JEDI _UPV_WP2_D2.1_Why a European label for technical, engineering and science-oriented degrees? Version: 2.1

JEDI

JEDI

JOINT EUROPEAN DEGREE LABEL
IN ENGINEERING

EELISA
European University

ENHANCE
European Universities of Technology Alliance

EUT+
EUROPEAN
UNIVERSITY OF
TECHNOLOGY

JEDI Why a European label for technical engineering and science-oriented degrees?

D2.1

Date: October 2023

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JEDI
JOINT EUROPEAN DEGREE LABEL IN ENGINEERING

Why a European label for technical engineering and science-oriented degrees?

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Project acronym: JEDI

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Authors: Nuria Llobregat & Luis Sánchez

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[1] PU – Public; PP - Restricted to other program participants (including the Commission Services); RE - Restricted to a group specified by the consortium (including the Commission Services); CO - Confidential, only for members of the consortium (including the Commission Services).

HISTORY OF CHANGES

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JEDI Partners

Name	Short name	Country
UNIVERSIDAD POLITÉCNICA DE MADRID	UPM	Spain
ÉCOLE NATIONALE DES PONTS ET CHAUSSÉES	ENPC	France
ISTANBUL TEKNIK UNIVERSITESI	ITU	Turkey
UNIVERSITATEA POLITEHNICA DIN BUCURESTI	UPB	Romania
BUDAPESTI MUSZAKI ES GAZDASAGTUDOMANYI EGYETEM	BME	Hungary
UNIVERSITE DE TECHNOLOGIE DE TROYES	UTT	France
HOCHSCHULE DARMSTADT (UNIVERSITY OF APPLIED SCIENCES H-DA)	H-DA	Germany
UNIVERSIDAD POLITECNICA DE CARTAGENA	UPCT	Spain
TECHNOLOGIKO PANEPISTIMIO KYPROU	CUT	Cyprus
TECHNICAL UNIVERSITY OF SOFIA	TU-SOFIA	Bulgaria
UNIVERSITATEA TEHNICA CLUJ-NAPOCA	UTC	Romania
CHALMERS TEKNISKA HOGSKOLA AB	CHALMERS	Sweden
UNIVERSITE PARIS SCIENCES ET LETTRES	PSL	France
UNIVERSITAT POLITECNICA DE VALENCIA	UPV	Spain
RIGAS TEHNISKA UNIVERSITATE	RTU	Latvia
TECHNOLOGICAL UNIVERSITY DUBLIN	TU-DUBLIN	Ireland

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Executive Summary

In the field of policy experimentation in higher education under the Erasmus+ program, the Joint European Degree label in engineering (JEDI) is part of the 2022 Erasmus+ Work Program call. The general objective of JEDI is to develop a prototype label for European joint degrees, co-developed with 16 HEIs from three European Universities (EELISA, EUt+ and ENHANCE) and under the perspective of engineering, technology, and science-oriented education. The added value of this project is built on the shared ambition of this consortia to redefine the education of engineering and technology degrees in Europe with the will to contribute to the development of an integrated European Engineering Education Space.

The project is based on the collaboration and discussion between agencies, academia, and diverse stakeholders. To ensure visibility and engage students, JEDI will create three co-labs for the decisive steps of validation and demonstration. All the partners, including associate partners, will appoint experts and stakeholders (e.g., HEIs, associations, students, and accreditation agencies) that will contribute to the optimisation of the set of criteria.

JEDI is a one-year project structured around four work packages (WPs), as depicted in the schematic. WP4 has three important objectives: to communicate the project and its results, to disseminate the outcomes towards the people responsible for joint degrees (in our HEIs and in external consortia) and to prepare recommendations for policy makers, accreditation agencies and European HEIs interested in implementing this label.

This project has yet to receive any additional funding from the three European Universities, estimating the costs specifically from the European Union funding and partners.

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1. About the Deliverable

Sixteen Higher Education Institutions from three European Universities, namely EELISA, EUt+ and ENHANCE, have joined to explore some common criteria for a potential European label for the European joint programmes under the perspective of engineering, technology, and science-oriented education. We share the vision that joint degrees substantially increase student opportunities and favour our HEIs' attractiveness and competitiveness.

This deliverable is part of the expected outcomes responding to a European Call and the concern of the involved universities that after the success of the Erasmus Programme, despite the initial problems of mobility agreements and recognition, it became clear that there was an added value of mobility, and a study-abroad experience significantly helps career prospects. Eighty per cent of Erasmus+ graduates are employed in less than 3 months after graduation, and the longer duration of the study abroad period is seen by most students as an added value as well as the complementarity of the study pattern and the possibility of accessing specialisations not available at the home university.

Joint degrees and labels help the formal recognition and certification of this often merely implicit added value. This is especially pertinent in situations where national degrees are positively discriminated against, joint labels will facilitate the recognition of degrees from all European countries.

JEDI partners share the vision that issuing this label, as a complementary certificate to the qualifications obtained by students graduating from joint programmes, is a necessary step for creating an integrated framework for engineering education. We also share the vision that awarding joint degrees developed in accordance with the Bologna instruments will increase the visibility, attractiveness, and reputation of our HEIs, both in Europe and beyond, and that these degrees will be the flagship outcomes of our European Universities. In addition, during the process of creation of European Universities, we, the partners participating in this project, also are developing, testing, and validating innovative recognition systems for transnational learning experiences that can bring valuable inputs for joint degrees and hence for the labelling system.

The general objective of JEDI is to develop a prototype label for joint European degrees, that is based on the common set of European criteria proposed in the annex of the ERASMUS-EDU-2022-POLEXP call that are adjusted and co-developed with our partners during our experimentation and that can be applied to any joint European degree, and whose compatibility with engineering, technology, and science-oriented degrees, in particular, has been verified.

In this deliverable we approach the European accreditation processes in general, focussing on processes in engineering, technology, and applied science degrees to find the basis of the following deliverables of the project.

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The objective of this deliverable is to study how relevant quality and accreditation processes are in engineering, technology, and applied science degrees, so that it becomes the basis of the following deliverables of the project.

With that general task, we will pay attention to the barriers, challenges and added value that joint degrees in engineering in Europe may bring, and particularly on how a label can contribute to the success of Joint Degrees in Engineering.

The report implies the participation of the involved partners and their respective alliances, to map and analyse national, regional, and local situations.

Mapping the specific situation of engineering degrees in terms of requirements, accreditation processes, etc., within the different existing contexts is the key to identifying potential barriers, added values, early adopters to formulate a consistent criteria proposal.

With the above, this deliverable approaches the main objectives of the WP2:

- Thorough analysis of current situation for accreditation of joint degrees, identifying the main barriers.
- Conclusions on the added value of a European label for engineering degrees.

In Section 2 we will expose the state of the art on accreditation in general focussing on the European case and situation of Technical, Engineering and Science-oriented degrees in Europe, as well as the situation of Joint Programmes, Joint Degrees, and programme labels in Engineering studies.

In Section 3 we will review the European accreditation process for engineering, technology, and applied science degrees and gather information on the accreditation procedures followed at the national level in some European countries.

In Section 4, we will approach the barriers, challenges and added value of Joint Degrees in Engineering that will lead to reach some conclusion in the final section of this Deliverable 2.1.

2. State of the Art

2.1. Background

Education has consistently held great significance for individuals and for society, yet its importance is not homogeneous over time. It has evolved in response to shifts in economic organization and changes in social context. In modern societies where science, technology and applied sciences abound throughout, the demand for education in engineering, technological and applied sciences education has become increasingly evident.

To explain and diagnose the knowledge, skills, competences, theoretical training, professional training, and even training in values that this education should bring out different accreditation agencies appeared. These accreditation agencies are organizations that evaluate the quality of educational institutions and their programs to ensure that they meet certain quality standards. These agencies may operate regionally, nationally, or internationally. They aim to ensure that academic institutions provide high-quality education to their students.

The accreditation or label that these organizations offer intends to assist students and their families so that they can make well-informed decision about where to study. Furthermore, this label may be a requirement or selection criteria when students wish to enrol in some higher educational institutions. They may even get to be a necessary condition for students to be eligible for some government financial aid.

Clearly, the accreditation processes must account for the diverse circumstances, nature, and intention of the education related to the knowledge, skills, and competences to be achieved for which a quality evaluation model must be applied with some variables that allow to compare the standards and analyse and justify if they comply with some predefined quality standards.

As a result of the worldwide accreditation concern, Engineers Australia EA, Engineers Canada EC, Engineers Ireland EI, Engineering New Zealand EngNZ, Engineering Council United Kingdom ECUK, and the United States Accreditation Board for Engineering and Technology ABET signed the Washington Accord in 1989, a multi-lateral agreement between bodies responsible for accreditation or recognition of tertiary-level engineering qualifications within their jurisdictions to work collectively to assist the mobility of professional engineers as consequence of the growing globalization need for a mutual recognition of engineering qualifications. This Washington Accord focused on academic programmes that enabled the practice of engineering at the professional level, benchmarking the standard for professional engineering education across those bodies. Subsequently additional bodies became signatories to this agreement.: Hong Kong Institution of Engineers HKIE (1995). Engineering Council South Africa ECSA (1999), Accreditation Board for Japan Engineering Education JABEE

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(2005), Institution of Engineers Singapore IES (2006), Accreditation Board for Engineering Education of Korea ABEEK (2007), Institute of Engineering Education Taiwan IEET (2007), Board of Engineers Malaysia BEM (2009), Turkey's Association for Evaluation and Accreditation of Engineering Programs MÜDEK (2011), Association for Engineering Education of Russia AEER (2012), India's National Board of Accreditation NBA (2014), Institution of Engineers Sri Lanka IESL (2014), China Association for Science and Technology CAST (2016), Pakistan Engineering Council PEC (2017), Peru's Institute of Quality and Accreditation of Computer Programs, Engineering and Technology ICACIT (2018), Federated College of Engineers and Architects of Costa Rica CFIA (2020), and Indonesian Accreditation Board for Engineering Education IABEE (2022), There are provisional signatories from Chile, Thailand, Bangladesh, Philippines, Myanmar, Saudi Arabia, and Nigeria recognised as having systems and processes in place to become full signatories, too, https://www.ieagreements.org/accords/washington/signatories

 To enhance the Washington Accord, in 2001, the organizations Engineering Council United Kingdom, Engineers Australia, Canadian Council of Technicians and Technologists (till 2022, now represented by Technology Professionals Canada), Hong Kong Institution of Engineers, Engineers Ireland, Engineering New Zealand, and Engineering Council South Africa signed the Sidney Accord. This accord aims to enhance the equivalency of degrees for engineering technologists or incorporated engineers among the signatories[2].

Nowadays, the Institute of Engineering Education Taiwan IEET (2014), Accreditation Board for Engineering Education of Korea ABEEK (2013), Accreditation Board for Engineering and Technology ABET (US, 2009), and Board of Engineers Malaysia BEM (2018) have also signed the Sidney Accord. Provisional Signatories: Provisional Signatories are recognized as having appropriate systems and processes in place to develop towards becoming a full signatory are Instituto de Calidad y Acreditación de Programas de Computación, Ingeniería y Tecnología ICACIT (Perú) and Institution of Engineers Sri Lanka IES). While the Washington Accord primarily recognises engineering level accreditation, the Sidney Accord extends this recognition to academic programs in engineering technology such as the National Diploma in Engineering, BEng Tech degree, and BTech degree.

In 2002, these agreements were extended to other engineering levels through the national engineering organisations of Ireland, the United Kingdom, South Africa and Canada, Engineers Ireland, Engineering Council South Africa ECSA, Engineering Council United Kingdom ECUK, and Technology Professionals

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[2] https://accreditation.org/accreditation-processes/accords/sydney-accord

Canada TPC (previously, till 2022, Canadian Council of Technicians and Technologists CCTT)[3].

