Potentialities and Constraints of Joint European Degrees in Engineering: Stakeholder Perspectives from the JEDI Project*

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Recent decades have witnessed various transformational initiatives for the harmonization of European higher education, Joint European Degrees (JEDs) representing one of the cornerstones. With its pioneering role in the establishment of Joint European Degree Label as a step towards JEDs, the JEDI Project, with its specific focus on engineering, has offered a model label with the participation of European University Alliances. This paper explores the potentialities and constraints of joint European degrees in engineering as perceived by multiple stakeholders associated with the industry, ministries, engineering, higher education, and accreditation. It employed a qualitative research design in which data was collected through focus group interviews and analysed through thematic analyses, revealing four overarching themes: (i) label and degree, (ii) quality assurance and accreditation, (iii) added value, promotion and recognition and (iv) long-term vision. Considering the potentialities and constraints of joint European degrees as discussed in this paper will provide guidance for practitioners and policymakers on their design and implementation.

Keywords: accreditation; engineering education; Joint European Degrees; Joint European Degrees in engineering; stakeholders

1. Introduction

Year 2024 marks the 25th anniversary of the Bologna Declaration [1], which sparked the most relevant recent transformation of European higher education institutions and has led to the establishment of the European Higher Education Area (EHEA). Along the process, a transition towards student-centred educational methods and a growing focus on professional skills have been perceived with impacts transcending European frontiers [2, 3]. In engineering, this has meant a new popularization of project-based learning approaches in all its configurations, including problem/challenge-based learning, analytic and synthetic and holistic project-based learning, service-learning, students' competitions, and hackathons following the Conceive-Design-Implement-Operate Model [4–7]. The interest has shifted to training transformative, skilled, and competitive engineers, capable of working in complex and changing environments and international contexts, together with a challenging need for standardizing engineering education across the EHEA during its construction [8]. This has led to an evolution of curricular planning and assessment methods and creation of accreditation networks and schemes for educational harmonization. For instance, the European Network for the Accreditation of Engineering Education was founded in 2006, which resulted in the creation of the EUR-ACE® scheme and label: *"a framework and accreditation system that provides a set of standards that identifies high-quality engineering degree programmes in Europe and abroad"*. In its desire for differentiating

European engineers from the competitors of emerging economies and especially American educational approaches, the EU strategy and related accreditation schemes imitate pioneering American models, with almost a century of tradition, such as the American Board for Engineering and Technology and its outcomes-based accreditation schemes [9].

Content-wise, due to the rapid pace of technological evolution that we are living through, these decades have seen a progressive incorporation of technologies from the Industry 4.0 realm [10, 11] into the engineering curricula both in Europe and worldwide. In addition, there is an increasing concern for sustainability under the auspices of United Nations' Sustainable Development Goals [12] and UNESCO's Education for Global Citizenship [13]. Within this scope, there is a desire to reach a more equitable, safer, and healthier society supported by emerging technologies (i.e., Society 5.0) [14], whose impacts on engineering programmes are already visible. All this has led to the recent coining of the concepts of "Engineering Education 4.0" [15, 16], centred around Industry 4.0 technologies, and "Engineering Education 5.0" [17], oriented to technologies beyond Industry 4.0 and underpinning the approach to Society 5.0 and to the human-centred Industry 5.0 [18] with sustainability and equity as key yardsticks. Similar moves are visible beyond the European frontiers, including initiatives like "New Engineering Education Transformation" from the Massachusetts Institute of Technology [19], the "Tec21" model from Tecnológico de Monterrey [20] and the creation of the design-led Singapore University of Technology and Design [21], among other educational reflections and transformations from leading engineering education institutions [22]. In short, well-planned educational innovation in engineering education, as a necessary complement to research, can lead to world-class universities capable of deploying transformative societal impacts [23] based on continuous change [24].

For successful construction of the EHEA and fostering European values towards increased equity and sustainability, educators and policy makers have seen a need for systematically nurturing students' mobility and internationalization and for the reinvention of collaboration schemes among higher education institutions from the EHEA and abroad. This has led to the reformulation of the classic Erasmus programme into the more international, versatile and personalized Erasmus+ programme [25], among other strategic actions described below with remarkable influences on content delivery and access to knowledge, international collaboration schemes, programme structures.

