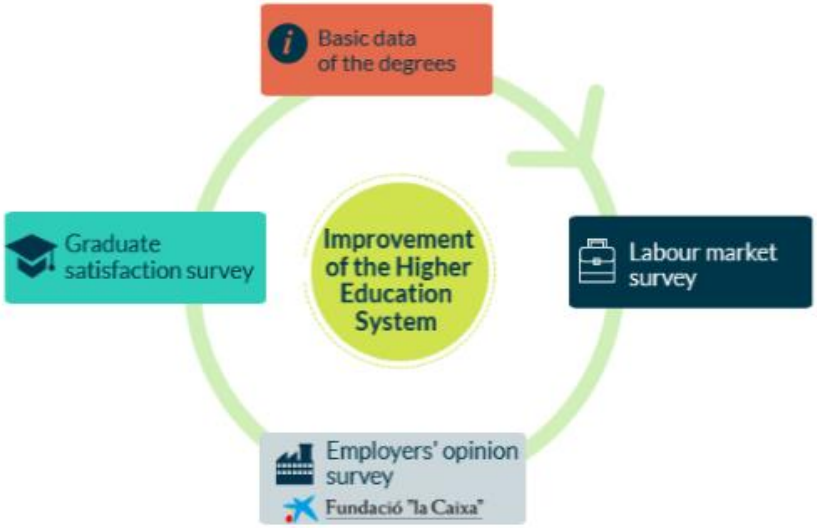
Figure 1. Degree programmes included in the Production Engineering field analysed in this report, classified according to the AQU Catalunya *Programme Catalogue*



The document brings together the analysis of key data to help understand how university education work in terms of the employability for the courses shown in the figure above. The aim is to provide facts that will help those responsible for universities in the political and academic spheres to make decisions aimed at improving university education. Moreover, this knowledge also has the potential to support current and future students in making informed decisions about their career paths.

Figure 2 shows the sources of information included in this analysis.

Figure 2. Sources of the information analysed in this report



The report also analyses the results of the latest **employer survey**, which gathers opinions on university education from the companies, organisations and institutions that recruit Production Engineering graduates. A new feature of this latest survey is the section on the professional skills that have been worked on the most and require the most improvement by **work placement students**. This report compares the results of this survey with the previous one (AQU CATALUNYA, 2021b)[6] to identify relevant differences.

[6] As this is an employer survey, a type of survey that usually generates relatively small samples, we cannot claim that the similarities or differences with the previous edition are statistically significant. Although we believe that the continuity we observe between the two editions is evidence of the robustness of our results, we recommend readers interpret the results with caution and from a critical perspective.

INDICATORS FOR DEGREE PROGRAMMES IN THE FIELD OF PRODUCTION ENGINEERING

Basic data on the degree programmes

The map in figure 3 and table 1 show the figures for supply and demand [7] for places in the different bachelor's degrees in the field of Production Engineering in Catalonia for the 2020-2021 academic year. Data for key indicators for the same year are also given: first-year drop-out rates, number of enrolled students and graduation rate within the theoretical duration of the degree programme (*t*) or one more year (*t*+1).[8]

In the 2020-2021 academic year, demand was in line with the supply of public places on all Production Engineering degree programmes, where over half the students graduated after more years than expected

- The balance between supply and demand varied substantially between courses, as shown in table 1.
- The detailed subfield with the highest demand was Aeronautical Engineering, where demand represented 154% of the supply of places. The degree programmes with the greatest excess supply were Electronic and Automation Engineering, where 13% of the places were not covered by the demand.
- In terms of first-year drop-outs, only two subfields have a worse rate than for the SUC overall: Electronic and Automation Engineering (18.4%) and Chemical and Materials Engineering (17.3%).
- The graduation rate in Production Engineering (44.4%) was significantly worse, 35% lower, than the overall SUC figure (79.4%). However, there are significant differences between subfields: the rate ranges from Aeronautical Engineering (62.8%) to Electronic and Automation Engineering (34.6%).

[7] Figures for supply and demand are differentiated by cost of tuition. A place is considered a public if it is at a centre belonging to one of the seven Catalan public universities. If the place is offered at a private university or centre affiliated to a public university, it is considered private.

[8] The graduation rate is calculated by dividing the number of graduates in the reference year by the number of students who enrolled as many years ago as there are theoretical academic years on the curriculum (*t*) or one more year (*t*+1).

Figure 3. Supply, demand and academic performance indicators in the field of Production Engineering (academic year 2020-2021)

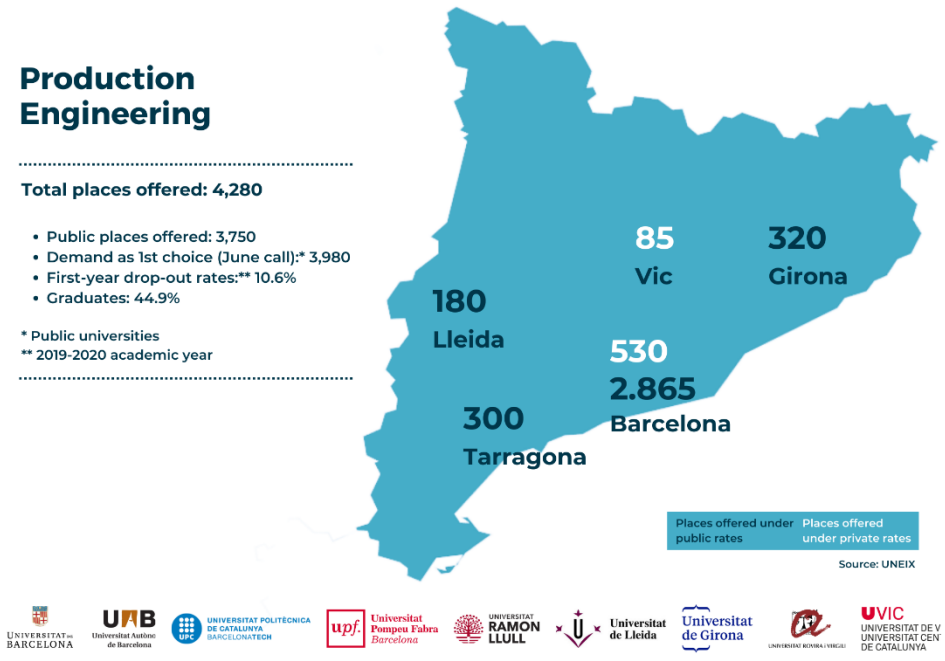


Table 1. Supply, demand and performance indicators by detailed subfield

With regard to the demand/supply ratio, excess demand is shown in green, demand matching supply in yellow, and low demand in red.
With regard to drop-outs, values below the SUC average are shown in green, similar values in yellow and higher values in red.
In relation to the graduation rate in *t* or *t*+1, detailed subfields with values below the SUC average are marked in red.

Detailed subfield[9]	Supply (private)	Supply (public)	Demand (private)	Demand (public)	Demand/supply[10]	1st-year dropouts[11]	Graduation in *t* or *t*+1
Aeronautical		345		531	153.9%	5.0%	62.8%
Automation and Electronic	160	1,265	82	1,100	87.0%	18.4%	34.6%

[9] The aggregate values shown on the map may not match the sum of the values in the table. This is because of bachelor's degrees offered as a group, i.e. students enter a common core subject for several degree programmes and, at a certain point in the curriculum, choose the degree programme they will continue studying and graduate in.

[10] The demand/supply ratio is calculated for publicly priced places only.

[11] Data for the 2019-2020 academic year.

Industrial and Organisation	200	775	67	846	109.2%	6.1%	46.7%
Mechanical and Industrial Design	310	1,315	214	1,285	97.7%	14.6%	39.5%
Naval	45	150	45	179	119.3%	5.1%	46.7%
Chemical and Materials	70	1,015		991	97.6%	17.3%	37.2%
Total Production Engineering	**530**	**3,750**	**270**	**3,980**	**106.0%**	**10.6%**	**44.9%**
Total SUC	**32,182**	**31,038**	**8,041**	**46,939**	**139.3%**	**14.4%**	**79.4%**

Degrees in the field of Production Engineering are much more male dominated than SUC degrees as a whole, but the percentage of women enrolled was similar to the total for all Engineering degrees

- In the 2020-2021 academic year, fewer than 3 out of 10 students were women. According to SOLER JULVE (2022), this is a "highly male-dominated" degree field, having the lowest proportion of women in all SUC degrees, along with ICT.
- There are differences between detailed subfields, as shown in table 2. In the academic year 2020-2021, the subfield with the highest percentage of women enrolled was Chemical and Materials Engineering (31.2%) and the lowest was Electronic and Automation Engineering (13.8%).
- A positive, albeit modest, trend can be seen in the rise in the proportion of women in all Production Engineering degrees.[12] The data show an average annual increase of 0.6%. If this rate does not speed up, it will take another 40 years for the field of Production Engineering to reach 50% female enrolment.
- However, Figure 4 shows horizontal segregation in terms of choice of degrees, with greater male representation in the most lucrative degrees, as pointed out in a previous longitudinal study by AQU Catalunya on gender and employment outcomes (AQU CATALUNYA, 2021a). As discussed in later sections, Production Engineering graduates have some of the best employment rates in the SUC, together with better

[12] A similar rise can be seen in Spain as a whole (see the Ministry of Universities data portal).

salaries and contractual stability. This difference in choice of qualifications may help explain the gender pay gap (ibid.).

Figure 4. Trend in the percentage of women enrolled in Production Engineering degrees

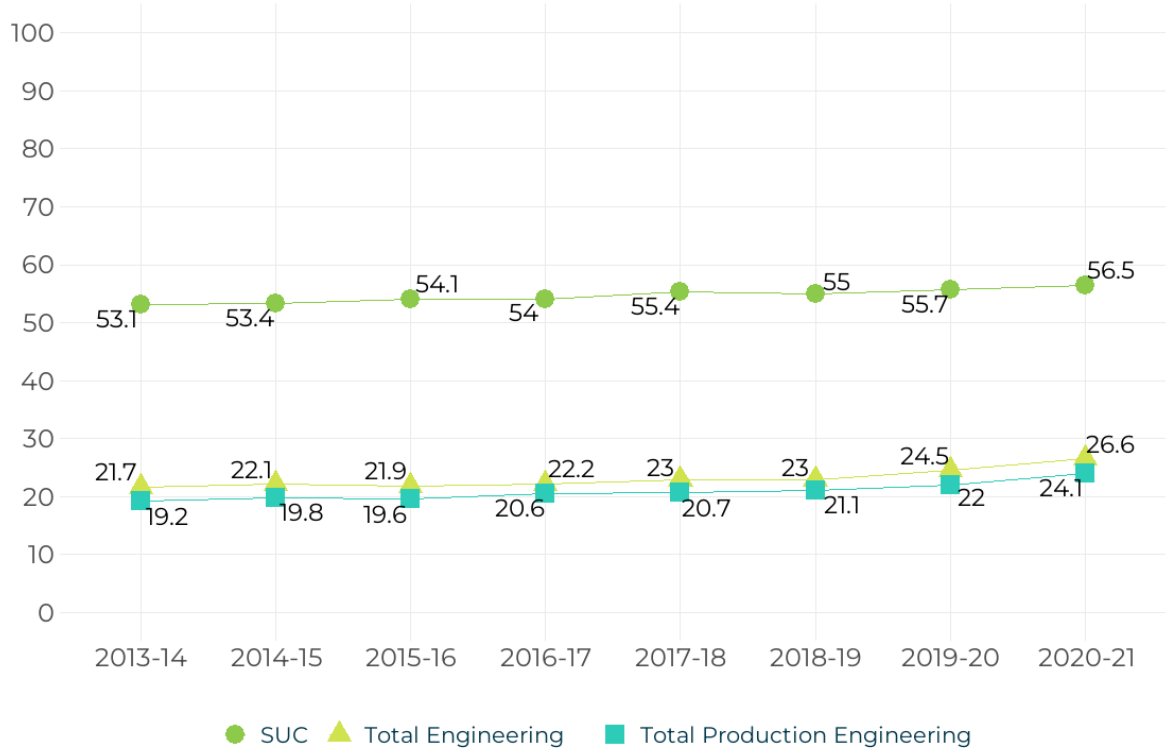


Table 2. Percentage of women enrolled by detailed subfield (2013-2014 and 2020-2021 academic years and percentage difference between the two)

Detailed subfield	2013-2014	2020-2021	Difference
Aeronautical	24.4%	26.5%	3.2%
Automation and Electronic	12.2%	13.8%	2.8%
Industrial and Organisation	20.1%	23%	4.8%
Mechanical and Industrial Design	14.2%	17.2%	5.5%
Naval	14.5%	18.8%	4.3%
Chemical and Materials	26.7%	31.2%	5.7%
Total Production Engineering	**19.2%**	**24.1%**	**4.9%**
All engineering programmes	**21.7%**	**26.6%**	**4.9%**
Total SUC	**53.1%**	**56.5%**	**3.4%**

Graduates' satisfaction with their university education in the field of Production Engineering

The data analysed in this section comes from the **satisfaction survey**, an annual survey carried out since 2015 by Catalan universities in coordination with AQU Catalunya. This survey asks recent graduates how satisfied they are with different aspects of their educational experience in the Catalan Higher Education System. The results below are based on data for the last three available years (2019, 2020 and 2021) for the Production Engineering degree programme.