The Dublin Accord primary recognises mutually the qualifications which underpin the granting of Engineering Technician titles in the four countries. Currently there are nine signatories, the five more recent ones being Engineers Australia EA (2013), Engineering New Zealand EngNZ (2013), Accreditation Board for Engineering Education of Korea ABEEK (2013), Accreditation Board for Engineering and Technology ABET (US, 2013), and Board of Engineers Malaysia BEM (2018),

Restricted to Europe, this concern started even earlier though its formalisation in the so-called Bologna Process. The ignition of this process was the Magna Charta Universitatum, issued at a meeting celebrating the 900th anniversary of the University of Bologna. Later on, in 1998, the ministers with education responsibilities Claude Allègre (France), Jürgen Rüttgers (Germany), Luigi Berlinguer (Italy), and Baroness Blackstone (UK) signed the Sorbonne declaration in Paris in 1998, committing themselves to "harmonising the architecture of the European Higher Education system", ("Sorbonne Joint Declaration: Joint declaration on harmonisation of the architecture of the European higher education system"[4]

The following year, 29 countries signed the Bologna Declaration: Austria, Belgium (Flemish Community and French Community of Belgium separately), Bulgaria, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom. The Bologna Process started to develop and get updated and fit in a serial of government meetings held in Prague (2001), Berlin (2003), Bergen (2005), London (2007), Leuven (2009), Budapest-Vienna (2010), Bucharest (2012), Yerevan (2015), Paris (2018), and Rome (2020).

Throughout this process, several countries have become participants:

- 2001: Croatia, Cyprus, Liechtenstein, Turkey, European Commission.
- 2003: Albania, Andorra, Bosnia and Herzegovina, North Macedonia, Russia, Serbia, Vatican City.
- 2005: Armenia, Azerbaijan, Georgia, Moldova, and Ukraine.
- May 2007: Montenegro.
- 2010: Kazakhstan.
- May 2015: Belarus.

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[3] https://www.ieagreements.org/accords/dublin/
[4] DAAD. http://www.bologna-berlin2003.de/pdf/Sorbonne_declaration.pdf. 25 Retrieved 16 September 2023.)

The Bologna Process has 49 participating countries that conform the so-called European Higher Education Area EHEA, to ensure comparability in the standards and quality of higher-education qualifications. All EU member states do participate in the process, with the European Commission additionally they have also become full members of the Bologna Follow-up Group and its board and supporting the decisions implementation of the Bologna Ministerial Conferences. Monaco and San Marino are the only members of the Council of Europe which have not adopted the process.

All participating countries in the Bologna Process commit to the following:

- Establish a three-cycle higher education system consisting of bachelor's, master's, and doctoral studies.
- Ensure the mutual recognition of qualifications and learning periods abroad completed at other universities.
- Implement a quality assurance system aimed at enhancing the quality and relevance of learning and teaching.

The three-cycle structure is not uniform within the Bologna Process: the first cycle includes a study programme with 180-240 ECTS credits to be achieved in 3-4 years, and the second cycle includes a 1–2-year study programme with 60-120 ECTS credits. To make this degree structure cater for comparable and transferable qualifications and facilitate mobility and recognition, the European and national qualifications frameworks used are based on the European Credit Transfer and Accumulations System (ECTS) in terms of quality (learning outcomes) and quantity (workload), Additionally, a Diploma Supplement is produced to graduates according to standards agreed by the Commission, the Council of Europe and the United Nations Educational, Scientific and Cultural Organization (UNESCO). The Diploma Supplement is designed to facilitate and support the recognition of academic qualifications, nationally and abroad, including information of the qualification awarded and its originating institution, the qualification level, the content of the course and results gained, and details of the national higher education system concerned (provided by the National Academic Recognition Information Centres (NARICs)[5].

Originally, the Bologna Declaration mentioned just two cycles as including all programmes of tertiary education, where the second cycle should lead to the master and/or doctorate degree. However, the 2003 Berlin Ministerial Communiqué introduced the doctoral programmes as the third cycle.

However, these 3 cycles did not fit and covered all tertiary education since some European countries were offering short cycle programmes which were practice-oriented and provided students with professional knowledge, skills, and

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[5]   https://education.ec.europa.eu/education-levels/higher-education/inclusive-and-connected-higher-education/diploma-supplemen

competences to facilitate entering the labour market, and these programmes eventually led to an undergraduate programme, or was part of it. In other countries this type of programme did not belong to higher education at all.

Consequently, in the 2018 Paris Communiqué was fixed that short-cycle higher education qualifications, typically between 90-120 ECTS credits, could be considered as qualifications within the overarching framework of EHEA. Each country had the discretion to determine whether these short cycle qualifications were to be integrated within its own national framework[6].

With the uprising mobility programmes, and transnational and international activities it became clear that professionals would reach a more complete education if they followed double or joint, national, or international, programmes. The establishment of these programmes is typically intricate as they must adhere the corresponding standards of the various accreditation agencies according to the surrounding conditions of the universities and/or degrees in which they are introduced.

2.2. Technical, Engineering and Science-oriented degree in Europe

When regarding Medicine as a Science-oriented degree, it becomes apparent that Science-oriented studies have been developed throughout universities since the first ones were incepted. This happened with the University of Al-Karowine (Fez, Morocco) that introduced studies in Mathematics, Astronomy and Medicine), short after its creation in 859. A similar situation happens in the oldest European universities.

Nowadays, with a university-productive system relationship, universities include Technical, Engineering and Science-oriented degrees in their programmes, aware that they are needed by society, that professionals in these fields contribute to reducing unemployment, and any research task developed by the university faculty, postdoctoral and even PhD students may help to improve the human capital and innovation of companies.

In fact, some universities have got regulated the possibility of developing an Industrial PhD in a company where candidates and the board designated to assess the PhD dissertation must abide some confidentiality compromise, and results cannot be publicised. In this line there are European initiatives promoting exist European Industrial Doctorates[7].

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[6]https://www.ehea.info/Upload/document/ministerial_declarations/EHEAParis2018_Communique_AppendixIII_952778.pdf
[7]https://ec.europa.eu/assets/eac/msca/documents/documentation/publications/finalbrochure_eid_en.pdf).

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As a result, there are a number of universities in Europe that primarily specialize in Technical, Engineering or Applied Sciences. In some of them, mainly Northern, there is a binary higher education system, with a distinction between research-oriented universities and professional higher education institutions (universities of applied sciences). Research universities offer highly academic, research-oriented programmes focused on specific subjects. Conversely, universities of applied sciences, on the other hand, are more practical and career-oriented, designed for those looking to enter a particular career type upon graduation. This distinction is prominent in several, mainly northern, European countries.

A bachelor's degree usually takes three years to complete at a research university as opposed to four years at a university of applied sciences which on the other hand do not provide doctoral studies.

All Technical, Engineering and Science-oriented degrees in Europe fit within the European Higher Education Area EHEA[8], where each country has its own nationally governed higher education, HE system, but all their qualifications are structured according to three 'cycles' defined as part of the Bologna Process:

- Bachelor's degrees, in 3 or 4 years. A bachelor's degree should prepare for further study, as well as for skilled employment.
- Master's degrees, in 1 or 2. A master's degree develops professional and research competences. A master's degree may be research-focused or more modular and assessed by coursework and/or exams.
- Doctoral studies, in 3 or 4 years. A PhD is required to work in academia and is useful to become a specialist in a particular field, or an industry researcher.

Most bachelor and master programmes allow, and in some instances may even require, a period of practical working in industry or working on industry-related projects.

The diversity, alongside shared concerns to provide adequate education and training skills has favoured the appearance of national and transnational organizations that gather universities or engineering professionals of one or various disciplines. Some of them are umbrella type organizations which accept many different disciplines, while others are discipline specific. And some award professional designations, including European Engineer, professional engineer, chartered engineer, incorporated engineer or similar. We will review them in Section 3.

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[8] https://education.ec.europa.eu/study-in-europe/planning-your-studies/higher-education-in-europe

However, and concerned with the educated competencies and skills that Engineering and Applied Sciences students should earn, we find the work, white and position papers, developed by different European societies such as:

- SEFI, the European Society for Engineering Education.
- European Association for Structural Dynamics.
- European Federation of National Engineering Associations.
- CESAER, the Conference of European Schools for Advanced Engineering Education and Research.

Additionally, national societies in various countries, such as:

- Azerbaijan. Caspian Engineers Society.
- France. Association Française de Mécanique, CDEFI (Conférence des directeurs des écoles françaises d'ingénieurs), CNRS ingénierie.
- Germany. Verein Deutscher Ingenieure.
- Greece. Technical Chamber of Greece (Τεχνικό Επιμελητήριο Ελλάδας).
- Ireland. Institution of Engineers of Ireland, Institute of Physics and Engineering in Medicine.
- Portugal. Ordem dos Engenheiros.
- Romania. General Association of Engineers of Romania.
- Russia. Russian Union of Engineers.
- Spain. IIE (Institute of Engineering of Spain) is the Federation of Associations of Engineers integrating more than 100.000 engineers in the following branches: Association of Aeronautical Engineers of Spain, National Association of Agricultural Engineers, Association of Civil Engineers, Federation of Associations of Industrial Engineers of Spain, National Association of I.C.A.I. Engineers, National Association of Mining Engineers, Association of Forestry Engineers, Association of Naval and Oceanic Engineers of Spain, Spanish Association of Telecommunications Engineers. There are other associations of Engineers that have full competencies in their field and are associated within the Institute of Graduates in Engineering and Technical Engineers of Spain (Instituto de Graduados en Ingeniería e Ingenieros Técnicos de España, INGITE). INGITE is a scientific entity representing associations of different branches of Technical Engineering which currently represents more than 300,000 professionals and students. The INGITE includes associations of Industrial Technical Eng., Technical Civil Eng., Technical Mines Eng., Technical Aeronautics Eng., Technical Agricultural Eng., Forestry Eng., I.C.A.I., Technical Naval Eng., Uaitie, Technical Telecommunications, Eng., Technical Topography Eng. There is some institutional declaration between IIE and INGITE to highlight and defend the relevance of their more than 500.000 engineers (https://www.ingite.es/declaracion-institucional).

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- Turkey: Chamber of Computer Engineers of Turkey, Chamber of Electrical Engineers of Turkey, Union of chambers of Turkish engineers and architects
- United Kingdom: Engineering Council, which controls the award of chartered engineer, incorporated engineer, engineering technician, and information and communications technology technician titles, through licences issued to 36 recognised Institutions – British Computer Society, British Institute of Non-Destructive Testing, Chartered Association of Building Engineers, Chartered Institute of Plumbing and Heating Engineering, Chartered Institution of Building Services Engineers, Chartered Institution of Highways and Transportation, Chartered Institution of Water and Environmental Management, Energy Institute, Institute of Acoustics, Institute of Cast Metals Engineers, Institute of Healthcare Engineering and Estate Management, Institute of Highway Engineers, Institute of Marine Engineering, Science and Technology, Institute of Materials, Minerals and Mining, Institute of Measurement and Control, Institute of Physics, Institute of Physics and Engineering in Medicine, Institution of Agricultural Engineers, Institution of Chemical Engineers, Institution of Civil Engineers, Institution of Diesel and Gas Turbine Engineers, Institution of Engineering Designers, Institution of Engineering and Technology, Institution of Fire Engineers, Institution of Mechanical Engineers, Institution of Railway Signal Engineers, Institution of Structural Engineers, Nuclear Institute, Royal Aeronautical Society, Royal Engineers, Royal Institution of Naval Architects, Society of Environmental Engineers, Society of Operations Engineers, The Welding Institute. There are also 19 professional affiliate institutions, not licensed, but with close associations to the Engineering Council: Association for Project Management, Chartered Association of Building Engineers, Chartered Institution of Civil Engineering Surveyors, Chartered Quality Institute, Institute of Mathematics and its Applications, Institute of Nanotechnology, International Council on Systems Engineering (UK Chapter), Professional engineering bodies not affiliated to the Engineering Council, Cleveland Institution of Engineers, Institution of Engineers and Shipbuilders in Scotland, Institute of the Motor Industry, Society of Professional Engineers UK, Women's Engineering Society.

There are also many student-run engineering societies, commonly at universities or technical colleges. concerned with the education and research in these engineering and applied sciences studies, such as:

- BEST: Board of European Students of Technology.
- EESTEC: Electrical Engineering Students' European association.
- ESTIEM: European Students of Industrial Engineering and Management.
- IGSO: International Geodetic Student Organisation.

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- Local students' organizations.