Traditionally, since the beginning of the Erasmus programme, internationalization of engineering students within Europe and the EHEA has been promoted through bilateral mobilities. These eventually lead to double degrees when the duration of the mobility and the complementarity of topics studied in the sending and host institutions are sufficiently relevant. The launching of the Erasmus Mundus programme, through which at least 3 institutions from at least 3 different countries (and multiple associated partners from the academic and non-academic world) develop joint master's degrees, supposed a radical innovation for the design and delivery of joint engineering degrees already two decades ago [26]. Nowadays, innovative schemes are materializing as a result of different European policies and funding bodies with synergic aims. The European Universities initiative [27] is supporting *"flagship transnational alliances of higher education institutions, paving the way towards the universities of the future"*, whose roadmap includes the articulation of joint degrees in many cases focused on engineering disciplines. The European Commission Horizon programmes have launched different calls on the "New European Bauhaus" with the aim to connect the European Green Deal with innovative living spaces and (educational) experiences [28]. Inspired by the transformative impacts of the original Bauhaus, developed on the crossroads of education, technology, life and art, the New European Bauhaus pursues the values of sustainability, aesthetics and inclusion, which may be collaboratively achieved through joint educational programmes among other options. Proposals for electronics and biomedical *Bauhäuser*, to cite some recent examples [29, 30], have been already envisioned. In connection with research, the European Institute of Innovation and Technology has been also supporting the creation of joint educational engineering programmes in trending topics like manufacturing, raw materials, digitalization, health, environment, and cities of the future [31].

Notwithstanding the transformative potential of these initiatives, a lack of harmonization is detected, which may affect their long-term impact and prevent the successful fine-tuning of the EHEA, at least taking European engineering education into consideration. On the other hand, the extremely competitive nature of research and development calls from the European Commission Horizon programmes and the original planning of the European Universities initiative may endanger the pursued equity among European higher education institutions. Hence, multistakeholder reflections and consensual ethics-guided agreements, leading to roadmaps, guidelines, and good practices, are

required for transforming European engineering education through internationalization and joint degrees.

1.1 The JEDI Project

Acknowledging the need for further educational harmonization, the European Commission, through the Erasmus+ Programme, recently launched the "ERASMUS-EDU-2022-POL EXP-HE" call on European policy experimentation in higher education [32]. The scope of the call was piloting European degree labels, more specifically: "*allowing alliances of higher education institutions and national authorities to examine, test and facilitate, on a voluntary basis, the delivery of a joint European degree label, based on common criteria. Later, the possible design and delivery, on a voluntary basis, at national, regional, or institutional level, of joint degrees at all levels, based on these co-created European criteria, could be envisaged, in accordance with the existing instruments of the Bologna Process*". In this experimental context, the JEDI "Joint European Degree label in engineering" project has explored and proposed a prototype label for joint European degrees in engineering, through the involvement of relevant European universities alliances focused on engineering education, namely: EELISA as project coordinator [33], EUt+ [34] and ENHANCE [35]. JEDI [36] aims at transforming and redefining the education of engineering, technology, and science-oriented degrees in Europe. Through a set of studies reviewing the state-of-the-art for the accreditation of joint degree programs in engineering, three "colabs" devoted to educational innovation, quality promotion and regulations, and involvement of stakeholders, good practices for future JEDs have been gathered and the foundations for an excellence label for outstanding engineering programmes fostering European values have been established. JEDI outcomes rely on an extensive collaboration with a diversity of relevant stakeholders, including university experts and academic decision-makers from European and third countries, alumni, joint degrees owners, student representatives, professional bodies, ministry employees, accreditation agencies and employers. The methodology to gather opinions and information from the stakeholders through focus group interviews is one of the contributions of this paper.

JEDI has proposed a design approach for future European degrees in engineering combining three dimensions: (1) learning outcomes and competences driven by the academic strategy of European alliances (e.g., the European Engineer profile as defined by EELISA), EUR-ACE label programme outcomes, regulated profession requirements and the participation of stakeholders, (2) European criteria as defined by European Commission in the recommendation [37], and (3) accreditation and quality assurance framework. Another tangible result from JEDI is the definition of a procedure to streamline the accreditation of joint European degrees for regulated professions in engineering at European level based on the commonly shared programme outcomes by the EUR-ACE label. Results from JEDI and the group of six Erasmus+ policy experimentation projects motivated the "Blueprint for a European Degree" in March 2024 [38], a communication presented by the European Commission to pave the way towards the creation of European Degrees.

Different studies have already devoted efforts to summarizing good practices, and some outstanding case studies of fruitful collaboration, leading to highly transformative engineering education experiences and joint programmes, can be mentioned here. Examples include: the CHARM-EU joint master's degree in "Global Challenges for Sustainability", which stands out for its hybrid learning environments [39] or the joint master's degree in "Digital Twins, Infrastructures and Cities", which applies virtual replicas to civil engineering in a blended and international learning environment [40]. In fields like biomedical engineering, the viability of joint programmes has been analysed [41] and universal schemes for facilitating internationalization aligned with the Sustainable Development Goals have been proposed [42]. The study on "Transnational collaboration and mobility in higher education" [43] provides some clues for launching and upscaling collaborative international educational actions, which can be directly transferred to engineering education.