Table 3. Sample, population, response rate and sampling error for the satisfaction survey of graduates in the field of Production Engineering and in the Catalan Higher Education System (SUC) as a whole (2019-2021)

Detailed subfield	Sample	Population	Response rate	Sampling error (±)
Aeronautical	221	618	35.8%	5.4%
Automation and Electronic	368	1,399	26.3%	4.5%
Industrial and Organisation	572	1,786	32%	3.4%
Mechanical and Industrial Design	573	2,245	25.5%	3.6%
Naval	84	424	19.8%	9.8%
Chemical and Materials	322	1,248	25.8%	4.8%
Total Production Engineering	**2,140**	**7,720**	**27.7%**	**1.8%**
Total SUC	**27,557**	**100,272**	**27.5%**	**0.5%**

This section explores data on satisfaction with the aspects of university education most relevant to the graduate employability the field of Production Engineering. A summary of their overall satisfaction is also provided.

In addition, this section analyses a question from the satisfaction survey that is closely linked to the subject of this report: the main reason for choosing the corresponding degree programme. This, in conjunction with the data from the employment outcomes and employer surveys, allows us construct a complete profile of students and recent graduates in the field of Production Engineering.

Reason for choosing and overall satisfaction with degrees in the field of Production Engineering

Nearly a third (29.4%) of students in the field of Production Engineering chose the degree for its career opportunities

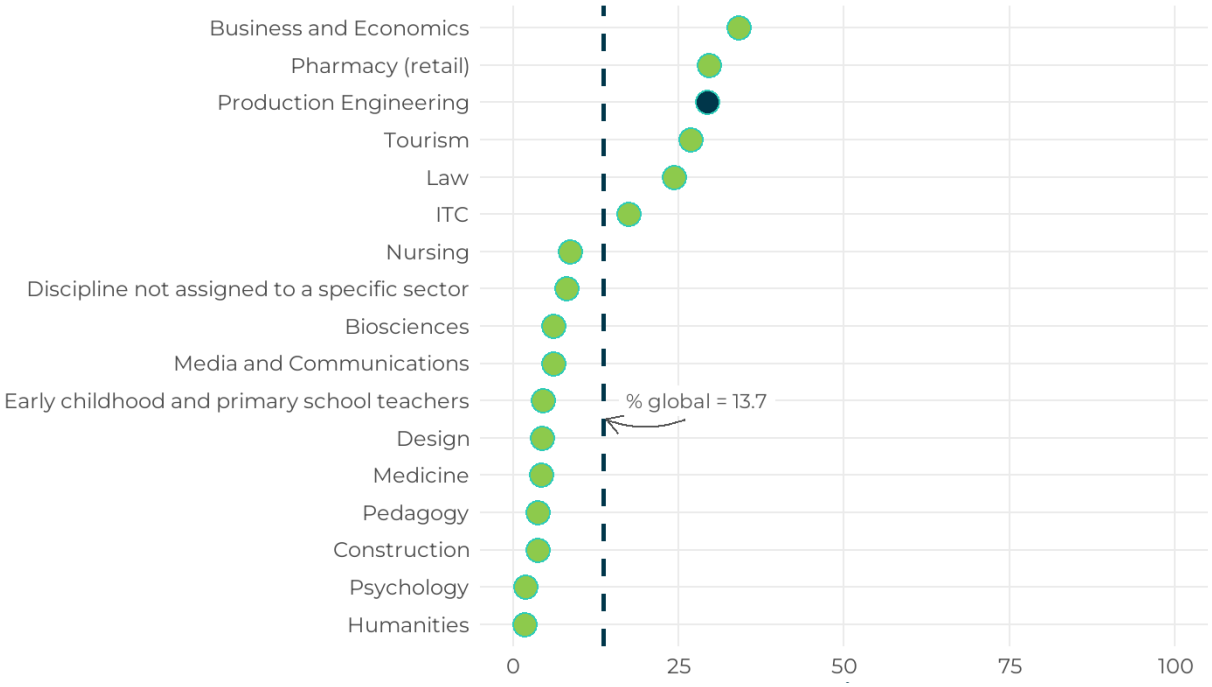
- All Production Engineering degrees had a significantly higher percentage of students who chose the degree for its career opportunities than the SUC as a whole (13.1% more).[13]
- This is particularly noticeable among Industrial Engineering and Organisation graduates (46%).
- It is worth noting that Production Engineering sector comes third in the employers study in terms of the percentage of students selecting the degree for instrumental reasons, as shown in figure 5.

Table 4. Main reasons why students chose their respective degrees (%)

Detailed subfield	Personal interest	Good career prospects	Cut-off mark	Other
Aeronautical	65.2	24	7.2	3.6
Automation and Electronic	68.8	22.3	2.2	6.8
Industrial and Organisation	45	46.9	1.2	6.8
Mechanical and Industrial Design	72.3	18	2.8	7
Naval	64.3	27.4	2.4	6
Chemical and Materials	53.1	31.2	5.6	10
Total Production Engineering	**60.5**	**29.4**	**3.1**	**7**
Total SUC	**73.1**	**13.7**	**5.4**	**7.8**

[13] To check whether the differences between the degree programmes analysed and the SUC as a whole are statistically significant, a tool developed by AQU Catalunya was used to carry out 1,000 simulations using the bootstrap method for simple random sampling with replacement in the infinite population scenario (EFRON, TIBSHIRANI, 1993), thus obtaining a distribution of the 1,000 simulated differences between the two groups. The bootstrap method is used to highlight a result where no specific reference is made; in other cases, the statistic used is specified.

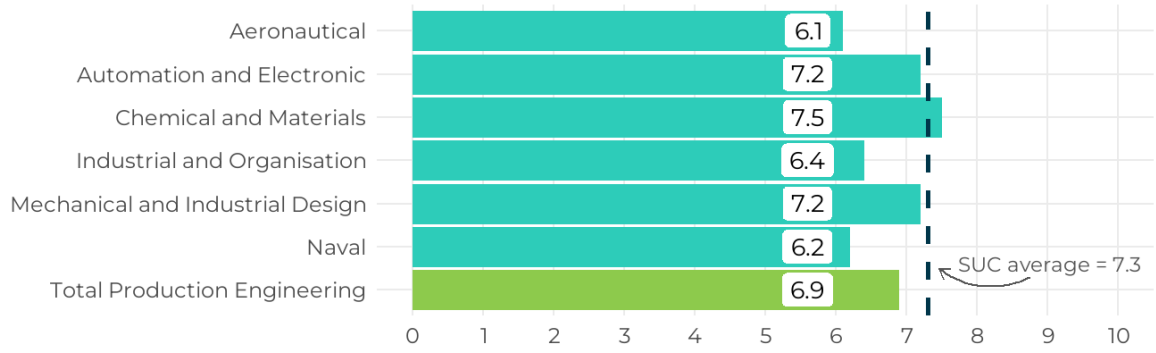
Figure 5. Percentage of students who chose the degree course due to its career opportunities, by sector in the employer survey



Overall degree satisfaction among Production Engineering graduates was 6.9, higher than for the SUC as a whole (7.3)

- There were no significant differences with regard the Electronic and Automation Engineering, Mechanical Engineering and Industrial Design, and Chemical and Materials Engineering degree programmes.
- The much lower figures for Aeronautical Engineering (6.1) and Naval Engineering (6.2) are particularly striking.

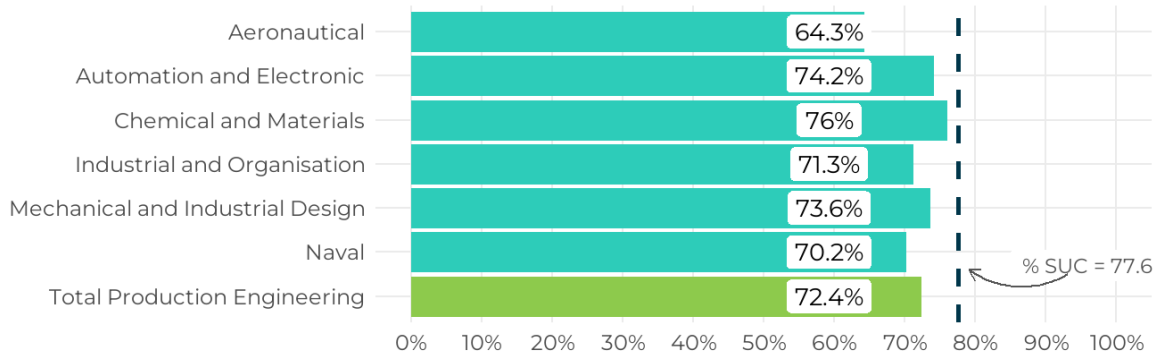
Figure 6. Overall satisfaction with the degree programme in the field of Production Engineering



Around 7 out of 10 graduates in the field of Production Engineering (72.4%) would repeat their degree, 5% below the SUC as a whole

- These differences were not statistically significant for Electronic and Automation Engineering, Naval Engineering and Chemical and Materials Engineering.
- The much lower percentage for Aeronautical Engineering (64.3%) is particularly striking.

Figure 7. Percentage of people who would repeat the degree programme in the field of Production Engineering



Satisfaction with the skills acquired, the external work placements and the bachelor's degree final project

Production Engineering graduates were highly satisfied with how their degrees improved their communication, personal and professional skills

- With regard to **communication skills**, all the degrees programmes, except the Chemical and Materials Engineering bachelor's degree, had **values below** the SUC average. The much lower figures for Industrial Engineering and Organisation (5.4) and Aeronautical Engineering (5.8) are particularly striking.

Table 5. Degree to which the education received improved certain skills, according to Production Engineering graduates

Statistically significant differences compared to the overall SUC averages are marked with an asterisk. The arrow points in the direction of the difference (↓ below or ↑ above the overall SUC value).

Detailed subfield	Professional skills	Personal skills	Communication skills
Aeronautical	6.4* ↓	6.9	5.8* ↓
Automation and Electronic	7.2	6.9	6.2* ↓
Industrial and Organisation	7.2	7	5.4* ↓
Mechanical and Industrial Design	7.3	7.0	6.5* ↓
Naval	6.1* ↓	6.5* ↓	6.2* ↓
Chemical and Materials	7.2	7.3	6.8
Total Production Engineering	**7.1**	**7**	**6.1**
Total SUC	**7.1**	**7.2**	**7.1**

Production Engineering graduates were more satisfied with both the bachelor's degree final project and external work placements than graduates in the SUC overall[14]

- The significantly lower figures for satisfaction with external work placements is particularly striking, with the exception of Electronic and Automation and Chemistry and Materials Engineering graduates.
- Electronic and Automation Engineering and Chemical and Materials Engineering graduates showed significantly higher values than the SUC average in their satisfaction with the bachelor's degree final projects: 0.8 and 0.7 points higher, respectively.

Table 6. Production Engineering graduates' satisfaction with the external work placements and bachelor's degree final projects

Statistically significant differences compared to the overall SUC averages are marked with an asterisk. The arrow points in the direction of the difference (↓ below or ↑ above the overall SUC value).

Detailed subfield	BACHELOR'S DEGREE FINAL PROJECT	External work placements
Aeronautical	7.3	5.6* ↓
Automation and Electronic	7.6* ↑	6.5
Industrial and Organisation	6.8	5.9* ↓
Mechanical and Industrial Design	7	6.4* ↓
Naval	6.3	5.6* ↓
Chemical and Materials	7.5* ↑	6.5
Total Production Engineering	**7.1**	**6.2**
Total SUC	**6.8**	**7**

[14] Graduates were required to rate the following statements: "The bachelor's degree final project was useful for consolidating skills from the degree programme" and "The external work placements allowed me to apply the knowledge acquired during the degree programme."