These organizations take care to guarantee or encourage the required skills and competencies that engineers, technical and applied science professionals should have. But the situation is simple as we find that most European countries follow a 3 (bachelor) + 2 (master) years system, for general studies and 4 (bachelor) and 2 (master) (e.g., Romania etc.), but there are some countries where they follow a 4+1, or even a 3.5 + 1.5 system. And in some cases, like in Spain we find that different universities may have a 4+2 or 4+1.5 system in some field like Aerospace Engineering ([C. Cattani, M.P. Legua-Fernández, L.M. Sánchez Ruiz, "The Bologna Puzzle: The Italian and Spanish pieces", International Meeting 4th Valencia Global 2014, pp. 554-561.).

There are also differences in the grading system. Indeed, the grading system differs per country in Europe[9].

In Austria, grades from 1 to 5 are used, with 1 being excellent and 5 being insufficient. In some European countries, grades are based on percentages from 0 to 100 and in other, grades range from A to F as in France, or from 0 to 10 as in Spain or Romania, 0 to 20 in Italy, or 0 to 30 in Portugal.

Usually, industrial internships are also included in the curricula that students can follow before graduating to and to help their insertion into the labour market. In addition to the channels provided by the universities, and usually included somehow included in their offering we find IAESTE (International Association for the Exchange of Students for Technical Experience) which is a non-governmental, independent, apolitical, and non-profit organization that organizes an abroad mobility program for paid internships in companies and institutions, mainly in the STEM sector.

Since new skills are being required within the Engineering curricula of the future professionals, mainly related to the digital and the so called cross-curricular skills, we find situations where the undergraduate students are offered to confront projects corresponding to real problems proposed by some company or industry. This is the case of the European Project Semester (EPS), a programme offered by several European universities to students who have completed at least two years of study. EPS is created with engineering students in mind, but other students who can participate in an engineering project are also welcome. EPS is a mixture of "Project Related Courses" and project organized/problem-based learning. It is crafted to address the design requirements of the degree and prepare engineering students with all the necessary skills to face the challenges of today's world economy. Students work in international and interdisciplinary teams of 3–6 students on their projects. Projects are done in cooperation with

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[9]   https://education.ec.europa.eu/study-in-europe/planning-your-studies/higher-education-in-europe

commercial businesses and industries or with research centres. There are minor differences between EPS-projects and the various EPS-providers, i.e., the university institutions participating in the EPS structure.

All providers have agreed about the following essential elements[10]:

- Semester lasts 15 weeks minimum.
- EPS is project centred.
- Working language is English.
- 30 ECTS per semester are offered in total, whereof the project covers min. 20 ECTS, accompanying subjects 5 to 10.
- Accompanying subjects must support the project subject English and a basic crash course in the local language must be an option.
- Subjects include Teambuilding and Project Management.
- Project groups are composed multinational, group size 3-6 students, min. 3 nationalities multi disciplinarily desired.
- An emphasis on EPS is teamwork.
- Project supervision focuses on the process as well as the product.
- EPS must have continuous assessment including an Interim report and a final report.

Similar approach can be found in EUt+ Certificate. EUt+ certificate is a label granted after validation of an academic semester spent at a university of the alliance. It aims to develop student mobility among the partners through automatic mutual recognition of training contents.

These new skills and the fast-evolving technology are put on stage in the Position Paper on Developing Graduate Engineering Skills developed within SEFI in 2016[11] by which students should be provided with excellence in education which stimulates their motivation and appreciation of the benefits of learning across borders, within their chosen engineering discipline, but also, and even more, outside the engineering world. Students should be guided in planning and implementing personal study goals to balance a strong focus on their own field with a refreshing view on a broader context.

The Position Paper considers a profound fact that engineers are transforming the world and, consequently, all stakeholders involved in their education should deliberate seriously on their responsibility in this transformation. And at the same time, considering that Engineering education is about creating the future and should embrace more than technical skills to better enable engineering students to understand the magnitude and context of their future role, this document

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[10] http://europeanprojectsemester.eu/
[11] https://www.sefi.be/publication/position-paper-on-engineering-skills/

supports several key common issues within the formation and education of the engineer. Like:

- The world undergoes rapid change. The engineering graduates should have the skills to function and thrive and be comfortable in their ability to adapt as their professional world continually changes on a local and international scale. Consequently, engineering curricula should support this by developing innovative, entrepreneurial, and social skills within the engineering graduate.

- Humankind continues to try to balance technological development and growth with the consequential environmental and social challenges these generate. The role of the engineer in helping to address this balance is central future to us all. Therefore, engineering education must broaden the actual engineering skills in addition to providing deep technological knowledge. Communication, collaboration, critical thinking, creative thinking (4 Cs), reflective thinking, systems thinking, and synthesis capabilities of novel solutions are necessary attributes that every engineer should possess, and engineering graduates should develop a deep understanding of ethics and sustainable development.

- Higher engineering education institutions should embrace diversity both in the students they attract and the staff they employ. Diversity is one very important factor for delivering innovative, sustainable, and well-designed solutions for industrial and societal needs.

- Engineering graduates' mobility and engineering programmes' comparability are important elements of the quality of engineering education, albeit they are not the only indicators of programme quality. Mobility and comparability are facilitated through various instruments such as the Bologna Declaration, European Qualifications Framework (EQF), and EUR-ACE Label. Across Europe there is no consensus in structuring engineering education, but rather a constructive diversity in the programme design, which can pose challenges in making comparisons and hinder student mobility. This reflects the need for both EQF level 6 and level 7 engineering degrees (first/second cycle, bachelor/master level).

- Greater attention must be paid to academic staff development and support. Just as the practice of engineering is changing rapidly, the attitude of new generations of students is also changing, and digital learning methods offer a multitude of possibilities. The complex challenge of educating the engineering students of the 21st century continues to evolve. Consequently, due consideration must be given to how our academic staff are equally evolving and supported as educators, and how to enhance their ability to teach, coach, supervise and inspire student learning, and the development of an engineering identity within our graduate engineers.

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- The education of the engineer should not conclude upon the completion of the first or second cycle. Within their first cycle degree, the engineering student must learn how to learn, and that learning is for life. Because what is considered state-of-the-art today becomes outdated news tomorrow.

- Industrial practices are continuously evolving. Therefore, it is critical to cultivate and strengthen the relationship and exchange of know-how between industry and academia - between professionals and educators. Programme learning outcomes must be validated by industry stakeholders to ensure the understanding of engineering principles and practices in graduate engineers. This is a crucial factor for competitiveness.

2.3. Joint Programmes and Joint Degrees

The primary objective of Erasmus mobility programme was to promote the educational mobility of both students and staff. It focused on formal and informal learning within the European Higher Education Area EHEA with a clear vocation for internationalization and create and increase a European conciseness and identity through short-term stays in higher education institutions for teaching, allowing students to benefit from the knowledge and experience of academics from other countries, and promoting the exchange of skills and experiences on pedagogical methods.

Soon it became clear that some of these exchanges were not easy to implement and that really students were getting more than education that they would have remained in their home institution to get their degrees, and that with some adequate fixing they should deserve more than their original degree corresponding to the studies they selected when they started their university career. Hence the possibility of getting double or dual degrees started to be considered and issued, as well as the idea of structuring joint programmes.

Although the terms 'joint degree' and 'dual degree' are sometimes used interchangeably, we should note that they do not mean the same concept. A 'dual' or 'double' degree requires students to complete two separate programmes at two universities, whereas a joint degree programme is for a single degree with one curriculum designed and offered collaboratively by two universities.

While double degrees are more common than joint degrees, they can be difficult to comply as students are required to complete the dual degree programme because there are separate sets of requirements for each degree. And some university regulations may require that a certain percentage, in some cases at least half, of the credits for its degree be taken on site. So, even when students are completing similar degrees at each institution, they may need to take more classes simply to reach the total number of credits to meet each partner's requirements. But there are cases when this is facilitated by the entities involved in the double degree which design adequate pathways so that students can

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obtain both degrees since the designed curricula satisfies the requirements of each involved degree.

In some cases, the involved institutions have gone even further as it happened in an agreement under the ATLANTIS program launching a dual triple Bachelor's degree program, which involved the Laurea in Ingegneria Gestionale degree program of Università degli Studi di Parma (UNIPR), the BS in Industrial Engineering degree program of New Jersey Institute of Technology (NJIT) and the Ingeniería Técnica Industrial especialidad Mecánica degree program of Universitat Politècnica de València (UPV). The participating students from these 3 institutions, after studying 2 years in their home university, studied select courses according to this agreement at UPV during the first semester of their third year, followed by one semester at UNIPR, and a full academic year at NJIT. After successfully following this programme, they received the corresponding diploma from the three institutions (Abdel-Malek, Ballester-Sarrias, Bernazzoli, Montanari, Sánchez-Ruiz, 2014).

A similar agreement exists between Technical University of Cluj-Napoca (TUCN) and University of Bergamo (UniBg) for civil engineering master program Structural engineering (TUCN) and Building Construction Engineering (UniBg). The syllabus was designed to be similar in both universities, and students attending one year at partner university is entitled to have both diplomas, if they defend their master thesis in both universities.

In this deliverable, the following definitions are recalled clarifying the distinctions between joint programs and joint degrees within the context of European higher education, as well as the related of double/multiple degrees[12].

Emphasis should be placed on the collaborative nature of joint programs and the official recognition of joint degrees.

- ***Joint programme****: This refers to an integrated curriculum that is coordinated and offered collaboratively by multiple higher education institutions from European Higher Education Area (EHEA) countries. The key outcome of a joint program can be either double/multiple degrees or a joint degree.*
- ***Joint degree:*** *A joint degree is a single document awarded to students who have successfully completed a joint program. This degree is typically conferred by the higher education institutions that are involved in offering the joint program. Importantly, it is nationally acknowledged and recognized as the official and legitimate credential of the joint program.*
- ***Double/multiple degrees:*** *Separate degrees are awarded by higher education institutions offering the joint programme attesting the successful*

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completion of this programme (if two degrees are awarded by two institutions, this is a 'double degree').

A **Joint Programme** involves collaboration in offering a study program where students can receive individual degrees from the participating institutions. A "Joint Degree" represents a more significant step toward European unity, as it entails students earning a single degree jointly conferred by two or more higher education institutions. This involves various organizational and accreditation considerations. The confusion often arises when trying to draw parallels with the types of degrees obtained by students, such as multiple degrees, dual degrees, and joint degrees. Joint degrees indeed go beyond in recognizing learning outcomes and competencies between higher education institutions (HEIs). They promote academic excellence, graduate employability, and cultural diversity within the educational sphere. This distinction is crucial for understanding the significance of joint degrees in the European higher education landscape.

A survey was conducted on this issue between JEDI partners asking them to explain if there were any difference between these concepts for them. The conclusions may be summarised as follows:

- A **Joint Degree Program**, also known as a "Diplôme conjoint," is a single program that is jointly designed, developed, and delivered by two or more higher education institutions. In this arrangement, students typically complete a unified curriculum that meets the requirements of all the participating institutions. Upon successful completion of the program, students receive a single diploma issued jointly by the collaborating institutions. The Joint Degree is often designed to promote international collaboration and foster a deeper integration of academic content.
- **A Double or Multiple Degree Program** involves students studying at two or more higher education institutions separately and earning distinct diplomas from each institution. In this case, the institutions maintain their separate academic structures and requirements. The program is designed to allow students to benefit from the expertise and resources of different institutions while obtaining multiple qualifications. It differs from a Joint Degree as the diplomas are awarded independently by each institution, and there might be less integration of curriculum compared to a Joint Degree.

Conversely, the European Commission, following the creation of the European Higher Education Area through the Bologna Process[13], has continued its strategic efforts to promote the development of a common European space. As part of its major initiatives, it has encouraged the establishment of joint programs through

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[13] Council Recommendation of 5 April 2022 on building bridges for effective European higher education cooperation

the Erasmus Mundus actions within the Erasmus+ program[14]. The implementation of Joint Programs that enable students to gain international experiences and acquire intercultural skills enhances European culture, mobility, and the values of the European Union.

Additionally, as a new focus area, there is an effort to promote the implementation of European Joint Degrees as tools to enhance collaboration among European Higher Education Institutions (HEIs) and as a mechanism for integration within European Universities. This underscores the commitment to further harmonize and strengthen the European higher education landscape.

2.4. Program Labels and Engineering studies

Quality assurance is the most efficient accreditation method, backed by emerging globalization –that calls for higher competition standards– and that, due to the pressure exerted by citizens, it is increasingly incorporated to this method of education.

