



European Ranking of Engineering Programs

Pilot version

1. Assumption and Methodology

Engineering education plays a key role in securing sustainable development of Europe, it is vital in creating innovative technologies and educating creative engineers capable of using science to solve problems but also aware of the social consequences of their actions. To meet these challenges in the age of growing internationalization of the industry, labor market and education, we need a tool to compare the quality of engineering and technology programs offered by the European universities. Rankings of universities and programs have become such an accepted form of comparing and assessment understood by a broad range of stakeholders.

General assumptions

The mission of the European Ranking of Engineering Programs – **EngiRank** is to fill in a gap regarding a current and trustworthy information on engineering studies in Europe. EngiRank will assess and classify European universities of technology. It will also compare the main disciplines of engineering education (rankings “by subject”). This will contribute to popularization of the new teaching methods and help meet the needs of ranking’s main stakeholders.

The EngiRank has been initiated and prepared by Warsaw based “Perspektywy” Education Foundation. The main partner of the project is the Foundation for the Development of the Education System – FRSE (Poland’s national agency of the Erasmus +), its supporting partner is IREG Observatory on Academic Ranking and Excellence – an international organization of rankers and analysts academic rankings.

The EngiRank is primarily addressed to the following groups:

- **Prospective students and their parents** – it will help in choosing a field of study and institution in Europe that, after graduation, will give best chances of finding a satisfactory job. It will also be helpful in study abroad and finding internship under the Erasmus + program,
- **Employers, including European Hi Tech industry** – it will help in looking for talented graduates of technology institutions,
- **University management** – ranking will help to monitor reforms and improve the quality of teaching.

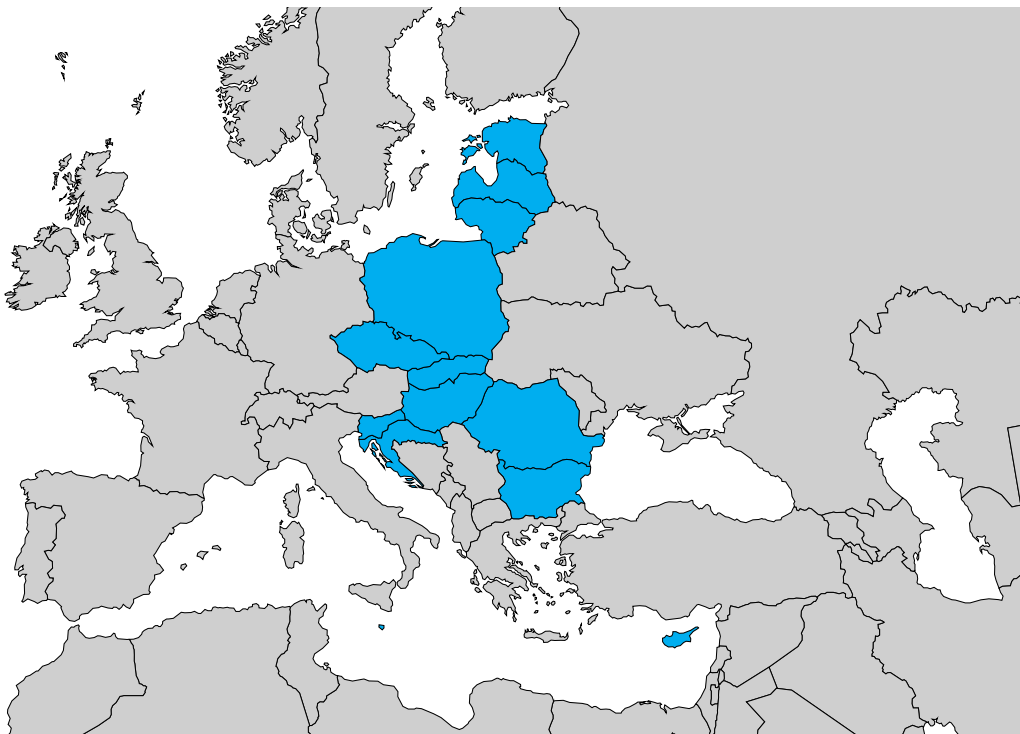
European Ranking of Engineering Studies (EngiRank) uses the results of the earlier research and reports prepared by the project's partner, and in particular:

- *"IREG Report: Engineering & Technology Rankings"* – a report prepared in 2017 and 2018 by "Perspektywy" Education Foundation with the support of IREG Observatory on Academic Ranking and Excellence,
- *"Index of Higher Education – Business Engagement (HEBE Index) - New indicators measuring the scope and quality of university-business cooperation in technical universities"* – a report on research carried by the Foundation for the Development of the Education System (FRSE) in 2018.