Graduate employment outcomes in the field of Production Engineering

The data analysed in this section comes from the **employment outcomes survey**, an annual survey carried out since 2001 by Catalan universities in coordination with AQU Catalunya. This survey asks about factors related to the employment activity of graduates and the quality of that employment activity (job suitability, contractual stability, earnings, etc.). The results below[15] are drawn from data from the latest survey, the fieldwork for which was carried out in 2020 among bachelor's degree graduates in the field of **Production Engineering** in the 2015-2016 academic year.

Table 7. Sample, population, response rate and sampling error for graduate employment outcomes survey for the field of Production Engineering and the SUC as a whole (2020)

Detailed subfield	Sample	Population	Response rate	Sampling error (±)
Aeronautical	84	197	42.3%	8.3%
Automation and Electronic	291	602	48.3%	4.2%
Industrial and Organisation	515	1,268	40.6%	3.4%
Mechanical and Industrial Design	293	636	46.1%	4.3%
Naval	42	113	37.2%	12.3%
Chemical and Materials	203	428	47.4%	5.1%
Total Production Engineering	**1,428**	**3,244**	**44%**	**2%**
Total SUC	**13,902**	**30,084**	**46.2%**	**0.6%**

[15] Data are included for graduates from on-site universities. The data presented in this report are weighted according to stratified sampling by degree and sampling unit.

Indicators on the graduate employment quality in the field of Production Engineering

In 2020, almost 9 out of 10 Production Engineering graduates (93.2%) were working three years after graduation

- Figure 8 suggests that the 2008-2012 recession had an impact on the employment rate for Production Engineering graduates, but slightly less so than for the SUC as a whole.
- Figure 9 shows that the employment rate (and the impact of the 2008-2012 recession) varies significantly depending on the Production Engineering subfield. Naval Engineering was the most affected subfield.
- In 2020, three degrees had an employment rate higher than the overall SUC figure (90.2%): Aeronautical Engineering (95.9%), Electronic and Automation Engineering (96.3%) and Industrial Engineering and Organisation (93%).

Figure 8. Employment rate trends for Production Engineering graduates

The year indicates when they responded to the survey, i.e. three years after graduation

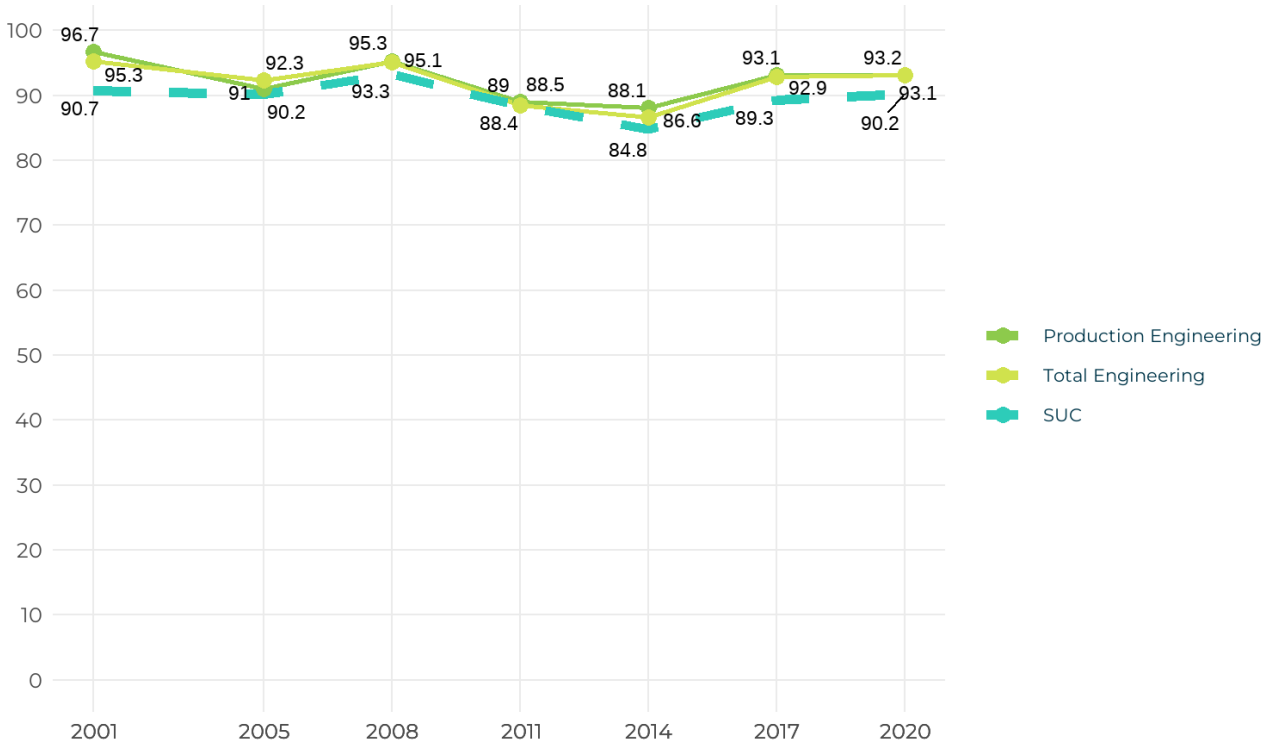
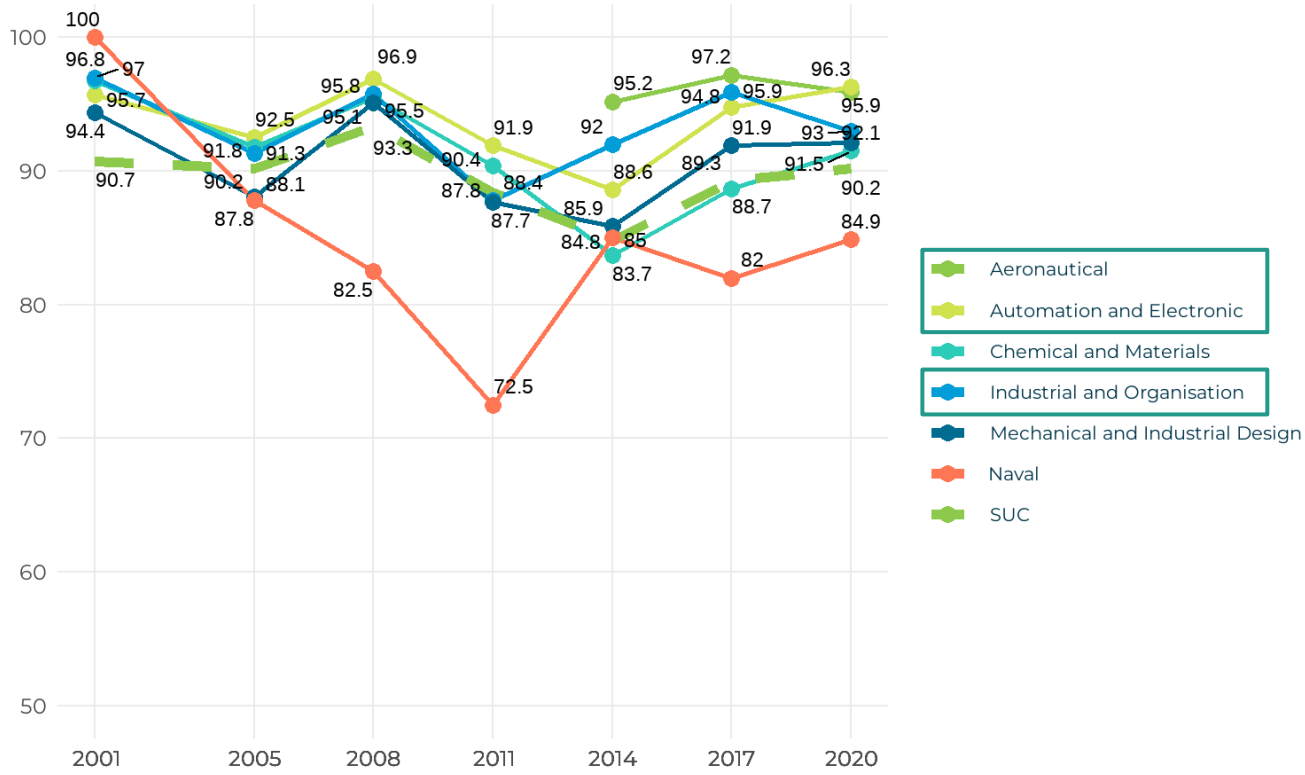


Figure 9. Employment rate trends for Production Engineering graduates, by detailed subfield

Degrees with a statistically significant higher employment rate than the overall SUC value in 2020 are marked with a green box. The left axis has been shortened for ease of reading.



Approximately 7 out of 10 Production Engineering graduates (73.2%) performed job functions specific to their degree

- The suitability rate was very similar to the overall SUC value.
- Only one subfield, Aeronautical Engineering, had a significantly lower rate (65.4%). However, the figure for people performing university functions (29.9%) was very high compared to the SUC rate (12.1%).
- All Production Engineering degrees had a better university suitability rate than the SUC, with the exception of Naval Engineering, which had a similar rate.

Table 8. Percentage of Production Engineering graduates performing functions specific to their degree, or university and non-university functions

Statistically significant differences compared to the overall SUC averages are marked with an asterisk. The arrow points in the direction of the difference (↓ below or ↑ above the overall SUC value).

Detailed subfield	Degree-specific functions	University-level functions	Non-university-level functions
Aeronautical	65.4*↓	29.9*↑	4.7
Automation and Electronic	72.6	19.8*↑	7.5
Industrial and Organisation	73.6	19*↑	7.4
Mechanical and Industrial Design	78.4	13*↑	8.5
Naval	72.4	14.7	12.9
Chemical and Materials	70	23.8*↑	6.2
Total Production Engineering	**73.2**	**19.3**	**7.5**
Total SUC	**74.7**	**12.1**	**12.9**

The gross monthly salary of Production Engineering graduates was 2,688 euros, 500 euros more than the average SUC salary (2,186 euros)[16]

> All the detailed subfields included in the analysis have significantly higher average salaries than the SUC as a whole. The average salary in Industrial Engineering and Organisation (2,898 euros) is particularly notable. It is worth noting that this is one of the subfields with the highest average salary in the whole SUC, exceeded only by Medicine and Dentistry and Telecommunications graduates.

[16] Only the salary for people working full time is used, so that salaries between degrees may be compared.

Figure 10. Distribution of gross monthly salaries in Production Engineering (2020)