The main types of accreditations are granted by regional, national, and international accreditation agencies.

Other types of accreditations cover specific fields of study, such as business, education, law, and medical accreditation.

This deliverable is developed under the call launched by the European Commission "European policy experimentation in higher education under the Erasmus+ programme, to support the development and piloting of the implementation of European criteria for the award of a joint European degree label.", two topics that were taken into consideration:

- Topic 1. Pilot a joint European degree label.
- Topic 2. Pilot institutionalised EU cooperation instruments to explore the feasibility for a possible European legal status for alliances of higher education institutions.

Under the first topic, six projects were selected to examine, test, and facilitate the delivery of a Joint European Degree label:

- ED-AFFICHE, European Degree - Advancing, Facilitating and Fostering International Collaboration in Higher Education.
- EDLab, European Degree Label institutional laboratory.
- ETIKETA, FilmEU Degree label.
- FOCI, Future-proof Criteria for Innovative European Education.

- JEDI, Joint European Degree label in engineering - Toward a European framework for engineering education.
- SMARTT, Screening, mapping, analysing, recommending, transferring, and transforming HE international programmes.

This label is meant to be a complementary certificate to the qualifications students obtain when graduating from joint programmes in the context of transnational cooperation between several higher education institutions, such as European Universities.

The label is a step towards a joint European degree, spanning several EU Member States, and designed to encourage student mobility and cooperation. It would involve the following:

- Reflect the skills and learning outcomes acquired by students who have followed a joint programme in several institutions and in several countries, in various languages.
- Be issued on a voluntary basis as a certificate attesting learning outcomes, achieved as part of transnational cooperation among several institutions, adhering on a common set of criteria.

The other four projects selected intend to allow alliances of higher education institutions, such as the European Universities, to test new forms of cooperation, such as a possible European legal status for these alliances:

- EGAI, UNITA as a model for institutionalized university cooperation: from the European grouping of economic interest to the European grouping of academic interest.
- ESEU, A European Status for ECIU University.
- Leg-UniGR, Blueprint for a legal entity for cross-border university alliances.
- STYX EUt+, Status and structure experience.

The aim of this legal status is to give university alliances, on a voluntary basis, the latitude to act together, make common strategic decisions, experiment joint recruitment, design joint curricula or pool resources and human, technical, data, education, research, and innovation capacities.

These actions align with the existing labels provided by different international accreditation bodies that develop them for universities to benchmark their bachelor's and master's degrees' quality when compared to some prefixed standards. This process is entirely voluntary and is meant to complement the existing national solutions, not being their aim replacing them. The goal is to facilitate deeper transnational cooperation, fully respecting the principle of subsidiarity and institutional autonomy.

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Hence, we find that the goal is to expand the use of labels in Engineering studies which nowadays are given by transnational accreditation agencies to individual bachelor's and master's degrees, will be extended to Joint European Degrees by benchmarking their quality against pre-established agreed criteria.

In the following section, we will delve into specifics of some of the existing quality Engineering degree labels that are implemented in Europe.

3. European Accreditation Process in Engineering

3.1. European accreditation process for engineering, technology, and applied science degrees

The EHEA system helps to ensure that higher education systems across Europe are compatible and that students, researchers and academics in Europe can collaborate and study or work abroad more easily. The purpose of accreditation is to ensure the quality of undergraduate and university courses and degree programs. Quality courses, programs, and institutions will provide credible content and competent instructors, as well as award credits that can be transferred to other institutions. Once a school has achieved accreditation, it is required to undergo a process of reaccreditation after a predetermined period of time.

The International Network for Quality Assurance Agencies in Higher Education (INQAAHE) is a global association of quality assurance organizations, both governmental and non-governmental. It was founded in 1991 with 8 member organizations and now has over 280. It articulates its role as "to promote and advance excellence in higher education through the support of an active international community of quality assurance agencies". Its membership list can be accessed online[15].

The European Association for Quality Assurance in Higher Education (ENQA) disseminates information, experiences, and good practices in the field of quality assurance (QA) in higher education to QA agencies, public authorities, and higher education institutions in the EHEA. It operates as membership organization, comprising 51 agencies in 28 countries, and was established in 2000 following a recommendation from the Council of the European Union in 1998[16].

The European Quality Assurance Register for Higher Education (EQAR) was established by ENQA, the European Students' Union (ESI), the European University Association (EUA) and the European Association of Institutions in Higher Education (EURASHE) – the European representative bodies of quality assurance agencies, students, universities, and other higher education institutions – to increase the transparency of quality assurance in higher education across Europe. EQAR publishes and manages a register of quality assurance agencies that substantially comply with the European Standards and Guidelines for Quality Assurance (ESG) to provide the public with clear and reliable information on quality assurance agencies operating in Europe. The register is web-based and freely accessible[17].

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[15] https://www.inqaahe.org/full-members-list
[16] https://www.enqa.eu/membership-database/
[17] https://www.eqar.eu/register/agencies/

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To implement the Lisbon Recognition Convention and, in general, to develop policy and practice for the recognition of qualifications, the Council of Europe and UNESCO established the ENIC Network (European Network of National Information Centres on academic recognition and mobility). The Council of Europe and UNESCO/CEPES jointly provide the Secretariat for the ENIC Network. The ENIC Network cooperates closely with the NARIC Network of the European Union. The Network is made up of the national information centres of the countries within the European Cultural Convention or the UNESCO Europe Region. Each national information centre integrated in ENIC is a body set up by the national authorities. While the size and specific competence of each of them may vary, they will generally provide information on:

- The recognition of foreign diplomas, degrees, and other qualifications.
- Education systems in both foreign countries and the ENIC's own country.
- Opportunities for studying abroad, including information on loans and scholarships, as well as advice on practical questions related to mobility and equivalence[18].

The NARIC (National Academic Recognition Information Centre) network is an initiative of the European Commission and was created in 1984. The network aims at improving academic recognition of diplomas and periods of study in the Member States of the European Union (EU) countries, the European Economic Area (EEA) countries and Turkey. The network is part of the Community's Lifelong Learning Programme (LLP), which stimulates the mobility of students and staff between these countries' HEIs. All member countries have designated national centres, the purpose of which is to assist in promoting the mobility of students, teachers, and researchers by providing authoritative advice and information concerning the academic recognition of diplomas and periods of study undertaken in other States. The main users of this service are HEIs, students and their advisers, parents, teachers, and prospective employers. The NARICs were designated by the Ministries of Education in the respective countries, but the status and the scope of work of individual NARICs may differ. In most states, institutions of higher education are autonomous, taking their own decisions on the admission of foreign students and the exemption of parts of courses of study programmes that students may be granted based on education undertaken abroad. As a result, most NARICs do not take a decision, but offer on request information and advice on foreign education systems and qualifications[19].

The duo ENIC – NARIC comprises countries beyond Europe as it includes Australia, Canada, Israel, the United States of America, and New Zealand, In Europe it also includes the Holy See (hence, all Pontifical Universities worldwide),

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[18] https://www.enic.org.uk/
[19] https://www.qqi.ie/

The website also provides information on the higher education systems of the member countries and the accreditation agencies[20].

With this aim, each country has established some national accreditation agency – in some countries there are regional agencies as well – which are gaining greater recognition as accreditation boards in many countries. The criteria for qualifying for national accreditation may be determined in each country by the department or ministry of education, or some other entity.

Next, we undertake the task of recalling how the accreditation process in general, and for engineering, technology, and applied science degrees in particular, in four of the European countries participating in this project: Germany, Ireland and Spain. They have been chosen as their environment for Engineering and Applied Sciences degrees proves the multiplicity and points out for the convenience and need to unify the process of accrediting double join degrees under a single quality label.

3.1.1. Accreditation and certification processes in national legislation

Bulgaria

In Bulgaria, there are two official documents that applies for programmes accreditations with 12-15 months of duration to accredit a new degree and no specific barriers adopting the European Approach for Quality Assurance of Joint Programmes:

- Bulgarian National Accreditation Agency[21].
- Accreditation of Higher Education[22].

The accreditation is valid for 6 years if the score is between 9-10. 5 years if the score is between 7-9 and below 7, the validation is for 4 years.

France

France has got several independent accreditation agencies for national diplomas working with the f Higher Education minister (Ministère de l'Enseignement supérieur)). French State has the monopoly to confer national diplomas (licence, master, doctorate) and therefore makes the decision to accredit diplomas which are delivered in public higher education institutions. There is a particularity for engineering degrees which are accredited by the State for public and for private engineering schools.

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[20] https://www.enic-naric.net
[21] https://neaa.government.bg/en/
[22] https://neaa.government.bg/en/accredited-higher-education-institutions/higher-institutions

Accreditation or visa can be provided only after an evaluation by a quality assurance (QA) agency.

For accreditation, there are 2 quality assurance agencies: CTI (Engineering Degree Commission) and Hcéres (High Council for Evaluation of Research and Higher Education), which are independent agencies.

Periodic evaluation of all French higher education institutions (engineering schools and universities) is done that leads to the accreditation of the institutions to award national diplomas and engineering degrees. Quality assurance agencies in France set up certification campaign and evaluate higher education institutions and training programs every 5 years according to geographical areas. It takes 2 years to accredit a new national diploma or a new engineering degree. The maximum duration for an accreditation is: 3 years for a new engineering degree and 5 years for a renewal of an engineering degree. The duration can be limited and shorter for any application for accreditation which doesn't comply to CTI evaluation criteria. Engineering Degree Commission (CTI) is the relevant body in charge of carrying out evaluation procedures that lead to the accreditation of the institutions to award the engineering degree "titre d'ingénieur diplômé" (art. L642-2 Code de l'éducation). It is an independent body established in 1934 with a relevant role in the accreditation of private engineering institutes in France. CTI is involved as soon as there is the engineering title (protected by the law). This quality assurance agency set up an assessment not only on the program but also on the Higher education institution.

This agency also assists the government in the accreditation of public engineering schools as a key consultant. Also, it is a full ENQA member and listed in EQAR. CTI (Engineering Degree Commission) recognises the European approach.

The CTI is responsible for accreditation decisions for private institutions; it issues recommendations to the relevant ministries for public owned higher education institutions.
On request and subject to the support of the relevant authorities in the host countries, the CTI can also carry out evaluation procedures of engineering programmes delivered by a foreign country.

The most important criteria for accreditation which are evaluated by the CTI are:

- 3 semesters within the walls of the school.
- Basic teachings in social and environmental responsibility.
- Basic teachings and projects in innovation and entrepreneurship.
- Training-research-development.
- European Higher Education Area rules: ECTS system, semesters, syllabus.
- 28 weeks (about 6 and a half months) minimum in internship.

- A minimum certified level in English (B2) for all students and in French (B2) for non-francophone students.
- A compulsory semester abroad.
- A minimum number of hours in face-to-face teaching during the three years of training (1800 hours).
- Individual contractors from socio-economic structures.

High Council for Evaluation of Research and Higher Education (Hcéres) is responsible for assessing licence, master and PHD's degrees in France. It is also in charge of evaluating the higher education institutions and the research. it is a full ENQA member and listed in EQAR. It also recognises the European Approach for Quality Assurance of Joint Programmes.

The Commission d'évaluation des formations et diplômes de gestion (CEFDG), also known as the National Commission for the Evaluation of Training and Qualifications in Management is an instance attached to Higher education ministry. It oversees evaluation for visa applications for bachelor and master by private business and management schools in France.

In general, there are difference between the criteria of the French quality agencies and the criteria of European approach, so the European approach cannot be used to evaluate a Joint degree with a French degree.

There are other bodies which are not quality assurance agencies but have quality assessment missions. France competences has been created in 2019 and is attached to Labour Ministry and is responsible for assessing applications to be registered on the RNCP (Repertoire national des certifications professionnelles). During the evaluation, France compétences checks mainly the adequacy of professional certifications with economic and social needs.

The Conference des Grandes Écoles CGE was established in 1973 and it provides quality labels for several training programs, like Mastère Spécialisé) or MSc (Master of sciences), Higher education institution (engineering schools, and business schools) can obtain this label after an assessment process which allows to be accredited for one of the CGE's training program.

It aims at creating the adequate atmosphere for the best research in the education, science and learning fields.