The analysis over 200 institutions based on the above indicate a need to introduce into the European education area rankings specializing in particular fields of research and education where *"Engineering & Technology"* and *"Medicine"* should be given priority.

Entry requirements

The results presented are a pilot version of the European ranking. It is a result of analysis of higher education institutions with the strong *"Engineering & Technology"* profile in 13 European countries: Bulgaria, Croatia, Cyprus, Czechia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia. These countries with fairly similar systems of education joined the European Union after 2004 – and are commonly called the *"New Europe"* group.



The over all EngiRank 2019 includes 81 schools:

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|-------------------------|--------------------------|
| • 8 schools in Bulgaria | • 3 schools in Latvia |
| • 2 schools in Croatia | • 2 schools in Lithuania |
| • 5 schools in Cyprus | • 27 schools in Poland |
| • 10 schools in Czechia | • 13 schools in Romania |
| • 1 schools in Estonia | • 5 schools in Slovakia |
| • 3 schools in Hungary | • 2 schools in Slovenia |

Besides the general “institutional” ranking, seven “Engineering & Technology” rankings “by subject” have been prepared. Selected disciplines follow FOS classification approved by OECD.

The main, overall European Ranking of Engineering Programs include higher education institutions that met three criteria:

- publications by researchers of the institution are indexed in the Scopus database;
- at least 30% of all publications of researchers of the institutions in the Scopus database in the period 2014-2018 fall into the Engineering and Technology category (Scopus data as of 24 September 2019);
- an institution has at least 1.000 students.

From over 200 schools considered, 81 met the above criteria for the “institutional” over all Ranking.

The criterion in the EngiRank “by subject” required at least 50 indexed publications in the Scopus database in the given discipline between 2014 and 2018 (Scopus database as of 24 September 2019).

The number of institutions in the EngiRank “by subject” varied. Below the number of institutions classified in various disciplines:

- Civil Engineering – 47 institutions,
- Electrical Engineering, Electronic Engineering & Information Engineering – 101 institutions,
- Mechanical Engineering – 106 institutions,
- Chemical Engineering – 117 institutions,
- Materials Engineering – 139 institutions,
- Medical Engineering – 44 institutions,
- Environmental Engineering – 49 institutions.

Methodology – criteria and indicators

The *European Ranking of Engineering Programs* takes into consideration 15 indicators grouped into five criteria: research effectiveness, innovation, quality of teaching, prestige and internationalization. The criteria were selected according to the best knowledge, the 20-years old experience of the “Perspektywy” Education Foundation in constructing ranking of higher institutions in Poland and analysis of international university rankings within the framework of IREG Observatory on Academic Ranking and Excellence. The general rule of construction of every criterion and indicator is the ability to obtain data for indicators for all ranked subjects from the one source.

In the main overall (“institutional”) EngiRank the following criteria and indicators were taken into account (there are their percentage weights in brackets):

RESEARCH EFFECTIVENESS (20%)

- **Publications [PUB]:** number of publications in the SCOPUS database 2014 – 2018 in relation to the total number of authors affiliated with the institution. *Source: SciVal (5%)*
- **Citations [CIT]:** number of citations in the SCOPUS database 2014 – 2018. *Source: SciVal (5%)*
- **Field-Weighted Citation Impact (FWCI):** relation of citations attributed to a publication to the average number of citations by similar publication in the SCOPUS database 2014 – 2018. *Source: SciVal (5%)*
- **Top 10 (Publications in Top 10 Journal Percentiles) [TOP-10]:** number of publications in 10% of most cited journals in relation to all publications of given institution. *Source: SciVal (5%)*

INNOVATION (35%)

- **External funding for research [FUND]:** value of projects done within Horizon 2020 EU Research & Innovation Programme 2014 – 2018 in relation to all academic staff employed by the institution: *Source: Horizon 2020 data base (7%)*
- **Patents (PAT):** the number of patents registered and granted to the institution by the European Patent Office: *Source: EPO-PATSTAT. (13%)*
- **Collaboration with environment (COL):** the ratio of publications in the Scopus database 2014-2018 that are co-authored by the academic staff and authors affiliated outside academia to all publications. *Source: SciVal (15%)*

QUALITY OF TEACHING (20%)