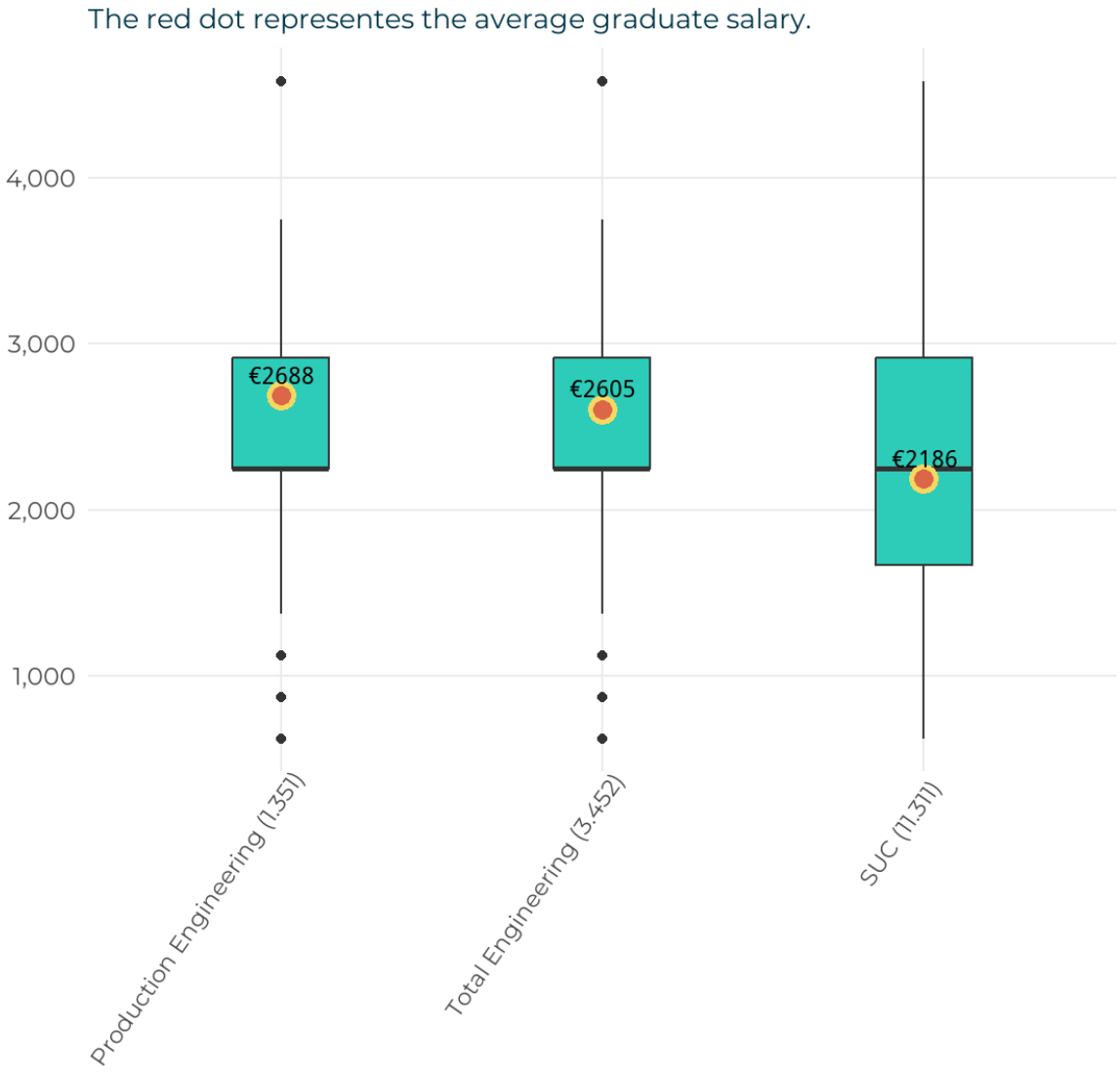


Table 9. Average gross monthly salaries by detailed subfield

Significantly different values from the overall SUC averages are marked with an asterisk. The arrow points in the direction of the difference (↓ below or ↑ above the overall SUC value).

Detailed subfield	Gross monthly salary (€)
Aeronautical	2,743*↑
Automation and Electronic	2,549*↑
Industrial and Organisation	2,898*↑
Mechanical and Industrial Design	2,557*↑

Naval	2,624* ↑
Chemical and Materials	2,455* ↑
Total Production Engineering	**2,688**
Total SUC	**2,186**

The percentage of permanent contracts was higher in the field of Production Engineering (75.9%) than for all Engineering degrees (71.2%) and in the SUC overall (56.3%)

- All the detailed Production Engineering subfields had a significantly higher percentage of permanent contracts than the SUC as a whole.
- The subfield with the greatest stability was Naval Engineering (86.7%), followed by Aeronautical Engineering (83.2%). And the least stability was for Chemical and Materials Engineering (65.1%).

Figure 11. Distribution of types of contracts for Production Engineering graduates (2020)

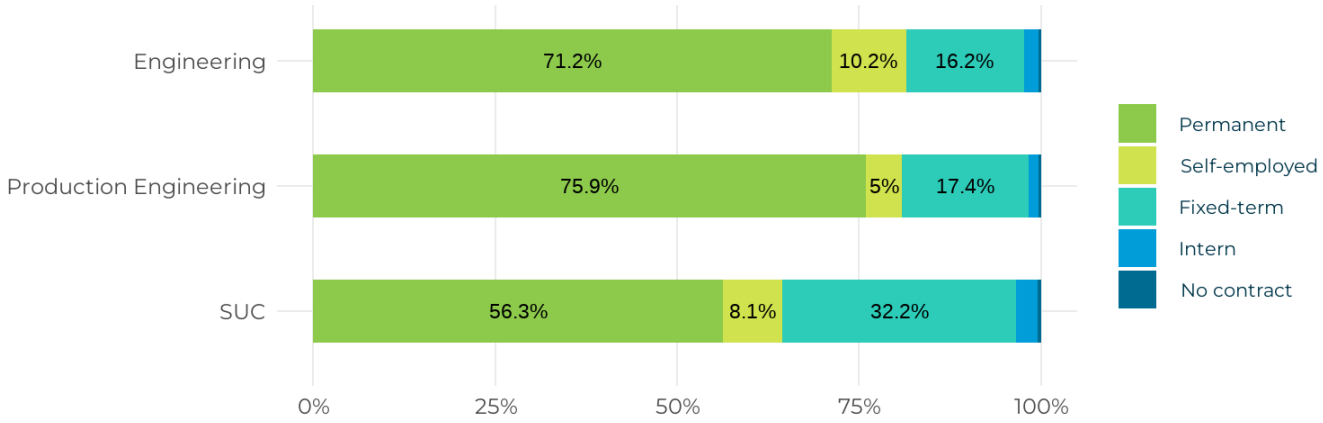
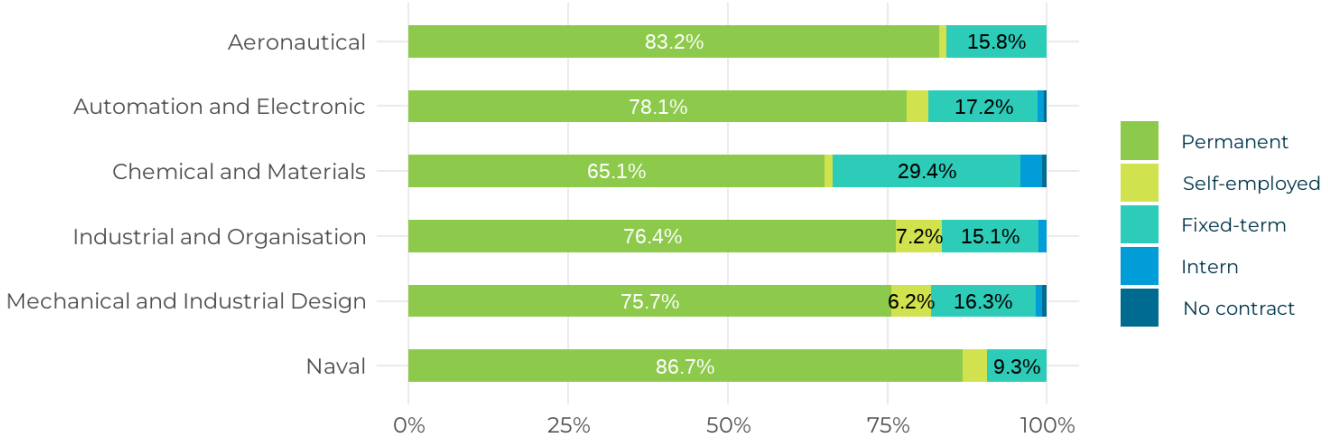


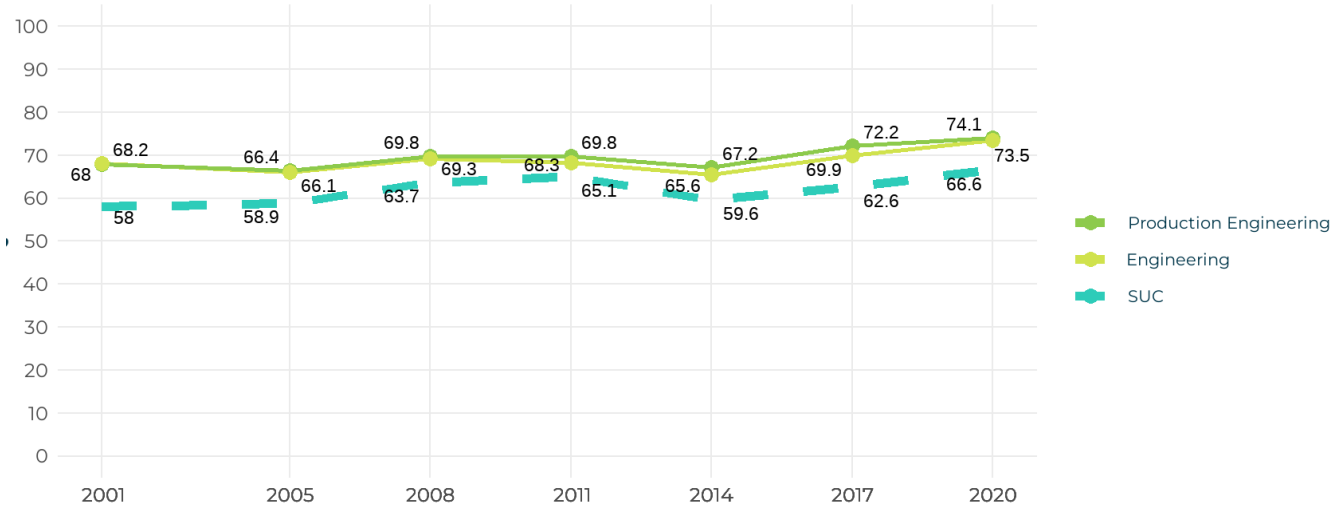
Figure 12. Distribution of the types of contract for Production Engineering graduates, by detailed subfield (2020)



Occupational quality in the Production Engineering field was almost 8% higher than for the SUC as a whole

> All detailed Production Engineering subfields had an occupational quality index (OQI) significantly higher than the SUC as a whole.

Figure 13. Trend in the occupational quality index (OQI) for graduates in the Production Engineering field (from 0 to 100)



The occupational quality index (IQO) is based on different indicators: contract (C), job satisfaction (S), remuneration (R) and fit (F). The value range is from 0 to 100 and the higher the rating the better the occupational quality experienced. The formula is IQO = f [(C + R + F) * S]. For further details, refer to Corominas et al. (2012).

Table 10. Average occupational quality index (OQI) for Production Engineering graduates, by detailed subfield (scale from 0 to 100)

Significantly different values from the overall SUC averages are marked with an asterisk. The arrow points in the direction of the difference (↓ below or ↑ above the overall SUC value).

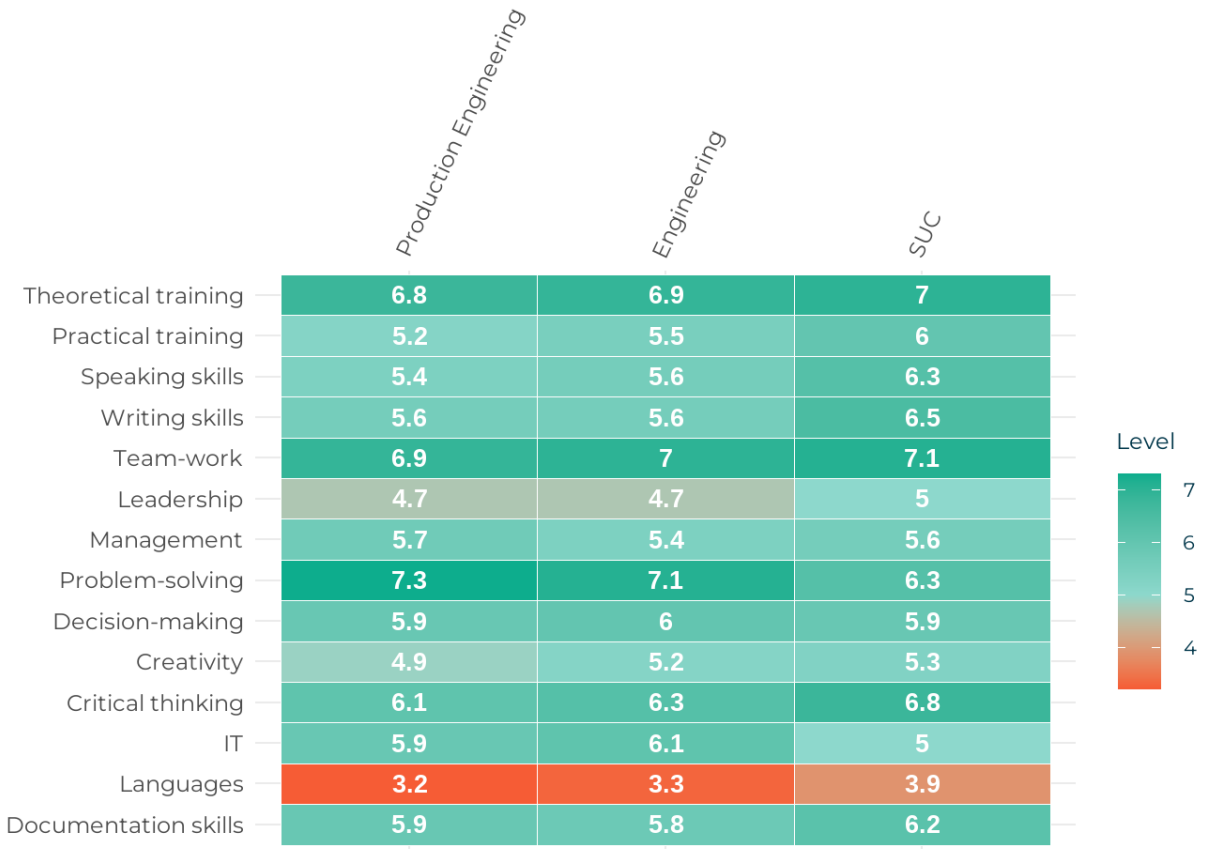
Detailed subfield	OQI
Aeronautical	73.8*↑
Automation and Electronic	74.1*↑
Industrial and Organisation	74.9*↑
Mechanical and Industrial Design	74.1*↑
Naval	74.3*↑
Chemical and Materials	71.7*↑
Total Production Engineering	**74.2**
Total SUC	**66.6**

Acquisition of skills on the degree course and their usefulness for work

Problem solving was the skill most highly rated in the education received by Production Engineering graduates, while language skills were the lowest rated.[17]

- Computer literacy was the skill with the biggest difference (5.9 vs. 5, +0.9 points) compared to the overall SUC rating.
- Leadership skills were rated as a failure (4.7).