Germany

German HEIs fall into three types: comprehensive universities, applied science universities, and arts & music colleges. Presently, Germany has around 400 HEIs, including around 120 comprehensive universities, 220 applied science universities (Fachhochschulen), and 60 arts & music colleges, and the total size of college & university students is close to 3 million. Higher engineering education

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is carried out mainly in comprehensive universities and applied science universities, which fall into two main categories: technical universities, and applied science universities. About two-thirds of engineers and 50% of corporate managers and Information Technology talents in Germany graduated from Germany's applied science universities, thus they are reputed as a qualified engineers' education site.

German universities and applied science universities have different objectives, and they cultivate engineering education talents of different types: universities give special attention to theory and fundamental research, and may confer the students a doctoral degree, while applied science universities include engineering courses as well as other technical disciplines, commerce-related, social work, and design. The former ones cultivate research-oriented engineers, and the latter ones cultivate applied engineers.

In 1948, the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in Germany (Kultusministerkonferenz or KMK) was founded by an agreement between all German states. Among its responsibilities, the KMK ensures quality development and continuity in tertiary education. Bachelor and Master programs must be accredited by KMK. In 1957, the German Council of Science and Humanities (Wissenschaftsrat) was founded, which conducts institutional accreditation of private and religious universities since 2001.

The Foundation for Accreditation of Study Programs in Germany or Accreditation Council (Akkreditierungsrat) was created by KMK in 2004 to certify accreditation agencies and establishes guidelines and criteria for system and programs accreditation. Nowadays there are ten certified agencies[23]:

- AHPGS – Accreditation Agency for Study Programs in Special Education, Care, Health Sciences and Social Work.
- AKAST – Agency for Quality Assurance and Accreditation of Canonical Study Programs.
- ACQUIN – Accreditation, Certification and Quality Assurance Institute.
- AQAS – Agency for Quality Assurance by Accreditation of Study Programs.
- AQ Austria – Agency for Quality Assurance and Accreditation Austria.
- ASIIN – Accreditation Agency for Degree Programs in Engineering, Informatics/Computer Science, the Natural Sciences and Mathematics.
- Evalag – Evaluation Agency Baden-Württemberg.
- FIBAA – Foundation for International Business Administration Accreditation.

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[23] https://www.inqaahe.org/

- OAQ – Swiss Center of Accreditation and Quality Assurance in Higher Education.
- ZEvA – Central Evaluation- and Accreditation Agency.

These agencies accredit Bachelor and Master's degrees programs of study, and quality management systems from state or state recognized HEIs in Germany and abroad. AKAST only accredit programs of study.

In Germany, universities can choose if they prefer system accreditation or program accreditation. The European approach is fully adopted in Germany however the provisions made in the Engineer and Engineering Chamber Act will have to be obeyed as well.

Hungary

Accreditation of Higher Education Institutes are conducted by the Hungarian Accreditation Committee (https://www.mab.hu/en/home-page/) and must be renewed by every 5-10 years with a two-step process: creating/founding the program and launching/offering the program.

- BSc programs are to be accredited by the Hungarian Accreditation Committee[24].
- MSc programs can be created and launched by the HEI on its own (since 2023), but if the program has no accreditation by an ENQA member organization, then the Hungarian Accreditation Committee has to accredit it within 3 years. In case of a BSc degree or an MSc degree with no ENQA accreditation, the required time is 3 months for creating/founding the program and 6-12 months to launching/offering the program. It's only the time required by the Hungarian Accreditation Committee, as obviously, the academic dedication must be considered (creating all documents by the university: 2-3 months; launching the programs: 6-12 months). The university administration procedures (on faculty and on university level) takes one extra month.

All relevant agencies approve/recognise the quality assurance policies/procedures in the same way.

Ireland

Quality and Qualifications Ireland QQI was established in 2012 as the agency responsible for the quality assurance of HEIs in Ireland, replacing predecessor agencies responsible for different sectors of higher education. It is responsible for the quality assurance of education and research within HEI, which have been subject to quality assurance since the 1990s.

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[24] https://www.mab.hu/en/home-page/

Higher engineering education is also a binary system in Ireland with universities and technical colleges. Technical colleges include Technological Universities (TU), Institutes of Technology (IT), and local institutes of technology, also being called universities of technology or polytechnic colleges. They grant National Certificates, National Diplomas, and Bachelor Degrees according to the academic achievements and the length of the programmes, and students can change their desired diplomas taking into consideration the program requirements and duration of studies involved.

Universities in Ireland enjoy a high degree of autonomy in designing courses independently and granting diplomas and certificates, there being a total of seven universities, including Trinity College Dublin, University College Dublin, and University College Cork. In addition to a unique and independent college diploma alliance—National University of Ireland (NUI) consisting of four universities (University College Dublin, University College Cork, University of Galway, Maynooth University) and five colleges (Royal College of Surgeons in Ireland, National College of Art and Design, etc.). All the member universities and colleges are authorized to grant diplomas and degrees in the name of NUI.

Latvia

License of a study programme gives the higher education institution the rights to implement a specific study programme. License is a prerequisite for announcing admission and enrolling students but not to issue state-recognised diplomas. Within two years after obtaining a licence, the study program must be included in the corresponding accreditation form in the corresponding accreditation form for a study field (study direction). Once included, the institution can issue state recognised diplomas to the study programme graduates, a process that takes about four months. Additionally, the cyclical accreditation of a study field must be performed with the aim to assess a study field and the corresponding study programmes. A positive accreditation outcome allows the institution to continue issuing state-recognized diplomas in study programs aligned with that field. The entire assessment and accreditation procedures together take approximately one year. Higher education institutions can choose any agency registered in the European Quality Assurance Register (EQAR) to perform the assessment of a study field.
 There is a plan to transition to the cyclical accreditation of higher education institutions as a whole instead of individual study fields, starting in 2025.

In the meantime, the accreditation process is valid for two or six years, depending on the accreditation outcome of the study field, with no regulations of European Approach for Quality Assurance of Joint Programmes established yet.

Spain

In Spain, the National Agency for Quality Assessment and Accreditation (Agencia Nacional de la Evaluación de la Calidad y Acreditación - ANECA) is the authorised national body responsible for the quality of the Spanish higher education system. It was created as a foundation in 2002 and there are some regional agencies that assume the accreditation (and quality levels) of university programs in their respective regions:

- ACPUA, in Aragon.
- ACSUCYL, in Castile and Leon.
- ACSUG, in Galicia.
- AQU, in Catalonia.
- AVAP, in Valencian Community.
- DEVA-AAC, in Andalusia.
- FCM Madrimasd, in Community of Madrid.
- Unibasq, in Basque Country.
- ACCUEE, in Canary Islands.

The Royal Decree 822/2021 establishes the three cycles in the Spanish university degrees, the ECTS model, and the European Standards and Guidelines for Quality Assurance of Higher Education (BOE2021-15781)[25]. It stipulates the number of years for each degree accreditation: those who have the bachelor's and associate's degrees of 240 credits must renew their accreditation within 6 years as maximum, and those of 300 or 360 credits within a maximum of 8 years, those who have the official master's degree must renew their accreditation within 4 years, and those who have the official doctoral degree must renew their accreditation within 6 years. ANECA's degree accreditation evaluation system includes four aspects: qualification accreditation (VERIFICA), credit review (ACREDITA), international quality labels (SIC) and degree monitoring (MONITOR).

The Qualification Verification (VERIFICA) applies when Spanish universities' official degree programs wish to be approved. The process is as follows: the university sends the official degree program to a centralised University Council (Consejo de Universidades CU) for accreditation, CU requests ANECA's evaluation committee to issue an evaluation report, which is sent to the university, CU, and local education authority. The CU will, after receiving the report, issue a verification resolution, for which the university may appeal. After obtaining the authorization of the regional authorities and the CU's confirmation of the official degree program, the Spanish Ministry of Education submits to the government recommendations on the establishment of the official name of the degree and

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[25] Royal Decree 822/2021, of September 28, which establishes the organization of university education and the quality assurance procedure, https://www.boe.es/buscar/doc.php?id=BOE-A-2021-15781

registration at the Registrar of Universities, Centers and Degrees (Registro de Universidades, Centros y Títulos, RUCT).

The ACREDITA is an accreditation process after the successful registration of the university's official degree program to periodically evaluate for renewal the implementation of the degree program. The specific process is as follows: universities submit degree programs to ANECA for renewal of accreditation every year with a self-assessment report and submit online. After receiving the report, ANECA organizes a panel of experts to review the report and related degree programs, conducts a visit to the university and participates in hearings, to compile the panel report. The ANECA's accreditation committee conducts the evaluation through the university's self-assessment report, panel report and other relevant information of the degree program, and issue to the university an interim assessment report. The university could make the decision to accept, propose measures to improve, or establish charges for the interim assessment report within 20 working days. Later, the accreditation committee will further analyse the degree program, and issue a final assessment report to renew the accreditation. The report is sent by the ANECA to the CU, the university and the autonomous community, and the final decision is issued by the CU on whether to renew the accreditation. The university may appeal within one month after the resolution is issued. If the appeal is successful, the CU will appoint the committee to evaluate it and deal with the claim. ANECA will be responsible for reviewing the CU report and sending the corresponding report within the maximum period of one month. Finally, after receiving the report, the CU issues a final decision.

To further enhance national recognition, ANECA cooperates with relevant institutions, to provide international quality labels (Sello Internacional de Calidad) that meets international standards for relevant degree programs. Particularly, ANECA cooperates with the Spanish Institute of Engineering (IIE) and awards the EUR-ACE engineering label. This is a certificate awarded to universities by the accrediting institution of the European Network for Accreditation of Engineering Education (ENAEE), involving the bachelor's or master's degrees in engineering evaluated with a set of established standards.

The Monitoring (MONITOR) label is established by ANECA to evaluate university degree programs that need external evaluation every year. For it, the university provides the Information Collection Form with its relevant degree programs. Then, ANECA assigns evaluators to review the consistency of relevant evaluations and sends a follow-up report of the degree program to the university and its regional authorities. Finally, ANECA publishes a monitoring report on its website.

As detailed above, Spain promoted the reform of its domestic higher education degree system from a previous "3+2+2" (3 years + 2 years + 2 years) to a general "4+1+3" (4 years + 1 years + 3 years), with some exceptions such as in Industrial

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Engineering and Aerospace/Aeronautic Engineering where the 4+3+3 is mostly applied, making it not aligned with other European countries. Nor does it the fact that there is no distinction between research and applied science universities. In Spain there are four technical universities:

- Universidad Politécnica de Madrid UPM.
- Universitat Politècnica de Catalunya UPC.
- Universitat Politiècnica de València UPV.
- Universidad Politécnica de Cartagena UPCT.

They are totally independent between themselves but the focus and accreditation systems for the applied sciences and engineering degrees on which they concentrate their education follow the same criteria as when those applied sciences and engineering degrees are delivered at any other Spanish university.

The verification process is regulated by the articles 26 and 27 of the RD 822/2021:

Article 26. Procedure for verification of curricula of official education. 2. The curricula verification procedure, which will culminate with the notification to the applicant university of the resolution of the Council of Universities on the verification of the curricula, may not last more than six months (without considering the possible claim procedure). In the case of degrees proposed by Centers with institutional accreditation, this period will not exceed four months. All public administrations will ensure compliance with such maximum deadlines, after which the application will be understood as estimated and the curricula verified.

Article 27. Official nature and registration of official university degrees in the Spanish Register of Universities, Centers and Degrees. 1. Once the curricula has been verified by the Council of Universities and after the authorization of the Autonomous Community has been issued, the official nature of the degree will be established by agreement of the Council of Ministers at the proposal of the head of the Ministry of Universities, and it will be published in the " BOE Official State Gazette", with which the university degree fully acquires its validity throughout the national territory. (There is no time limit in the regulations, normally between 6 and 8 months). In total between 12 and 14 months. This is for all the agencies in Spain.