- **Availability of teaching staff (SSR):** ratio of students to academic staff in academic year 2017-2018 *Source: data provided by institutions. (10%)*
- **Accreditations (ACCRE):** number of accreditations granted to school by selected accrediting organizations. *Source: Accreditation Board for Engineering and Technology (ABET), European Network for Accreditation of Engineering Education (ENAE), The Royal Institute of British Architects Certificate (RIBA), Institutional Evaluation Programme (EUA-IEP) databases. (10%)*

PRESTIGE (5%)

- **National recognition (PREST)** – measured by institution's position in national rankings (if there are no rankings published in a country, the data of the Webometrics will be used instead). In the case of Poland the Perspektywy University Ranking (Poland) was the source. *Source: Webometrics database; Perspektywy database (5%)*

INTERNATIONALIZATION (20%)

- **International students [INTS]:** measured by the ratio of foreign students to the total number of students. *Source: data provided by institutions (4%)*
- **Student mobility (outbound) [E-OUTS]:** measured by the ratio of outbound students of the Erasmus+ program to the total number of students in the academic year 2017/18. *Source: Erasmus+ database (2%)*
- **Student mobility (inbound) [E-INS]:** measured by the ratio of inbound students of the Erasmus+ program to the total number of students in the academic year 2017/18. *Source: Erasmus+ database (2%)*
- **Student internships [E-INTERNS]:** ratio of number of student going abroad for internships to total number of students in academic year 2017/18. *Source: Erasmus+ database (2%)*
- **ICI (International Collaboration Impact) [ICI]:** indicator measured by the average number of publications co-authored by foreign author in 2014-2018 in the Scopus database. *Source: SciVal (10%)*

EngiRank „by subject”

Due to the limited availability of data in the EngiRank “by subject” six indicators grouped into two criteria were used.

RESEARCH EFFECTIVENESS (80%)

- **Publications [PUB]:** ratio of publications in the SCOPUS database 2014 – 2018 to the total number of authors affiliated with the institution. *Source: SciVal (15%)*
- **Citations:** ratio of the number of citations in the SCOPUS database 2014 – 2018 to the number of publications in the relevant discipline. *Source: SciVal (15%)*
- **Field-Weighted Citation Impact) [FWCI]:** the number of citations in the relevant discipline in the Scopus database normalized for the given discipline; ratio of citations to average number of citations in the given discipline. *Source: SciVal database. (15%)*
- **Top 10 (Publications in Top 10 Journal Percentiles) [TOP-10]:** the ratio of publications in 10% of the most cited journals to the total publications attributed to the institution. *Source: SciVal database. (15%)*
- **Collaboration with the environment [COLLAB]:** the ratio of publications in a given discipline in 2014-2018 in Scopus database co-authored by the academic staff and authors affiliated outside HE sector to the total number of publications. *Source: SciVal database. (20%)*

QUALITY OF TEACHING (20%)

- **Accreditations (ACCREDIT):** number of accreditations granted to school by selected accrediting organizations. *Source: Accreditation Board for Engineering and Technology (ABET), European Network for Accreditation of Engineering Education (ENAE), The Royal Institute of British Architects Certificate (RIBA), Institutional Evaluation Programme (EUA-IEP) databases. (20%)*

The rankings „by subject” include a total of **149 schools**:

EngiRank - Chemical Engineering includes **117 schools**:

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|-------------------------|--------------------------|-------------------------|
| • 3 schools in Bulgaria | • 11 schools in Hungary | • 12 schools in Romania |
| • 4 schools in Croatia | • 3 schools in Lotvia | • 6 schools in Slovakia |
| • 3 schools in Cyprus | • 3 schools in Lithuania | • 4 schools in Slovenia |
| • 17 schools in Czechia | • 1 uczelnia z Malta | |
| • 2 schools in Estonia | • 48 schools in Poland | |

EngiRank - Civil Engineering includes **47 schools**:

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|------------------------|--------------------------|-------------------------|
| • 4 schools in Croatia | • 3 schools in Hungary | • 3 schools in Romania |
| • 3 schools in Cyprus | • 1 schools in Lotvia | • 3 schools in Slovakia |
| • 7 schools in Czechia | • 2 schools in Lithuania | • 2 schools in Slovenia |
| • 1 schools in Estonia | • 18 schools in Poland | |

EngiRank - Electrical Engineering, Electronic Engineering & Information Engineering

includes **101 schools**:

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|-------------------------|--------------------------|-------------------------|
| • 5 schools in Bulgaria | • 7 schools in Hungary | • 18 schools in Romania |
| • 4 schools in Croatia | • 2 schools in Lotvia | • 5 schools in Slovakia |
| • 5 schools in Cyprus | • 3 schools in Lithuania | • 3 schools in Slovenia |
| • 12 schools in Czechia | • 1 uczelnia z Malta | |
| • 2 schools in Estonia | • 34 schools in Poland | |

EngiRank - Environmental Engineering includes **49 schools**:

- 1 schools in Bulgaria
- 3 schools in Croatia
- 3 schools in Cyprus
- 5 schools in Czechia
- 2 schools in Estonia
- 2 schools in Hungary
- 1 schools in Lotvia
- 3 schools in Lithuania
- 1 uczelnia z Malta
- 15 schools in Poland
- 9 schools in Romania
- 2 schools in Slovakia
- 2 schools in Slovenia

EngiRank - Materials Engineering includes **139 schools**:

- 7 schools in Bulgaria
- 4 schools in Croatia
- 4 schools in Cyprus
- 17 schools in Czechia
- 2 schools in Estonia
- 10 schools in Hungary
- 2 schools in Lotvia
- 3 schools in Lithuania
- 1 uczelnia z Malta
- 55 schools in Poland
- 24 schools in Romania
- 7 schools in Slovakia
- 3 schools in Slovenia

EngiRank - Mechanical Engineering includes **106 schools**:

- 5 schools in Bulgaria
- 4 schools in Croatia
- 3 schools in Cyprus
- 16 schools in Czechia
- 2 schools in Estonia
- 7 schools in Hungary
- 3 schools in Lotvia
- 3 schools in Lithuania
- 1 uczelnia z Malta
- 39 schools in Poland
- 13 schools in Romania
- 7 schools in Slovakia
- 3 schools in Slovenia

includes **EngiRank - Medical Engineering** includes **44 schools**:

- 1 schools in Croatia
- 1 schools in Cyprus
- 6 schools in Czechia
- 1 schools in Estonia
- 2 schools in Hungary
- 1 schools in Lotvia
- 2 schools in Lithuania
- 16 schools in Poland
- 11 schools in Romania
- 1 schools in Slovakia
- 2 schools in Slovenia

Methodology - method of calculation

The higher value of each indicator in the criterion (except SSR), the higher position of an institution in the ranking. The value of SSR had been transformed. This way all the indicators used in the European Ranking of Engineering Programs meet the criterion of uniform –preference. Criteria that spread asymmetric had undergone logarithmic transformation to ensure comparable set of criteria.

The methodology of the ranking is based on the **Multi-Attribute Utility Theory (MAUT)**. According to the theory, it was assumed – firstly - that it is possible to estimate the utility that expresses the impact of the individual criteria taken into account on the final assessment of the university. Secondly, it was assumed that if the criteria are not equally important, then bringing them to comparability is possible by weighting the criteria using real coefficients. Thirdly, it was assumed that the final rating is the sum of weighted partial utilities.

The methodology for conducting the ranking is as follows. We distinguish between so-called small and large ranking points. For each of the criteria taken into account, in addition to the criterion for recognition in the country (national reputation), a school - the winner is selected who obtains 100 small ranking points. Then, for all other schools, a proportional distance to the winner is calculated, according to the value of the indicator for the given

school, and small ranking points are allocated.

For the criterion regarding recognition (prestige) at the country level - measured by means of an indicator reflecting the position of the university in the national ranking - 100 small ranking points are obtained by the university occupying the highest position in the country in the ranking. The university with the lowest ranking in a given country obtains 20 small ranking points. Other universities in a given country are assigned small ranking points, in proportion to their position in the national ranking. It should be noted that in this indicator the highest maximum number of small points will be obtained by as many universities as countries included in the ranking.

Small ranking points obtained by the university for all criteria are added together and ranked in the ranking from the highest to the lowest number of points obtained in total. The sum of small ranking points is also normalized in such a way that the school which obtained the highest number of small ranking points receives 100 large ranking points and the remaining schools are allocated large ranking points in proportion to the sum of small ranking points from 15 criteria. In this way, a linear order of the set of ranking participants is obtained relative to the number of large ranking points obtained.

In order to determine the position of schools in the ranking, a discrimination threshold of 0.5% of the number of points with a higher total number of large ranking points is introduced. This means that schools that obtained scores that differ by less than 0.5% in the number of points from schools with more points will occupy the same position in the ranking.