Figure 14. Graduates' rating of the education they received, by skill, in 2020 (from 0 to 10)

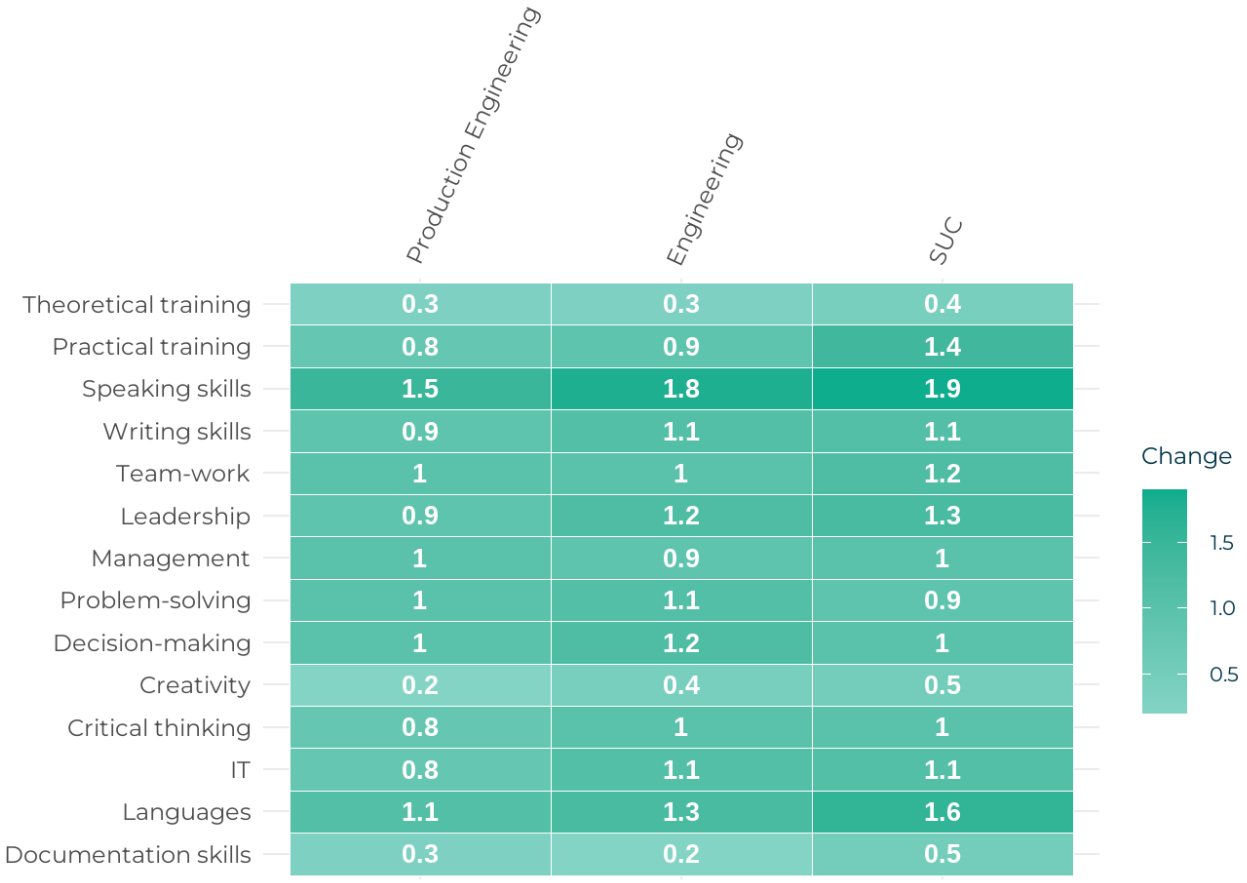


[17] Skills values by detailed subfield are not given, as there were no substantial differences between subfields.

Despite relatively low values in the acquisition of certain skills, the students' assessment of their training improved from 2005

- However, in general, this increase was slightly slower than for the SUC overall. For example, SUC students' assessment of their practical training increased by 1.4 points from 2005, while it increased by only 0.8 points among Production Engineering students.
- The increase in oral expression (1.5) and language skills (1.1) are particularly striking.

Figure 15. Difference between the assessment of training acquired in the 2020 survey compared to the 2005 survey (scale 0-10)

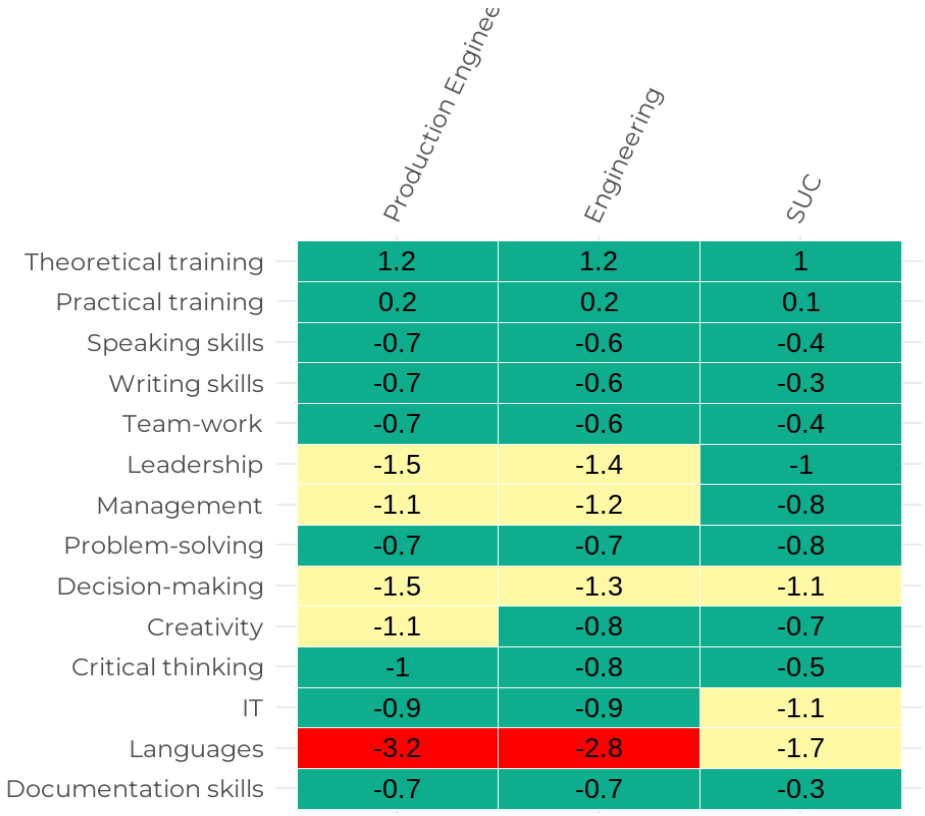


Language proficiency is the skill that graduates underline as the main shortcoming in their [18]education with respect to its usefulness for work

- Decision making, leadership, management and creativity were the next skills in terms of shortcomings.
- Contrarily, theoretical knowledge received a higher score for the education received than for its usefulness at work. This is also the case, albeit to a lesser extent, with practical knowledge.

Figure 16. Difference between the education provided and its usefulness for work, by skill, in 2020 (from 0 to 10)

Scores below -2.0 (inclusive) are in red; Scores between -1.0 (inclusive) and -2.0 are in yellow; Those above -1.0 are in green.



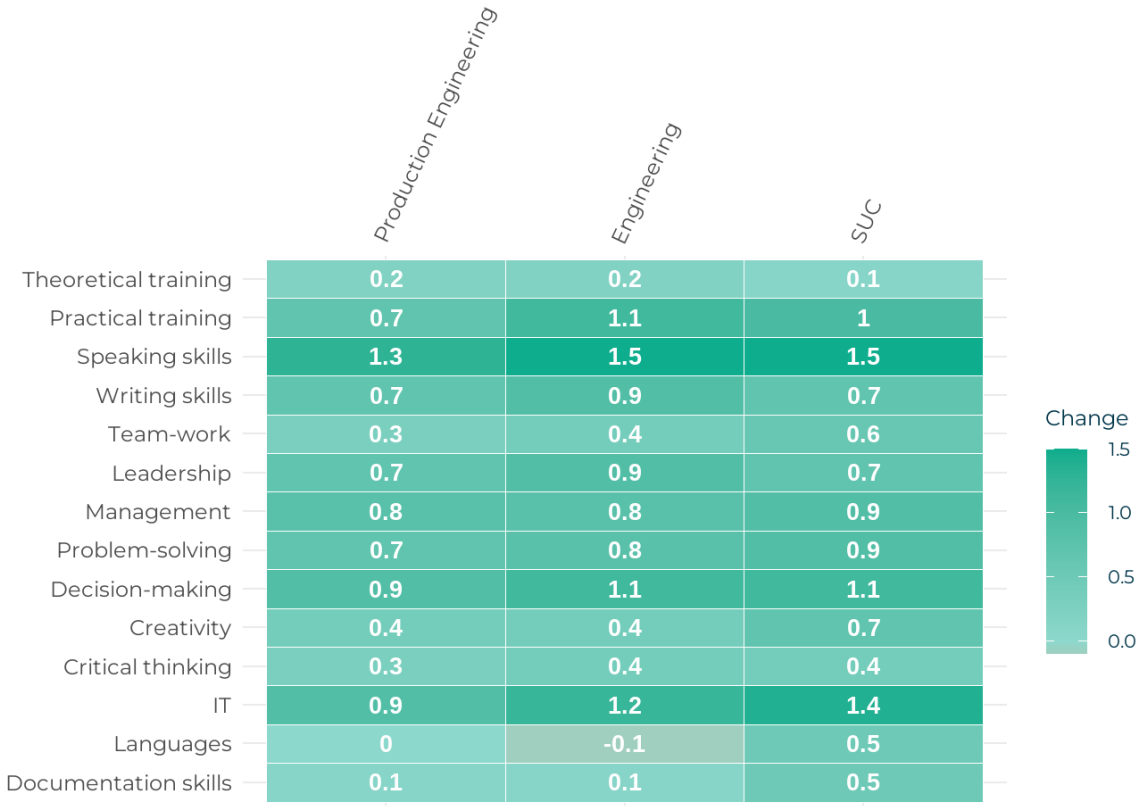
[18] The table shows the difference between the education provided to work on each skill and the usefulness of the skill for work, according to graduates. Therefore, a negative score means that the usefulness of a skill is greater than the education provided to work on it, which indicates an educational shortcoming. For example, if graduates rate the education provided for language proficiency at 5.5 and the usefulness of this skill for work at 8, the result is an educational shortcoming of -2.5.

The results are shown for graduates who perform university functions in their jobs.

However, training shortcomings dropped[19] between 2005 and 2020 in most skills, with the exception of language proficiency, theoretical training and documentation, which remained the same

> Particularly noteworthy is the improvement in oral expression, decision-making and computer skills.

Figure 17. Difference between training shortcomings in 2020 and 2005, by skill (scale of 0 to 10)



[19] Since shortcomings are mostly expressed in negative values, this means that where the deficit in 2020 was smaller (closer to 0 or positive) than in 2005, this difference will necessarily be positive. That is, a positive difference means that the shortcomings dropped or, in the case of positive values, the surplus increased, which is the case when the training received in a skill is worth more than its usefulness at work.