Usually, validity of the accreditation is for 6 years. The renewal process begins in the fifth year. Legislation is included in RD822/2021 in:

Section 4: Renewal of accreditation

Article 34. Procedure for renewal of the accreditation of degrees taught in university canters that are not institutionally accredited. Universities that are not institutionally accredited must renew the accreditation of their official university degrees in accordance with the procedure that each Autonomous Community establishes in relation to the universities in its field of competence, which will be resolved by the Council of Universities based on the mandatory and binding report of the corresponding quality agency, within the following periods:
a)   The accreditation of official university undergraduate degrees that have 240 credits must have been renewed within a maximum period of six years, from the starting date of teaching the degree or renewal of the previous accreditation.
b)   The accreditation of official university undergraduate degrees that have 300 or 360 credits must have been renewed within a maximum period of eight years, from the starting date of teaching the degree or the renewal of the previous accreditation.
c)   The accreditation of official university master's degrees must have been renewed within a maximum period of six years, from the starting date of teaching the degree or the renewal of the previous accreditation. d)   The accreditation of the official university doctoral degrees must have been renewed within a maximum period of six years, from the starting date of the doctoral program or the renewal of the previous accreditation.

The European Approach is fully recognized in Spain.

Sweden

Sweden does not have a system of accreditation of institutions nor degree programmes. Instead, UKÄ (Swedish Higher Education Authority) has a system with audits of each university's quality management system in conjunction with appraisal of applications for degree-awarding powers. UKÄ decides which higher education institutions are to be entitled to award a specific degree. The requirements for specific degrees are listed in an annex 2 "System of Qualifications" to the Higher Education Ordinance of Sweden[26][27].

It takes 10,5 months to accredit or certificate a new Degree and the period of validity is indefinite. Sweden has not adopted the European Approach.

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[26]https://www.uka.se/swedish-higher-education-authority/for-higher-education-institutions/appraisal-of-applications-for-degree-awarding-powers
[27] https://www.uhr.se/en/start/laws-and-regulations/Laws-and-regulations/The-Higher-Education-Ordinance/

Romania

The changes that have taken place in the Romanian higher education, as well as all over Europe and in other parts of the world, have been equally numerous, radical, and continuous. At the beginning of the 90s, the first private HEIs were established in Romania, and the number of the public HEIs and of new study programs/specializations has grown rapidly. As a result of these developments, the National Council for Academic Evaluation and Accreditation (NCAEA) was created. Between 1993 and 2006, NCAEA conducted activities of evaluation, accreditation of institutions and of study programs. The national higher education system has further undergone other significant transformations; following the signing of the Bologna Declaration, in 1999, by European education ministers, Romania became a member of the Bologna Process, aimed to create the European Higher Education Area by 2010, through a series of changes and transformations. These changes continue to take place following the decisions taken in the ministerial conferences that take place periodically until 2020. One of the central goals of the Bologna Process is academic quality assurance. The achievement of this goal depends on the correspondences established between the senses of academic quality and the transformations that take place in the field of higher education. Thus, quality assurance in education is an obligation that is applicable to all higher education institutions in Romania.

Romanian Agency for Quality Assurance in Higher Education (ARACIS) is a body with legal prerogatives to issue and to propose to the Ministry of National Education advises and recommendations based on its own evaluations, which concretize the knowledge/experience in the field, and therefore the ARACIS Guide and its annexes are recognized in Romania as specific norms and regulations in the field of quality assurance in higher education. The ARACIS Methodology and Guide provide the compliance with the ESG – European Standards and Guidelines for Quality Assurance in Higher Education, hereinafter named ESG, approved in 2015 in the Yerevan conference by ministers in charge with higher education of the European Higher Education Area, that explicitly define the activities, policies, and processes of quality assurance.

The main objective of ARACIS activities is to assure and improve quality. The accreditation is the process of assuring and improving academic quality, that takes place in two stages, through which an education provider is first provisionally authorized to operate as a higher education institution, with the right to conduct the educational process and to organize admission sessions, and then accredited and recognized as a part of the national higher education system, with the right to issue diplomas, certificates and other documents recognized at national level, and to organize graduation, Licence (1st Cycle), Master (2nd Cycle) and Doctoral (3rd Cycle) examinations.

After the accreditation process, the HEI enters the periodic external evaluation process. Accreditation is applicable to study programs and study fields (domains)

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as well, as per the law. The standards, standards of reference and performance indicators are the same for both quality assurance in already accredited institutions and for accrediting newly established institutions. The difference is determined by their level of achievement. With a view to authorization, accreditation and periodic evaluation, the minimum level of achievement of performance indicators is considered. In quality assurance, the standards of reference may be set at optimal institutional levels, above the minimum required level.

The external evaluation with a view to accreditation performed by ARACIS is aimed at:

- Assuring the academic community, the beneficiaries, and the public at large that the accredited institution satisfies the minimum quality standards of the higher education system.
- Promoting the commitment of the institution to the continuous development of academic quality, proven by learning and research outcomes.
- Promoting institutional standards for quality management and quality culture and demonstrating their status through relevant evidence and documents.
- Supporting and encouraging the institution to evaluate itself and to cooperate in its external evaluation to assure and develop quality.
- Working together with other higher education institutions, as well as with the National Qualifications Authority (NQA) for achieving, monitoring, and comparing academic quality.
- Not accepting study programs of education providers which do not meet the minimum standards of academic quality.

According to the legislation in force, an education providing organization undergoes the evaluation procedure, for the external evaluation of quality or, as the case may be, for obtaining the provisional authorization to operate or the accreditation of the study programs and/or its own accreditation as an education providing organization.

As per the provisions of the GEO no. 75/2005 on Quality Assurance in Education, approved as amended through Law no. 87/2006 as amended, only higher education institutions that are authorized to operate provisionally or are accredited under art. 29, para. (4) letter. a) and b) and art. 35, para. (1) can use the name of university or other similar names; the accreditation of higher education institutions is conducted according to the law, approved by the Government, upon the initiative of the Ministry of National Education, based on the ARACIS advise as per art. 31, letter. g).

Study program: a study program/specialization consists of all the activities of design, organization, management, and the process of teaching, learning and

research carried out in a certain field, which lead to the obtaining of an academic qualification.

Study programs are differentiated by:

- Level of university diploma: licence (1 st Cycle), master's (2nd Cycle), doctorate (3rd Cycle).
- Form of education: full-time, part-time, distance learning.
- Field of specialization of knowledge, as per the academic division of Learning and with the professional division of labour.
- Duration of studies, respectively the number of the ECTS transferable credits.
- Language of teaching.

Study programs are concretized in:

- Curriculum, which includes all disciplines that lead to an academic qualification, distributed by year of study, their weight being expressed European Credit Transfer System (ECTS) study credits.
- Discipline/course program or syllabus outlining: the teaching and learning themes and practices associated with teaching, learning and evaluation, as well as the recommended bibliography.
- The organization of students and teaching staff for the study program implementation period.
- The system of academic quality assurance for all activities required for carrying out the study program.

Provisional authorization to operate for study programs and/or institutions is the first stage of the accreditation procedure; it is the result of an external evaluation conducted by ARACIS, based on a self-evaluation report submitted by the applicant. The provisional authorization to operate is the document which confers the higher education institution or the education providing organization the right to carry out educational activities and organize, if necessary, admission examinations for a study program. The provisional authorization to operate for a study program is granted based on the advice of ARACIS or of another agency registered in EQAR and of the Ministry of National Education, through a Government Decision initiated by the Ministry of National Education, within maximum 90 calendar days from its submission. The provisional authorization to operate can be granted to a higher education provider, by Government Decision, at least six months before the beginning of a new academic year, if the education providing organization has initiated at least three study programs that have been submitted and received advise for provisional authorization to operate from ARACIS or from another agency registered in the EQAR and from the Ministry of National Education, except for higher education institutions that only provide

theological higher education, which may receive provisional authorization to operate if they have initiated at least one study program that has been submitted and received advise for provisional authorization to operate from ARACIS and from the Ministry of National Education.

Accreditation is the quality assurance modality that certifies the observance of standards by education providing organizations and by study programs. The accreditation is proposed and granted, based on the results of an external evaluation process carried out by ARACIS or by another agency registered in the EQAR, in recognition of the academic quality of an education providing organization/structure already provisionally authorized to operate and complies with the minimum standard requirements and performance indicators concerning the quality of education. The accreditation of a study program is granted by Government Decision initiated by the Ministry of National Education, based on ARACIS advise, within 90 calendar days from its submission. The accreditation at institutional level for an education providing organization is awarded by a Law promoted by the Government, upon the initiative of the Ministry of National Education, based on the ARACIS advise, in compliance with the legislation. Accredited higher education institutions are integrated into the national higher education system and have the right to issue diplomas, certificates and other study documents recognized by the Ministry of National Education, and to organize graduation examinations for the completion of the Licence, master's and/or Doctorate study programs.

Turkey

According to Turkish Higher Education Quality Council (THEQC), programme accreditation is the processes of evaluation and external quality assurance in which the accreditation agency assesses whether the higher education institution fulfils a set of predetermined academic or disciplinary standards in a specific field[28].

THEQC is responsible for institutional external evaluation of higher education institutions in Türkiye; programme accreditation is conducted through recognition and authorization of national and international accrediting agencies by THEQC.

Specifically with regard to engineering degrees, currently, there is one national agency with active registration, Association for Evaluation and Accreditation of Engineering Programs-MÜDEK, which is a full member of ENAEE (European Network for Accreditation of Engineering Education) and is authorised to award EUR-ACE label and also a member of Washington Accord (WA), and one internationally recognised accrediting agency, which is Accreditation Board for Engineering and Technology (ABET). There are also internationally recognised

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[28] https://yokak.gov.tr/akreditasyon-kuruluslari/akreditasyon-kuruluslari-nedir

accreditation agencies recognised by THEQC, namely Agency for Quality Assurance through Accreditation of Study Programmes (AQAS), The Accreditation, Certification, and Quality Assurance Institute (ACQUIN) and Accreditation Agency for Study Programmes in Engineering, Informatics, Natural Sciences and Mathematics (ASIIN), which are not directly related with accreditation of engineering programmes in Türkiye but in general accreditation of programmes in higher education institutions[29].

The accreditation process is 12 months (MÜDEK, ABET) and 12 to 18 months (AQAS).

For MÜDEK, the accreditation is valid for 5 years (no deficiencies) or 2 years (if weaknesses identified). In the case of ABET, it is 6 years (no deficiencies) or 2 years (one or more weaknesses), and for AQAS it is 6 years (for programmes that already produced graduates) and 4 years (for all other cases).

According to THEQC, European Approach is not available to higher education institutions in Türkiye. In addition, the qualifications received from foreign higher education institutions are recognized in accordance with related articles in the Regulations on Recognition and Equivalence of Foreign Higher Education, which was created based on The Lisbon Recognition Convention Qualifications and Article 7/p of Higher Education Law No. 2547[30].

3.1.2. Engineering and regulated professions degrees in national legislation

Bulgaria

According to the Bulgarian Law on Higher Education, the issuing of double diplomas and joint degree is within the academic autonomy of the universities. The double or joint degree diploma can be issued based on an agreement with a foreign university.

France

Both Joint Degree and Double Degree is permitted, and the norms and law provide the national operating framework.

According to the norms and laws, there are difference between a Joint Degree and a double/multiple degree:

For Joint degree and multiple degree in international partnership, there are common rules:

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[29] https://yokak.gov.tr/akreditasyon-kuruluslari/uluslararasi-taninan-akreditasyon-kuruluslari
[30] https://denklik.yok.gov.tr/en/Pages/accreditation-recognition-equivalency.aspx

- Obligation to be accredited by national ministry, signing of a partnership agreement between higher education institutions with specified éléments (Cf. Code de l'éducation, Art. D 613-17 et suivants sur les diplômes en partenariat international).

And there are differences between international joint degree and multiple degree:

- For joint degrees, the diploma is recognised in France if it is also recognised by the partner countries (mutual recognition of the joint degree). It means that all the states authorities must recognise the diploma in their own country whereas for multiple degrees each diploma must be recognised by the country in which it is delivered.
- For joint degree, a single degree is awarded by the all the higher education institutions which deliver the joint program, and for multiple degrees, several degrees are awarded, by each higher education institution offering the joint program.
- For joint degrees, according to the law, the assesment and certification process for an engineering degree is managed by the Engineering degree commission – CTI. An engineering joint degree must be evaluated by the CTI before its accreditation.
- The parchment is also different between joint degrees and multiple degrees. For joint degree, there is only one common parchment, and for multiple degrees, each higher education institution makes its parchment (cf. Circulaire du 7 mai 2023 sur les modalités d'élaboration des diplômes nationaux).