The opinion of employers regarding the education received by Production Engineering graduates

Scope and methodology of the employer survey

This section contains the results of the third edition of the **employer survey**, a three-yearly survey carried out by AQU Catalunya to find out the opinion of companies and organisations based in Catalonia (hereinafter, employers) as to whether university education responds to their needs. The ultimate aim of the study is to provide the university system with information that will enable it to assess whether the educational offer needs to be adapted to the needs of the labour market. New to this edition of the employer survey is a question about the skills of work placement students.

The questions upon which the study is based are as follows:

- How satisfied are employers with the training of **recent graduates**?[20]
- How satisfied are employers with the education received by **work placement students**?
- What factors explain the difficulties employers face when recruiting?
- Which competences should be improved?

The fieldwork was carried out through the sending of mass e-mails between May and July 2021 to employers that have signed an internship agreement with the SUC universities and/or appear in their job banks. We assume that this list of employers (*n* = 29,865) constitutes the universe of the graduate labour market in Catalonia. We also enlisted the help of professional associations and chambers of commerce to disseminate the questionnaire. In the end, a total of **2,423 employers** responded to the survey, of which **1,729** had recruited recent graduates and/or taken on work placement students. Among these organisations, **209** were in the field in question, **183** of which stated they had recently recruited graduates and **160** stated they had taken on work placement students. The Girona and Manresa Association of Industrial Technical Engineers and the Agency for Qualification of Professional Engineers helped disseminate the online questionnaire.

In terms of methodology, there are a number of aspects to be taken into account when conducting employer surveys.

First of all, it is difficult to access this population pool. In particular, it is difficult to obtain a well-defined universe of employers with associated contact details. Indeed, it is common in

[20] In the employer survey, we define "recent graduate" as a person who has completed their studies in the two years prior to receiving the survey and who has little or no professional experience. We limit the definition of a recent graduate because we want to ascertain the opinion of the employers on the **skills acquired at university**.

the literature to find that university employer databases are used as a sampling frame of graduate employers (BYRNE, 2022).

Secondly, employer surveys – and online surveys in general – tend to have a low response rate (BYRNE, 2022; MANFREDA et al., 2008).

Finally, it is important to note that numerous methodological studies – both quantitative and qualitative – highlight that, although the results of a survey with relatively few responses should be treated with caution, a low response rate does not mean that the sample is unrepresentative (GROVES, 2006; METERKO et al., 2015).

Below are the results of the third edition of the employer survey. Firstly, it describes the factors and difficulties faced by employers when recruiting; secondly, it details the skills of graduates that these companies believe should be improved; it goes on to discuss the skills most worked on during the work placement period and those that work placement students most need to improve; and, finally, the skills that will be most relevant in the future in the field of Production Engineering according to the organisations themselves are mentioned.

Number of employers that responded to the survey

Table 11. Number of answers from employers that recruit graduates and take on work placement students from the field of Production Engineering

Detailed subfield	*No.* who hire	% of the total number of responses	*No.* taking on students	% of the total number of responses
Industrial and Organisation	52	28.4	45	28.1
Automation and Electronic	45	24.6	37	23.1
Mechanical and Industrial Design	43	23.5	43	26.9
Chemical and Materials	32	17.5	25	15.6
Naval	6	3.3	4	2.5
Aeronautical	5	2.7	6	3.8
Total Production Engineering	183	100	160	100

Factors and difficulties when recruiting graduates

Nine out of 10 companies in this sector that hire graduates required a specific degree when recruiting

- A total of 30% required a specific university master's degree and 86% considered it important to have a high or intermediate level in English. Out of the sectors analysed, they ranked fifth, together with Economics and Business, in requiring English proficiency.

Figure 18. Important factors when considering Production Engineering graduates as job candidates

In the selection process for recent graduates, was it important that they had a university degree?

Response	n	Percentage
Yes, a specific bachelor's degree	163	90
Yes, any bachelor's degree	10	6
No	8	4

In the selection process for recent graduates, was it important that they had a master's degree?

Response	n	Percentage
Yes, a specific master's degree	54	30
Yes, any master's degree	11	6
No	114	64

In the selection process for recent graduates, was their level of English important?

Response	n	Percentage
Yes, a high level was required	80	44
Yes, an intermediate level was required	76	42
No	27	15

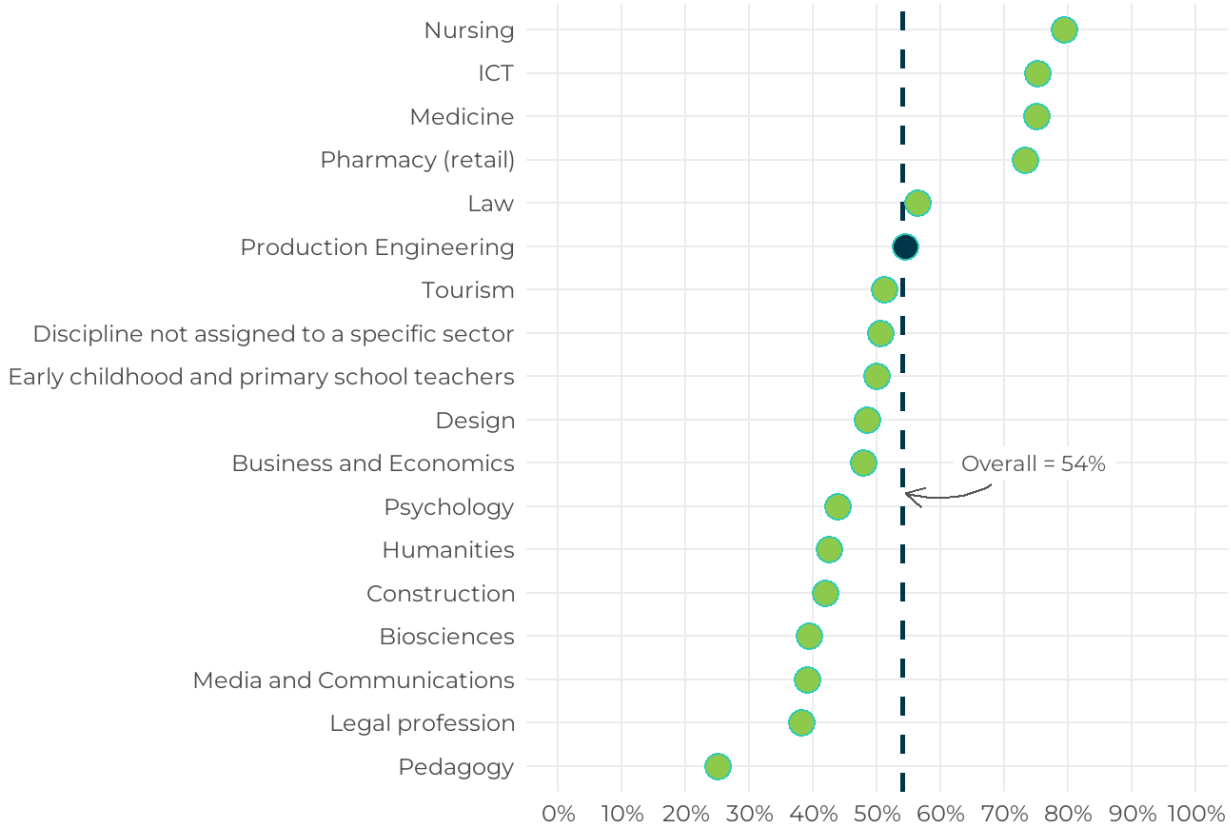
In the selection process for recent graduates, was their level of foreign languages (excluding English) important?

Response	n	Percentage
Yes, a high level was required	15	8
Yes, an intermediate level was required	25	14
No	141	78

Nearly 55% of employers reported difficulties in recruiting professionals in the sector

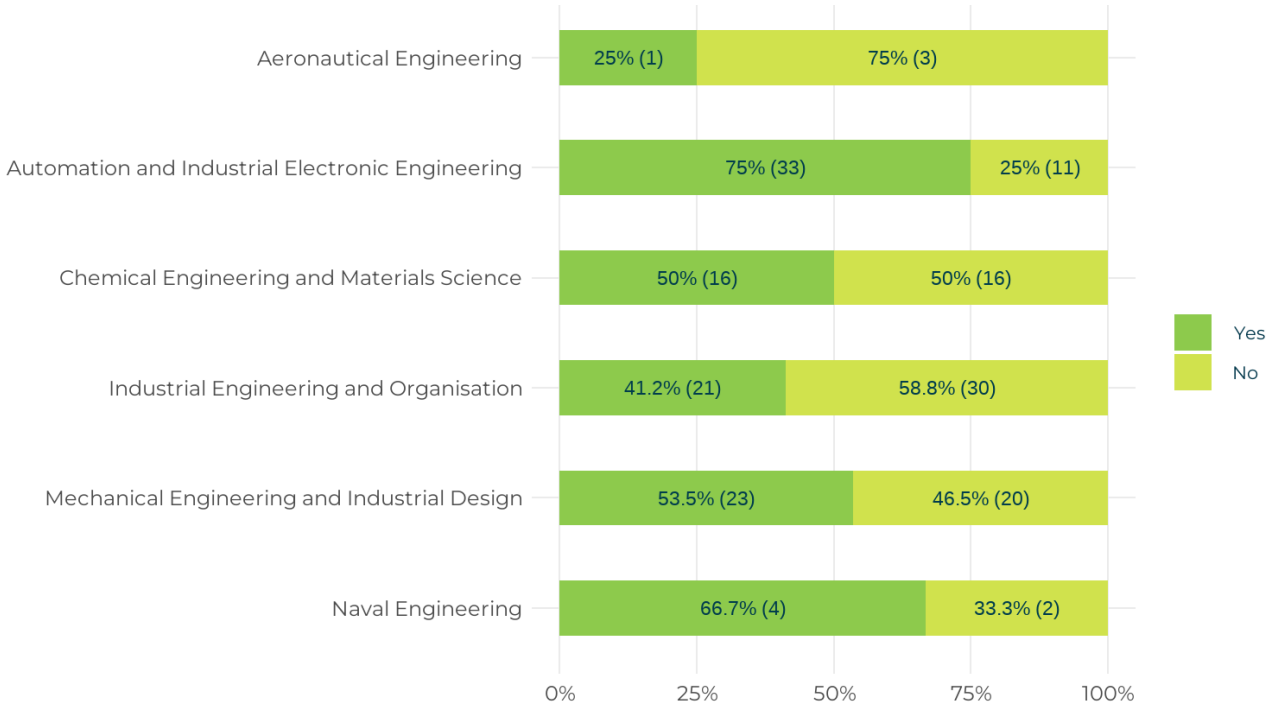
- The Production Engineering sector is right in the middle of the Employers survey and represents the sixth highest percentage, behind Law and Pharmacy Offices.
- The percentage of organisations reporting difficulties in contracting decreased by 12% compared to the previous survey (66.5%).[21]
- There are differences between subfields: organisations recruiting graduates in Electronic and Automation Engineering had the most difficulty (75%), as shown in figure 20.

Figure 19. Comparison of companies who face difficulties when recruiting, by sector included in the employer survey



[21] As this is an employer survey, a type of survey that usually generates relatively small samples, we cannot claim that the similarities or differences with the previous edition are statistically significant. Although we believe that the continuity we observe between the two editions is evidence of the robustness of our results, we recommend readers interpret the results with caution and from a critical perspective.

Figure 20. Percentage of employers who face difficulties when recruiting, by degree



Skills shortages among graduates (61%) make up the main difficulty when it comes to recruiting the right profiles

> Also noteworthy are the lack of graduates in the field (34%) and candidates being unwilling to accept the proposed salary (16%).

Figure 21. Main reasons for difficulties in recruiting the right profiles in the field of Production Engineering

Response	n	Percentage
Lack of qualified people with the necessary skills for the job	60	61
Lack of graduates in this field	33	34
They do not accept the salary	16	16
Other (specify)	15	15
Limited resources prevent vacancies being properly advertised	13	13
Unwillingness to be geographically mobile	12	12
They do not accept the work schedule	5	5
They do not accept the type of contract	1	1

Employers who answered that lack of skills needed for the job was the main reason for difficulties in recruitment (*n* = 60) point to some of the skills where they found the biggest training shortcomings:[22]

- Technical skills and knowledge in specific areas such as systems programming, process engineering, renewable energy and industrial design (*n* = 13).
- English proficiency (*n* = 3).
- Project management skills (*n* = 3).
- Knowledge of specific software such as Altium or SAP (*n* = 2).

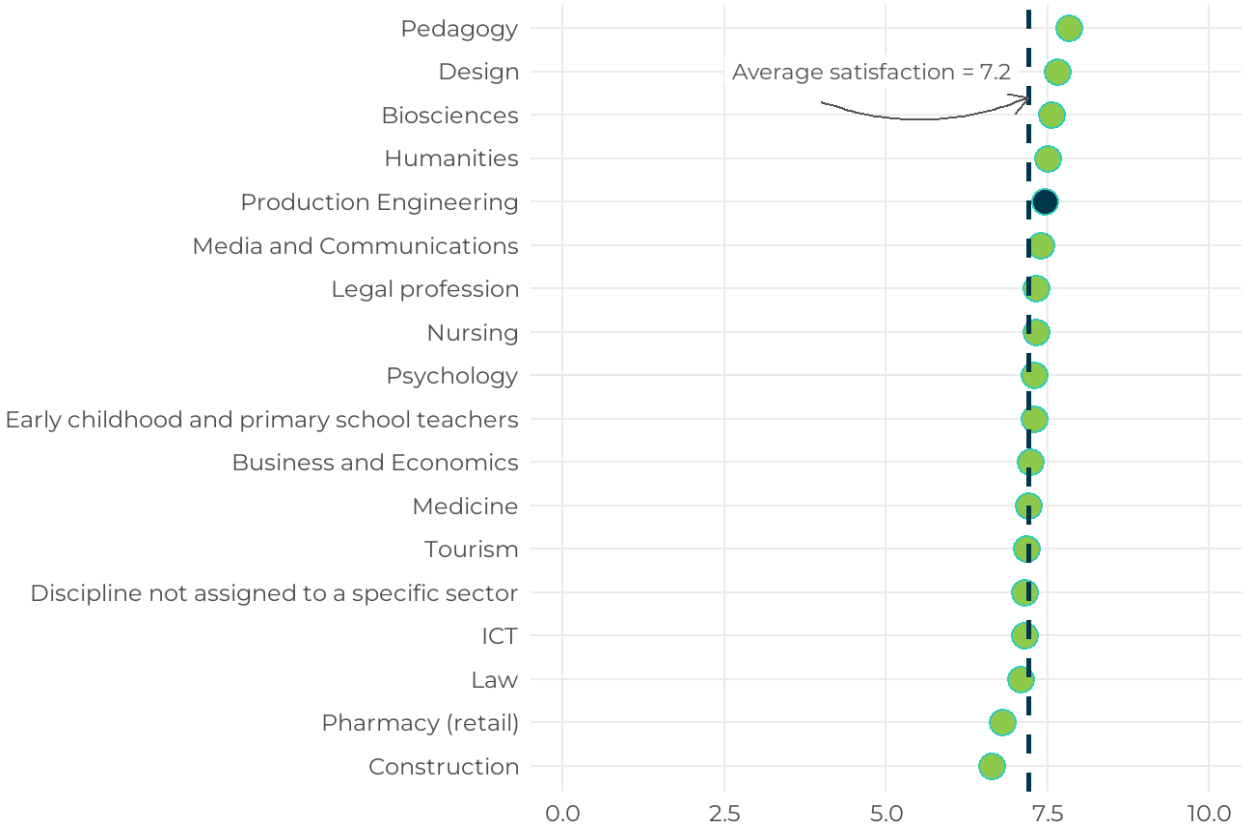
[22] A topic-based analysis of the answers in the employer survey was carried out in order to group them by topic. Answers were in the form of an open-ended field in the survey, where respondents were asked to answer the following question: "You have indicated that you have had difficulties in recruiting staff due to a lack of qualified people with the necessary skills for the job. Can you specify which skills?"

Satisfaction with recent Production Engineering graduates' skills and skills they should improve[23]

Production Engineering is the fifth-ranking employment field in terms of employer satisfaction (7.5) with graduates' skills

- There are differences between detailed subfields, although most have satisfaction scores between 7.1 and 7.5.
- The subfield with the highest employer satisfaction was Aeronautical Engineering (9) and the lowest Naval Engineering (5.3).

Figure 22. Comparison of the average satisfaction with the skills of recent graduates, by sector included in the employer survey (from 0 to 10)



[23] In the employer survey questions on skills, employers are asked to choose between 1 and 5 skills that they think recent graduates should improve. Therefore, the percentages shown represent the percentage of employers that have selected a given skill.

Almost 5 out of 10 employers (48.9%) believe that the ability to apply acquired knowledge and solve problems in new or unfamiliar environments is the skill graduates most need to improve

- At a similar proportion (46.1%), the second-placed skill that graduates should improve was the ability to plan, map out, calculate, design and execute technical actions.
- The skills of integrating knowledge and making judgements based on incomplete or limited information (31.1%) and communicating effectively with non-technical persons ranked third and fourth in requiring improvement, according to respondents.
- The results are very similar to those published in the previous employers project (AQU CATALUNYA, 2021b).

Figure 23. Skills that recent graduates in Production Engineering should improve

In red, the skills selected by more than 30% of employers.

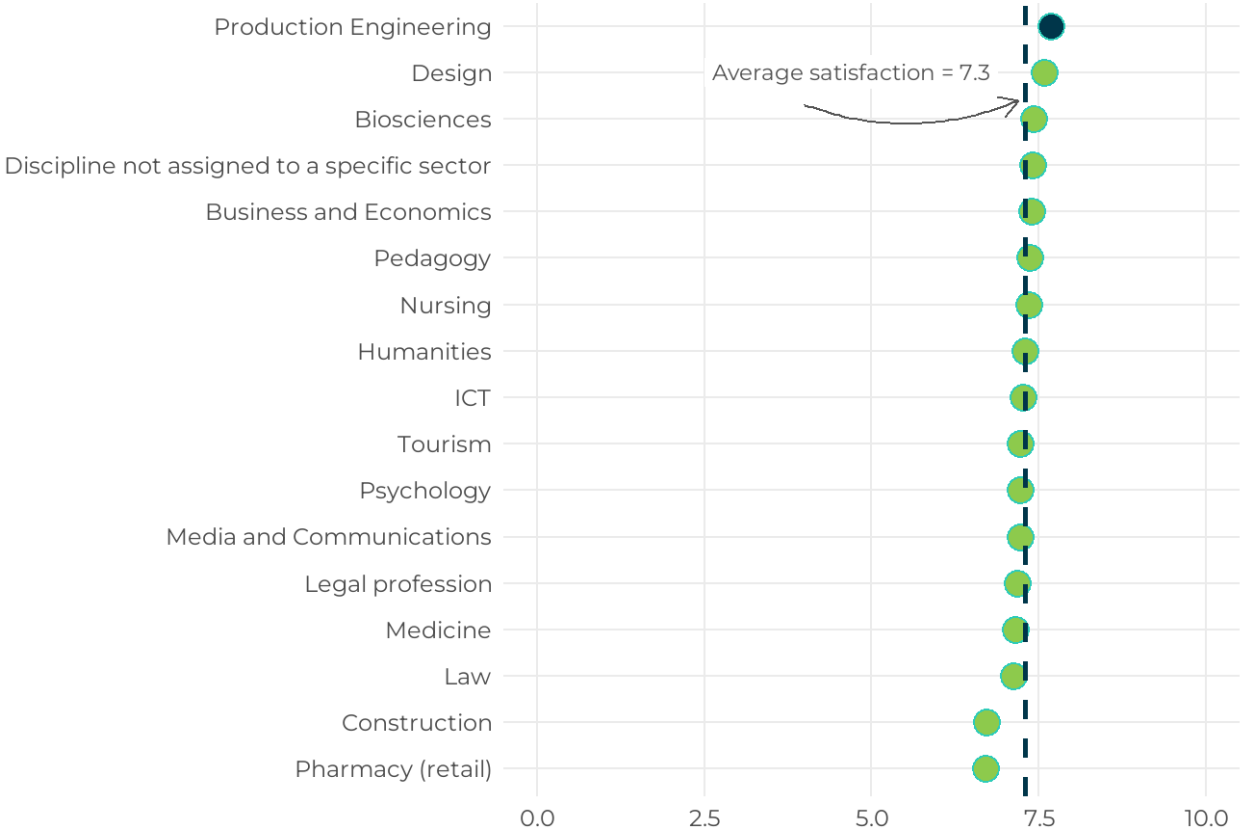
Skill	n	Percentage
Apply knowledge and solve problems in new and unfamiliar environments.	88	48.9
Plan, map out, calculate, design and execute technical actions in a given field of specialisation.	83	46.1
Integrate knowledge and make judgements based on incomplete or limited data.	56	31.1
Communicate effectively with people without technical training.	54	30.0
Manage different environments both technically and financially.	52	28.9
Offer objective solutions while under the constraints and pressures of differing interests.	47	26.1
Manage, organise and oversee multidisciplinary teams, especially in multilingual environments.	37	20.6
Use software that is specific to the professional activity performed.	33	18.3
Ensure occupational safety by anticipating risks and preventing them.	32	17.8
Promote quality in the organisation, its customers and suppliers.	29	16.1
Manage research, development and technological innovation.	27	15.0
Harness science and technology to improve the level of well-being in society.	12	6.7
Manage the environmental and social risks of the solutions adopted.	6	3.3

Employer satisfaction and opinion on the skills of Production Engineering work placement students

Employers in the field of Production Engineering stand out as the sector most satisfied (7.6) with the skills of work placement students, slightly above the overall SUC average (7.3)

> Employers that take on work placement students from Production Engineering degree programmes were the most satisfied (8.8), while employers' satisfaction with Biotechnology students (6.8) was below the average for the field (7.6) and the SUC as a whole (7.3).

Figure 24. Comparison of the average satisfaction with the skills of work placement students, by sector included in the employer survey



Skills that have been worked on the most during the work placement period

Skills related to the application of knowledge and problem solving (63.7%), planning, mapping, calculation, design and execution of technical actions (58.8%) and the use of specific software (47.5%) were the ones most worked on during the work placement period

- Also noteworthy is the ability to integrate knowledge and make judgements based on incomplete or limited data (30%).
- Three of these four skills are also the ones that employers considered recent graduates most needed to improve, as shown in Figure 23.

Figure 25. Skills in the field of Production Engineering worked on the most during work placement

Skills selected by more than 30% of the employers are highlighted in green.

Skill	n	Percentage
Apply knowledge and solve problems in new and unfamiliar environments.	102	63.7
Plan, map out, calculate, design and execute technical actions in a given field of specialisation.	94	58.8
Use software that is specific to the professional activity performed.	76	47.5
Integrate knowledge and make judgements based on incomplete or limited data.	48	30.0
Manage different environments both technically and financially.	40	25.0
Communicate effectively with people without technical training.	38	23.8
Promote quality in the organisation, its customers and suppliers.	34	21.2
Ensure occupational safety by anticipating risks and preventing them.	28	17.5
Offer objective solutions while under the constraints and pressures of differing interests.	28	17.5
Manage research, development and technological innovation.	26	16.2
Manage, organise and oversee multidisciplinary teams, especially in multilingual environments.	15	9.4
Manage the environmental and social risks of the solutions adopted.	8	5.0
Harness science and technology to improve the level of well-being in society.	8	5.0
Others	4	2.5

Comparison between skills recent graduates most need to improve and those that were the most difficult to work on during work placement

Broadly speaking, the skills graduates most need to improve are those worked on the most during work placement

- Skill in using specific software stands out as one of those most worked on during work placement, but only 18.3% of employers thought recent graduates needed to improve on it.

Figure 26. Comparison between the percentage of employers that select a skill that graduates should improve and the skills they have worked on during the work placement period

The skills are ranked from most to least selected.