Germany

For Joint Degrees, the European Approach is permissible.

According to Section 10, Paragraph 1 of the MRVO[31]:, joint-degree programs are programs that lead to joint degrees. In addition, they must have the other characteristics listed in Section 10 (1) of the Ordinance:

- Integrated curriculum.
- Study shares at one or more foreign universities of usually at least 25 percent.
- Contractually regulated cooperation.
- Coordinated admission and examination procedures.
- Joint quality assurance.

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[31] https://www.akkreditierungsrat.de/sites/default/files/downloads/2019/Musterrechtsverordnung.pdf

Hungary

There is no long-term experience in joint degrees. There are/were multiple double degree programs and Erasmus Mundus programs in Hungary, mostly applying/offering existing courses/subjects in the programs.

However, BME is preparing a "real" joint degree program (https://www.digitwin4ciue.eu/) with completely new courses, created and offered together with partner institutes.

Ireland

In Ireland, Technological Universities, Institutes of Technology, and other education institutions authorized by QQI are entitled to get National Certificates from the National Certificates for Educational Awards NCEA. To get a National Certificate, a student must take two-year-duration courses or get one-year continuing education to obtain National Diploma or study another two years to get Bachelor of Engineering.

In 2018, driven by The Technological Universities Act 2018, Ireland's first technological university was established—Technological University Dublin (TU Dublin), combined by the original Dublin Institute of Technology, Institute of Technology, Tallaght, and Institute of Technology, Blanchardstown. These technological universities facilitated the higher engineering education, making it stand out from traditional university education, with priority to elevating the presence of engineering education in the industry.

Ireland also pays special attention to further education and training (FET), and generally, al HEI offer short-term FFT courses embedded in their curriculum. To make FET flexible, NCEA established Accumulation of Credits and Certification of Subject (ACCS), so that students could add up their credits earned from different colleges and schools, to obtain corresponding certificates or degrees.

Engineering education in Ireland trains different-level engineering practitioners with varied directions including middle-level engineering technicians and high-level engineers.

Engineer certificates are uniformly issued by Engineers Ireland (formerly known as Institution of Engineers of Ireland: Corporate Membership of Engineers Ireland, and Chartered Engineer (CENG). It is not easy to get this CENG title, for a candidate must be over 25 years old, and meet the academic requirements of engineering degrees or corresponding certificates. and after four years of work experience, the candidates must submit a report, and pass an interview to finally get the CENG title. Such a screening mechanism sets up another benchmark to guarantee the quality of talent cultivation for Irish engineering education.

JEDI _UPV_WP2_D2.1_Why a European label for technical, engineering and science-oriented degrees? Version: 2.1

JEDI
JOINT EUROPEAN DEGREE LABEL IN ENGINEERING

Latvia

Both Joint Degree and Double Degree is permitted in this context. There are no significant differences in their requirements and conditions, except the diploma format and language. As part of the licencing and accreditation process, institution must demonstrate that the study program aligns with the qualification to be obtained upon program completion, adhering to the professional standards or professional qualification requirements.

Romania

Double Degree is permitted and there are several universities offering them. During the accreditation process, the compliance with the national qualification to be acquired upon completion of the study programme with the professional standard or the requirements for professional qualification must be demonstrated. New education law published in September 2023 introduces joint degree and double degree as formal terms, but there are no norms to apply the new degrees.

Spain

The curriculum system of Engineering Education is regulated nationwide, and the universities are given some freedom when they submit their degrees for accreditation. Each engineering discipline requirements are fixed by a corresponding decree. Therefore, the engineering education shows an obvious government-led tendency, and universities' training programs are kind of a refinement of the government decrees.

The decrees regulating the bachelor's and master's degrees in engineering education are published in the State Official Journal (Boletín Oficial del Estado BOE) and are, respectively:

BOE 2007-22447   Building Technical Engineer
BOE 2009-2735   Mining Technical Engineer
BOE 2009-2736   Civil Public Technical Engineer
BOE 2009-2737   Aeronautical Technical Engineer
BOE 2009-2738   Roads, Canals, and Ports Engineer
BOE 2009-2739   Mining Engineer
BOE 2009-2740   Industrial Engineer
BOE 2009-2741   Aeronautical Engineer
BOE 2009-2803   Agricultural Technical Engineer
BOE 2009-2804   Forestry Technical Engineer
BOE 2009-2805   Agricultural Engineer
BOE 2009-2806   Forestry Engineer
BOE 2009-2892   Naval Technical Engineer
BOE 2009-2893   Industrial Technical Engineer
BOE 2009-2894   Telecommunication Technical Engineer
BOE 2009-2895   Topography Technical Engineer

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JEDI

BOE 2009-2896   Naval and Marine Engineer
BOE 2009-2897   Telecommunication Engineer
BOE 2010-12269   Architect

The Spanish Regulations are not clear about the difference between a Joint Degree and double/multiple degrees, but it seems that, implicitly, a Joint Degree is a single degree imparted by two or more universities. The Sixth Additional Provision of Royal Decree 822/2021 regulates the accreditation of international joint degrees, but it doesn't specify if it can lead to multiple degrees or just one. It is the same with the Seventh additional provision of Royal Decree 822/2021 (about International Joint Degrees in European Universities Project of European Commission), that only says that a joint degree is a single academic programme in which participate three or more universities of the European Alliance. But again, there is no indication about the number of awarded diplomas, so we can assume that it is only one.

The impartation of a double degree by a Spanish university is regulated in RD 822/2021, article 24, which establish the requirements for an academic programme which awards of two different degrees. In this article it is said that it is not possible the organization of an academic programme which awards more than 2 degrees, but it seems that this article only apply to the accreditation of national degrees because we have consulted this aspect with the Ministry of Universities and the answer is that there is no limit in the awarding of multiple degrees in collaboration with foreign universities via the European Approach for Quality Assurance of Joint Programmes.

Both Joint and double/multiple degrees are imparted by two or more universities, but a Joint Degree implies that there is an academic programme that is jointly designed and imparted by all the participant universities and leads to the awarding of a single diploma by all the universities. In the case of double/multiple degrees, most of the times each university has an academic programme that leads to the awarding of a single degree by that university. But via an agreement between the universities, a student can spend one or more semesters in each university and the all the universities recognise the studies in the other universities. So, at the end of the academic programme the student is awarded with the diplomas of all the participant universities, which can be two or more.

The principal benefits of a Joint degree are that it is considered more prestigious because it is imparted jointly by several universities and the degree is recognised by all the countries of the participant universities. As it is designed by all the universities from the beginning, the academic programme can be more coherent that in the case of double/multiple degrees. The principal disadvantages are the accreditation process of a joint degree is something new and unknown for the universities and the accreditation agency, it is necessary a good coordination of

all the universities in the design and impartation phases and it is necessary one or more mobilities periods of the student, which suppose an extra monetary cost that can dissuade the students of joining it.

The principal pros of a double/multiple degrees are that the student is provided with several degrees, which can provide more benefits in working selection processes, and it is easier to implement for the universities because they have to carry out a national accreditation process and can combine students that only want the national degree, without any mobility, with students who want to carry out the mobilities and obtain several degrees. The principal cons are the less coordination between the universities and the whole academic programme is less coherent.

There are no specific requirements and specific agencies responsible for assessing Engineering Degrees.

Sweden
Only joint degrees are regulated in Sweden (Higher Education Act, chapter 1 § 17)[32]. There are no specific requirements and specific agencies responsible for assessing Engineering Degrees and there are no regulated professions in Engineering.

Turkey
According to Article 4 of Regulation on Joint Education and Training Programs between Turkish Higher Education Institutions and Higher Education Institutions Abroad: "A joint diploma is defined as an interconnected single degree diploma". A dual diploma is defined as interconnected multiple degree diplomas; and a double diploma is defined as unconnected multiple degree diplomas.

Joint, dual, and double diplomas are issued jointly by two or more higher education institutions in the name of the student upon the completion of study. Also, a joint degree programme is an education and training programme jointly established or conducted within the scope of the current programmes between a higher education institution in Türkiye and one or more higher education institutions abroad that are recognized by the Council of Higher Education[33] .

The qualifications received from foreign higher education institutions are recognised in accordance with related articles in the Regulations on Recognition and Equivalence of Foreign Higher Education, which was created based on The

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[32] https://www.uhr.se/en/start/laws-and-regulations/Laws-and-regulations/The-Swedish-Higher-Education-Act/

[33]https://www.yok.gov.tr/Documents/Kurumsal/egitim_ogretim_dairesi/Uluslararasi-Ortak-Egitim-Ogretim-Programlari/Yurtdisi_Yuksekogretim_Kurumlariyla_Ortak_Egitim_Ogretim_Programlarina_Dair_Yonetmelik_EN_2822202022.pdf

Lisbon Recognition Convention Qualifications and Article 7/p of Higher Education Law No. 2547[34].

According to the Guide of Determination of Scientific Identity and Structured Clinical Examination, which was created in accordance with Regulations on Recognition and Equivalence of Foreign Higher Education, determination of scientific identity for engineering graduates is done through an Oral Placement Exam made by the commissions established by authorised universities within the scope of the Placement Exam decision taken during the equivalence process, and the written Placement Exam, which includes the written and practical application stages when necessary. Only those who apply to the Council of Higher Education for recognition and equivalence of their qualifications from a foreign institution and found eligible for Placement Exam can apply for these exams. Certain universities are authorised in certain fields by the Council of Higher Education in Türkiye to administer Determination of Scientific Identity and Structured Clinical Examinations. For example, there are currently five Turkish universities authorised to conduct these exams in the field of engineering specifically. There are, for example, eight other Turkish universities authorised to conduct structured clinical examinations[35].

3.2. Engineering related Quality labels in Europe

Ensuring that mandatory global standards are met in specific fields is the focus of international accreditation agencies. Commercial accreditation and medical accreditation are two fields with numerous international accreditation boards or agencies addressing the wide range of specialties. International agencies also oversee distance education and online education programs.

Accrediting agencies intend to check and certify that students receive a thorough education that prepares them to enter professions in their corresponding fields.

When the accreditation process is run and shows evidence of the quality of the programmes assessed, then a quality label or Quality Seal is issued.

There are two main types of Engineering Quality labels in Europe: EUR-ACE and EURO-INF, the former being applied to several engineering fields while the latter correspond to a specialised field. Next, we will review their main characteristics:

EUR-ACE
The European Network for Accreditation of Engineering Education (ENAEE) was established in 2006 as an organization to promote quality in engineering

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[34] https://denklik.yok.gov.tr/en/Pages/accreditation-recognition-equivalency.aspx
[35] https://denklik.yok.gov.tr/DuyuruBelgeleri/2021/2022-ilmi-huviyet-tespiti-kilavuzu.pdf

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education across Europe and beyond. It is rooted in the Bologna process which aims to build the European Higher Education Area.

ENAEE was founded on 8 February 2006, at the end of the first EUR-ACE® project, by 14 European Associations concerned with engineering education.

It stemmed from ESOEPE, the "European Standing Observatory for the Engineering Profession and Education", that had been established on 9 September 2000 aimed at building confidence in systems of accreditation of engineering degree programmes within Europe, facilitating exchange of information, developing voluntary agreements on accreditation of engineering educational programmes and recognition of engineering qualifications, and the development of standards for competency requirements of graduate engineers.

Members of ENAEE are agencies and professional organisations with an interest in the education and formation of engineering professionals. Furthermore, it expands beyond Europe, as its actual members encompass:

- AAEPO – Agency for accreditation of educational programs and organizations, Kyrgyz Republic.
- AAQ – Swiss Agency of Accreditation and Quality Assurance.
- Acredita CI – Agencia Acreditadora Colegio de Ingenieros de Chile.
- AEER – Association for Engineering Education of Russia.
- ANECA – National Agency for Quality Assessment and Accreditation of Spain.
- ARACIS – The Romanian Agency for Quality Assurance in Higher Education.
- ASIIN – Fachakkreditierungsagentur für Studiengänge der Ingenieurwissenschaften, der Informatik, der Naturwissenschaften und der Mathematik e.V. – Germany.
- CTI – Commission des Titres d'Ingénieur – France.
- EC – Engineering Council – United Kingdom.
- EI – Engineers Ireland.
- FINEEC – Kansallinen Koulutuksen Arviointikeskus Karvi – Finland.
- ICACIT – Instituto de Calidad y Acreditación de Programas de Computación, Ingeniería y Tecnología en ingeniería - Perú.
- IIE – Instituto de la Ingeniería de España.
- JEA – Jordan Engineers Association.
- KAUT – Accreditation Commission of Universities of Technology – Poland
- KazSEE – Kazakhstan Society for Engineering Education.
- Müdek – Association for Evaluation and Accreditation of Engineering.
- Programs – Turkey.
- OE – Ordem dos Engenheiros – Portugal.

- Quacing – Agenzia per la Certificazione di Qualità e l'Accreditamento EUR-ACE dei Corsi di Studio in Ingegneria- Italy.
- ZİDEK – Association for Evaluation and Accreditation of Agricultural Engineering Educational Programs, Turkey.
- ZSVTS – Association of Slovak Scientific and Technological Societies.

ENAEE influence is also expanding through Associate Members:

- CIAEP – Center for Independent Accreditation of Engineering Programs, Ukraine.
- CoPI – Conferenza per l'Ingegneria, Italy.
- ENGINEERS EUROPE, Belgium.
- ENTER – Educators Professional Development, Portugal.
- FIGURE – A Network of French Universities for Engineering, France.
- IGIP – International Society for Engineering Education, Austria.
- LACCEI – Latin American and Caribbean Consortium of Engineering Institutions, United States.
- SEFI – Société Européenne pour la Formation d'Ingénieurs, Belgium.
- TEK – Academic Engineers and Architects in Finland, Finland.

EURO-INF

The Euro-Inf Quality Label is awarded to degree programmes at Bachelor's and master's level that comply with the Euro-Inf Framework Standards and Accreditation Criteria, an outcome elaborated by the European Quality Assurance Network for Informatics Education EQANIE[36].

The Euro-Inf Quality Label was created with the goal of promoting the implementation of quality assessment practice for informatics education systems in Europe and its objectives were[37]:

- To enhance quality and transparency of educational programmes in informatics.
- To provide information on study programmes across Europe through an appropriate label for accredited educational programmes in informatics.
- To facilitate mutual transnational recognition of qualifications.
- To increase mobility of students

The quality of informatics degree programmes derives from a functioning qualification process, the interaction of its elements and the level of achievement of objectives. Accreditation with EQANIE involves reviewing the logics and efficacy of a qualification process within a degree programme in the field of informatics, and the key element of the Euro-Inf framework are its learning

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[36] https://eqanie.eu
[37] https://eqanie.eu/quality-label/

outcomes statements at Bachelor's and Master's level, which were developed, tested, and refined in several rounds in the context of the Euro-Inf Project 2006-2008, and The Euro-Inf Spread Project, (https://eqanie.eu/projects/the-euro-inf-spread-project-2009-2011/).

The label successfully intends to reflect the expectations of the European labour market and required entrance qualifications for entering higher levels of studies in the field of informatics. Therefore, the label is widely recognised and facilitates both academic and professional mobility. Benefiting institutions, graduates, and employers.

3.3. European Approach for Quality Assurance of Joint Programmes

According to the European Approach for Quality Assurance approved by EGEA ministers in May 2015 "Joint programmes" are understood as an integrated curriculum coordinated and offered jointly by different higher education institutions from EHEA countries and leading to double/multiple degrees or a joint degree.

This approach should be applied depending on the needs of the cooperating higher education institutions and the requirements of their national frameworks, following some standards on:

- Eligibility: status, joint design and delivery, and cooperation agreement.
- Learning outcomes: level, disciplinary field, achievement, regulated professions.
- Study programme: curriculum, credits, Workload.
- Admission and recognition: admission, recognition.
- Learning, Teaching and Assessment: Learning and teaching, Assessment of students.
- Student Support.
- Resources: Staff, facilities.
- Transparency and documentation.
- Quality Assurance.

The procedure for the External Quality Assurance should jointly select a suitable EQAR-registered quality assurance agency that brings:

- Self-Evaluation Report.
- Review panel.
- Site visit.
- Review report.
- Formal outcomes and decisions.
- Appeals.
- Reporting.

- Follow-up.
- Periodicity.

4. Barriers, Challenges and Added Value of Joint Degrees in Engineering

4.1. Barriers and challenges

Quality accreditation within the Bologna Process pursues effective quality assurance and enhancement of activities developed to assure it. During this process, HEIs have increased their awareness on quality assurance while they increased their international mobility, created double, multiple or joint degrees, and in some case even developed Erasmus Mundus Joint Masters.

However, each of these shared degrees between different HEIs need to duplicate their efforts in what concerns accreditation following the rules at each of the HEIs involved.

This is the first barrier that a Joint Degree in Engineering must face. The existence of national quality assurance agencies, stakeholders and public authorities with domestic jurisdiction makes necessary to go through each of them to fulfil the corresponding accreditation processes so that the degree is fully recognized and may be considered valid in its announced terms.

Dealing with different type of universities, of applied sciences or research universities, public or private is a barrier as their general focus and fees criteria are different and institutions involved must work on these issues and agree on them almost before starting the whole process.

When there are significant differences in the way in which the signatories of the Bologna Process are carrying out the agreements, it presents a notable challenge that might be mitigated if a higher harmonization within the Bologna Process happened to be in place. This situation arises, for instance when there is a difference in the minimum length of studies in the institutions involved awarding a Short First Cycle, or a First Cycle degree within EHEA, for instance with France's diplomas of 2 years (according to CTI - commission des titres d'ingénieur), or Spain's bachelor's degrees of 4 years.

In case of civil engineering in Hungary, there are strict requirements for certificates that are issued by the Hungarian Chamber of Engineers. There is a given list of topics/competences with given number of ECTS that are needed to obtain a certificate. These must be considered in case of a Joint Degree, too.

The selection process of Joint Degree in Engineering students is a challenge however, it is not an insurmountable obstacle; in practice, experience suggests that it is a relatively minor challenge.

The following, which is not exhaustive, list sums up the main obstacles and challenges identified:

- Non-homogeneous harmonization in the curricula design (different minimum or maximum ECTS credits per course or related to compulsory courses).
- Consideration of cultural factors impacting joint degree accreditation.
- Consideration of legal and regulatory factors to fulfil different quality accreditation and assurance processes.
- Consideration of the specific regulatory in Joint Degrees in Engineering regulated professions are involved.
- Forcing programmes to go through a new accreditation procedure every time the consortium partners for the Joint Degree in Engineering change (relevant in case not all partners are able to join in from the start, due to restrictive national legislation).
- The selection of student's criteria.
- Tuition fees agreement.
- The use of foreign languages in a degree programme.
- The possibility to create an interdisciplinary degree.
- The obligation of double or multiple enrolment of students in some HEIs upon arrival at the university.

4.2. Benefits and European added value

Neither the existence of the EHEA nor the agreement on recognitions criteria of equivalence of standards have been sufficient as enablers for Joint Degrees in Engineering.

Most of the barriers and challenges described above may become a benefit and added value for the students involved in following a Joint Degree in Engineering, for instance when the use of foreign languages is involved in a degree. This barrier or challenge will become a benefit and added value once overrun.

Joint Degrees in Engineering will bring benefits and added value by increasing transparency and student protection by facilitating academic and professional mobility.

The existence of Joint Degrees in Engineering will enhance the internationalization of the participating institutions by facilitating and encouraging them to:

- Rethink current teaching structures.
- Rethink learning methods and assessment of competencies achieved by students.
- Update their faculty with other methodologies in place in other HEIs involved in the Joint Degree in Engineering.
- Benefit from networking opportunities and educational resources and offerings of partners as well as expertise of academic staff employed in

partner universities to rise to new collaborative research and development projects.
- Higher internationalization opportunities for students.
- To contribute to the ranking of the university in various international charts.
- Attracting more students and a more diverse student body.
- Being able to offer programmes which we could not offer by ourselves.
- Improving international connections that can be potentially extended to e.g., joint R&D activities. Offer specializations to our students in different fields where we don't have expertise.
- Wide participation through socially and geographically inclusive admission through tailored measures.
- Empowering engineering systems, processes, and products throughout international learning.
- European vision of regulated professions.
- Recognition of the degree at European level.

The **teaching staff** involved in a Joint Degree in Engineering will benefit from:

- Rethinking the learning methods and assessment of competencies achieved by students.
- Updating with other methodologies in place in the HEIs participating in the Joint Degree in Engineering.
- Facilized mobility to partner institutions to get external on-site experiences.
- Collaborative research and development projects with international partners.
- English skills, experience in international setting and recognition. Cooperation with the foreign colleagues helps to broaden the professional network and fosters sharing of experience.
- Opportunities and influences to expand their expertise.
- Collaboration in engineering education research.
- Recognition of the degree at European level.
- Consider the European values in the design of the courses.
- Enrich the courses with the participation of diverse students.

Added value and benefits from Joint Degrees in Engineering will primarily accrue to the **Graduates, Society, the Industry,** and the service industry through:

- An increasing transparency of competencies and skills achieved by graduates.
- Facilitating the academic and training mobility with a clear impact on the graduates' employability.
- A wider spectrum and open-mindedness to deal with new and diverse surrounding conditions.

- Broader skills and competences, a global mindset, and cross-cultural competences
- Better preparation to deal with interdisciplinary environments.
- Homogeneous feeling of becoming a European Engineer.
- Creation of a more solid and quality programme equipping the graduates
- Upgrade the students' language and intercultural skills.
- Offer internship opportunities in partner institutions to students enrolled in joint degree programmes.

4.3. How a label can contribute to the success of Joint Degrees in Engineering

Europe faces a jungle of procedures that is not easy to match.

A Joint European Degree Label in Engineering JEDI will contribute to the success of Joint Degree in Engineering by decreasing the barriers and challenges and making them become advantages.

Moreover, the barriers and challenges will become an added value when overrun by providing a simpler higher transparency and student protection from which the HEIs themselves, the society and the industry will benefit.

JEDI relies on the definition of "Accreditation" given by the EUR-ACE Framework Standards (about which more later): "Accreditation of an engineering programme is the result of a process used to ensure the suitability of that programme as the entry route to the engineering profession", obtained by "peer review of written and oral information by trained and independent panels including academics and professionals". It is understood that this must consider certain specificities of each (large) sector of engineering for which the programme under examination is implemented.

Accreditation of Joint Degrees in Engineering will ensure transparency and hence build TRUST, favouring mobility of students and engineers.

 Organically, JEDI will contribute to harmonise the idea of being accredited as a European Engineer, respecting the rich cultural diversity of European HE Institutions and European University Alliances.

JEDI will contribute to the success of Joint Degrees in Engineering by its strong and favourable influence on:

- International and local market development.
- Academic and professional recognition facilitating mobility.
- Creation and reinforcement of the European spirit.

5. Conclusions and future steps

In summary, JEDI encapsulates several barriers and challenges, as outlined in this deliverable, primarily related to the design and accreditation of Joint Degrees in Engineering. Nevertheless, the benefits and added values suggest that the efforts invested in their examination and implementation will yield worthwhile returns.

Several questions should be considered in the subsequent steps such as the criteria applicable to degrees for regulated professions and what are the specificities of this kind of discipline in the joint programme design, accreditation, and implementation, and *if there are any implications for the professions involved.

JEDI should guarantee the level of the countries involved' programmes, but it also should serve the purpose of introducing a more robust system of quality assurance.

JEDI is based on the consortia formed by 16 universities integrated in various university alliances focused on engineering, and thus also consider the technological readiness level in each Joint Degree in Engineering.

JEDI will consider its own desk research, consultations with agencies, universities, and stakeholders for validation of separate criteria and the demonstration of a prototype in both existing and emerging joint degrees to:

- Comprehensively review the European accreditation process, specifically Engineering, technology and applied science degrees.
- Gather information on the accreditation procedures followed at the national level in European countries and identify the criteria, standards, and quality labels used for accrediting degrees in Engineering.

This deliverable research should be expanded to review joint existing programmes, their type, their owners, and partners and approach the main question of this project about whether issuing a label of Joint European Degree in Engineering is a pertinent issue to be considered and developed.

6. References

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