Skill	Percentage (graduates)	Percentage (interns)	Ranking (graduates)	Ranking (interns)
Apply knowledge and solve problems in new and unfamiliar environments.	48.9	63.7	1	1
Plan, map out, calculate, design and execute technical actions in a given field of specialisation.	46.1	58.8	2	2
Integrate knowledge and make judgements based on incomplete or limited data.	31.1	30.0	3	4
Communicate effectively with people without technical training.	30.0	23.8	4	6
Manage different environments both technically and financially.	28.9	25.0	5	5
Offer objective solutions while under the constraints and pressures of differing interests.	26.1	17.5	6	9
Manage, organise and oversee multidisciplinary teams, especially in multilingual environments.	20.6	9.4	7	11
Use software that is specific to the professional activity performed.	18.3	47.5	8	3
Ensure occupational safety by anticipating risks and preventing them.	17.8	17.5	9	8
Promote quality in the organisation, its customers and suppliers.	16.1	21.2	10	7
Manage research, development and technological innovation.	15.0	16.2	11	10
Harness science and technology to improve the level of well-being in society.	6.7	5.0	12	13
Manage the environmental and social risks of the solutions adopted.	3.3	5.0	13	12

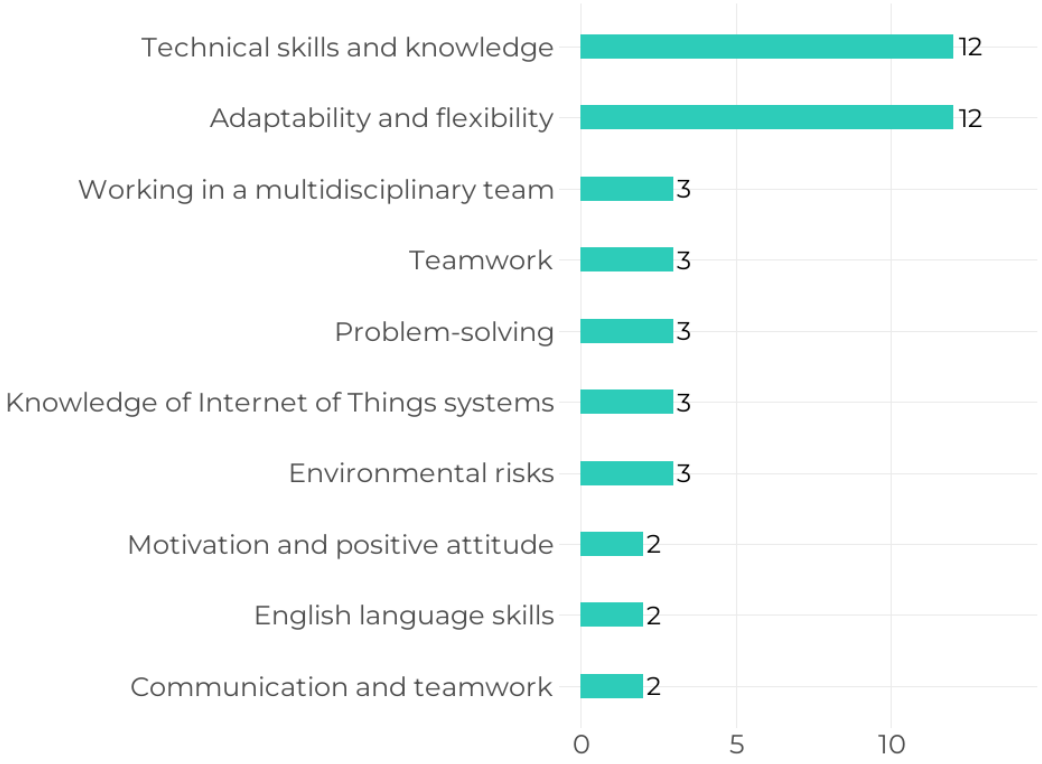
Outlook

Technical knowledge and adaptability and flexibility were the most important knowledge and skills for the future, according to employers

- Also notable are teamwork, problem solving, environmental risks and the Internet of Things.

Figure 27. Key words that appear most frequently in the answers on the skills that will become more important in the future

The figure represents the number of times the keyword appears.



Employers highlighting technical skills that will be the most relevant in the future pointed to the following:

- Interpretation and diagnosis with digital media and algorithms to facilitate resolution.
- Programming with languages such as Python, C++ and Matlab, and knowledge of SQL language.
- Knowledge of manufacturing, mechanisation and PLC programming.
- BIM projects.

CONCLUSIONS

- Compared to the SUC as a whole, the field of Production Engineering is notable for having the lowest **overall satisfaction** level with the degree programme among recent graduates. Satisfaction was particularly low for the subfields of Aeronautical Engineering and Naval Engineering. It is also worth mentioning that Production Engineering graduates felt they had not been able to apply the knowledge acquired during their studies to the same extent as SUC students during **work placement**.
- However, Production Engineering degrees lead to **better paid and more stable** career paths, compared to SUC employment outcomes indicators. The gross monthly salary for graduates from the degree programme analysed amounted to 2,688 euros; 500 euros more than the average for SUC graduates as a whole. The average salary for graduates in Industrial Engineering and Organisation is particularly striking (2,898 euros), being the subfield analysed with the highest volume of graduates.
- Production Engineering degree programmes are highly male dominated. In the 2020-2021 academic year, only 24% of enrolled students were women. This stems from the phenomenon known as "horizontal segregation", whereby the choice of degree field is a function of gender, with the most lucrative degrees chosen mainly by men. These differences in choice may partly explain the wage gap for SUC graduates (AQU CATALUNYA, 2021a). Thus, a rise in the number of women enrolling in Production Engineering degree programmes could improve employment outcomes for female graduates.
- The group of students analysed also tended to have significantly **higher levels** of job **suitability** and **contractual stability**, leading to a higher **occupational quality index (OQI)**.
- The analysis of the perception of skill acquisition, among both students and employers in Production Engineering, helps identify areas for improvement in terms of training. Despite the room for improvement, it is worth noting that all 209 **companies surveyed** were **highly satisfied** with the skills of recently graduated recruits. Graduates reported particularly high shortcomings in **foreign language acquisition** during their studies, an aspect also highlighted by employers in relation to their difficulties in finding suitable profiles. Indeed, employers in Production Engineering were among those giving greater importance to English proficiency when recruiting.
- Production Engineering graduates also expressed **relatively low satisfaction** with regard to the acquisition of **communication skills**. In this respect, the employers stressed that effective **communication with non-technical people** is one of the skills that recent graduates most need to improve.
- Employers also considered that the skills recent graduates most needed to improve on were the **ability to apply acquired knowledge and solve problems in new or unfamiliar environments** and the **ability to plan, map out, calculate, design and execute technical actions in their specialisation**.

- These skills are among the ones companies worked on most during work placements, suggesting that work placement and classroom **training are complementary**. The fact that work placement reinforces training in **specific software programmes** also reaffirms this idea. Some companies, although a minority voice, stated that lack of knowledge of specific software can be a **difficulty when recruiting**. However, it is reasonable to expect training in industry-specific software to take place on the job, either as newly hired workers or trainees.
- Finally, the employer survey gives industry a voice regarding the skills they believe will be most important in the future, and thus help design programmes tailored to the needs of emerging tasks and industrial sectors. In this sense, **programming with languages such as Python**, **BIM** projects and the **Internet of Things** are among the skills that will become more relevant.

DATA SHEET

Employer survey

Technical information of the 3rd edition of the employer survey (2021-2022)

Population	Organisations likely to have hired recent graduates from the Catalan higher education system in the last three years
Sampling frame	Companies, organisations and institutions that have signed a work placement agreement and/or are listed in Catalan universities' job banks.
Survey type	Online. Software used SurveyMonkey
Average time taken	6’ 45”

Summary of the responses to the 3rd edition of the employer survey (2021-2022)

Sampling frame (all sectors)	29,865
Population of employer organisations in Production Engineering	Unknown
Responses (all sectors)	2,423
Response rate (all sectors)	8.11%
Response from employer organisations in Production Engineering	209

RELATED STUDY PROGRAMMES

Bachelor's degrees offered in the 2021/2022 academic year

Below are the active degree programmes for the 2021-2022 academic year in the field of Production Engineering, classified by the detailed subfield in the AQU Catalunya *Programme Catalogue*. The universities where they are taught are also shown.

Aerospace Engineering	**UPC**
Aerospace Systems Engineering	✓
Aerospace Technology Engineering	✓
Aerospace Vehicle Engineering	✓

Electronic and Automation Engineering	**UAB**	**UdG**	**UdL**	**UPC**	**UPF**	**URV**
Energy Engineering				✓		
Energy and Sustainability Engineering			✓			
Renewable Energies and Energy Efficiency Engineering	✓					
Electrical Engineering		✓		✓		✓
Industrial Electronics and Automation Engineering	✓	✓		✓	✓	✓
Engineering in Industrial Electronics and Automation			✓			

Industrial Engineering and Organisation	UAB	UdG	UdL	UPC	UPF	URL
Industrial Organisation Engineering					✓	
Engineering in Industrial Organisation	✓					
Industrial Organisation and Logistics Engineering			✓			
Industrial Technology Engineering		✓		✓		✓
Industrial Technologies and Economic Analysis				✓		

Mechanical Engineering and Industrial Design	UAB	UdG	UdL	UPC	UPF	URV	UVic-UCC
Industrial Design Engineering							✓
Industrial Design Engineering and Product Development				✓			
Automotive Engineering	✓			✓			
Automotive Engineering							✓
Mechanical Engineering	✓	✓	✓	✓	✓	✓	
Mechatronics Engineering							✓

Marine Engineering	UPC	UPF
Marine Systems and Technology Engineering	✓	
Logistics and Maritime Business		✓
Nautical and Maritime Transport	✓	
Marine Technologies	✓	

Chemical and Materials Engineering	UAB	UB	UdG	UdL	UPC	URL	URV
Materials Engineering		✓			✓		

Nanoscience and Nanotechnology	✓						
Chemical Engineering	✓	✓	✓	✓	✓	✓	✓
Textile Design and Technology Engineering					✓		

REFERENCES

AQU CATALUNYA (n.d.) *Activities*.

AQU CATALUNYA (2021a) *Women's employment outcomes twenty years after finishing university*. Barcelona: AQU Catalunya.

AQU CATALUNYA (2021b) *The opinion of employers regarding the education received by Industrial Technology graduates*. Barcelona: AQU Catalunya.

BRENNAN, J. (2018) "Linking employability and internal quality assurance: How to make a difference for graduates". In: MARTIN, Michaela. *Quality and Employability in Higher Education: Viewing Internal Quality Assurance as a Level for Change*. Paris: UNESCO, p. 43-57.

BYRNE, C. (2022) "What determines perceived graduate employability? Exploring the effects of personal characteristics, academic achievements and graduate skills in a survey experiment". *Studies in Higher Education* 47 (1): 159-176.

EUROPEAN COMMISSION (2022) *Proposal for a Council Recommendation on building bridges for effective European higher education cooperation*. Strasbourg: European Commission.

COROMINAS ROVIRA, E.; VILLAR HOZ, E.; SAURINA CANALS, C.; FÀBREGAS ALCAIDE, M. (2012) "Construcción de un Índice de Calidad Ocupacional (ICO) para el análisis de la inserción profesional de los graduados universitarios". *Revista de Educación,* 375. January-April 2021: 351-374.

EFRON, B.; TIBSHIRANI, R. (1993) *An Introduction to the Bootstrap.* Boca Ratón: Chapman & Hall/CRC.

GROVES, Robert M. (2006) "Nonresponse Rates and Nonresponse Bias in Household Surveys". *Public Opinion Quarterly* 70 (5): 646-675. doi: 10.1093/poq/nfl033.

MANFREDA, K. L.; BOSNJAK, M.; BERZELAK, J.; HAAS, I.; VEHOVAR, V. (2008) "Web Surveys versus other Survey Modes: A Meta-Analysis Comparing Response Rates". *International Journal of Market Research* 50 (1): 79-104.

MATISOFF, B. S. (1986) "Manufacturing Engineering: Definition and Purpose". In: *Handbook of Electronics Manufacturing Engineering*. Dordrecht: Springer. <https://doi.org/10.1007/978-94-011-7038-3_1>.

METERKO, M.; RESTUCCIA, J.; STOLZMANN, K.; MOHR, D.; BRENNAN, C.; GLASGOW, J.; KABOLI, P. (2015) "Response Rates, Nonresponse Bias, and Data Quality: Results from a National Survey of Senior Healthcare Leaders". *Public Opinion Quarterly* 79 (1): 130-144. doi: 10.1093/poq/nfu052.

RODRÍGUEZ ESPINAR, S.; PRADES NEBOT, A.; BASART CAPMANY, A. (2007) "Accions per facilitar la inserció laboral". In: RODRÍGUEZ ESPINAR, S. *Educació superior i treball a Catalunya: anàlisi dels factors d'inserció laboral.* Barcelona: AQU Catalunya, page 329-365.

SOLER JULVE, I. (2022) "Vía Universitaria desde la perspectiva de género". In: ARIÑO, A.; LLOPIS, R.; MARTÍNEZ, M.; PONS, E.; PRADES, A. *Via Universitària: Accés, condicions d'aprenentatge, expectatives i retorns dels estudis universitaris (2020-2022).* Castellón de la Plana: Xarxa Vives, p. 88-100.

Agència per a la Qualitat del Sistema Universitari de Catalunya

May 2023 · AQU-3-2023-EN

Web: www.aqu.cat · Twitter: @aqucatalunya