However, a set of internationally accepted guiding principles for the future joint European programmes in engineering has not yet been achieved. Besides, while Erasmus Mundus programmes have demonstrated their capability to find unique ways to collaborate within the boundaries of existing legislative frameworks, their impact on pan-European educational policy implementation is not yet significant [44], which delays the implementation of necessary educational changes. In addition, "*Europe's mobility ambitions should go far beyond joint degrees*" [45], taking into consideration the diversity of learning experiences, the added value of different types of mobilities, and fostering creativity and flexibility in the ways programmes and courses are designed and implemented.

To this end, this study will explore and present the opportunities and challenges of JEDs in engineering through the lens of multiple stakeholders so as to contribute to the creation of guiding principles

for the establishment of prospective JEDs in engineering, summon potential future partners for expanding the mentioned alliances of higher education institutions centred around engineering and, in a collaborative way on the basis of widely accepted principles, influence future policymaking in higher engineering education in Europe.

2. Methodology

This study employed a qualitative research design, which provides a platform for researchers to reach a deeper comprehension and interpretation of the topic being investigated [46]. Accordingly, stakeholders' opinions regarding the potentialities and constraints of Joint European Degrees in Engineering were explored through focus group interviews, which is one of the data collection methods in qualitative research. [47] describes focus group interviews as a series of discussions that take place in groups of invited participants with certain attributes and experiences in common and that are moderated in accordance with a previously defined scheme by a researcher, which reflects the procedure followed in the current study.

2.1 Data Collection

The methodology used to structure and gather conclusions from the focus groups was based on the elements that needed to be explored in depth regarding the proposal and the work carried out during the initial months within the JEDI framework. To raise awareness about the importance of harmonizing the European Education Area and the potential tools to be created among higher education institutions for this purpose, it was considered essential to engage with the stakeholders involved in the design, purpose, and dissemination of the proposed outcomes. Therefore, clear objectives and research questions were defined with stakeholders that were involved or interested in the definition of engineering degrees in Europe with a view of long-term degrees evolution. As a result, semi-structured interview protocols were created for the focus groups in line with feedback and suggestions coming from the stakeholders as well as the researchers involved in the project. The interview protocols included a variety of questions; the struc-

ture of the questions was divided into three global questions that were: "What difference do you make between a label and a degree?", "What are the added values of a label?", "What could be the criteria to evaluate the degree of success of a label?". In their finalised forms, the interview protocols were in parallel with the phases for instrument development for focus group interviews [48], more specifically, they were in line with the objectives of the study, and created through conducting a brainstorming session with project members, using the questions created in the brainstorming session to formulate the path for questioning, and sharing the draft version of the path with the project members to receive their feedback before the initiation of the focus group interviews.

The focus group interviews were conducted virtually [49] due to such advantages as lack of travel requirement, efficiency and constituting a forum for participants to express their opinions in their own environment. The focus groups were carried out with a pre-established duration of two hours using the interview protocols to ensure participants' proper understanding of the issues to be discussed. Each focus group was started by the facilitator's general presentation of the JEDI label, its goals, and expected outcomes and continued with debate through the questions in the interview protocol regarding the current situation and the future of the JEDI label.

2.2 Participants

"Focus groups use a homogeneous, purposeful sample composed of information-rich participants. This homogeneity fosters a sense of commonality that results in greater sharing of insights" [50]. The participants in the current study were recruited in accordance with purposeful sampling. The participant selection (see Table 1) was made thanks to an initial list that was compiled as part of the reflection work of co-labs to receive feedback on possible approaches to implementing the label to possible European joint degrees. The contacts were proposed by the various universities that make up the project, ensuring proper and diverse geographical, cultural, academic, and professional representation. Ethical approval was received from the Institutional Review Board of the Coordinating

Table 1. Participants of the JEDI Focus Groups

Universities and Students (USs)	Unions and Professional Bodies (UPBs)	Accreditation Agencies and National Leaders (ANLs)
• Universities' mobility officers • Faculty • Student representatives • Deans/Vice-deans for international relations	• Faculty • Directors/Managers of professional bodies for engineering	• Accreditation agencies • National authorities' representatives

Institution before the initiation of the study and ethical aspects were carefully considered given that the sessions were recorded and transcribed for a proper analysis of the inputs and elements discussed. Therefore, participants were duly informed that the sessions would be recorded, preserving the confidentiality and maintaining the anonymity of their positions as well as their utterances by signing a data protection document, which the project stores in its database.

Three focus groups were organised as part of the JEDI project under three knowledge axes and with the purpose of building a long-term vision of an integrated European framework for engineering education:

- The current understanding of European educational purposes and strategies among the university community (focus group of Universities and Students -USs-).
- The definition of an engineering degree and the competencies/skills to be included for a European purpose (focus group of Unions and Professional Bodies -UPBs-).
- The interests and joint construction purposes of accreditation agencies and national authorities based on the European pillars intended to be disseminated (focus group of Accreditation Agencies and National Leaders -ANLs-).

The focus groups were characterised by the representation as shown in Table 1.

The USs focus group was composed of five invited focus group participants accompanied by four JEDI members not including the moderator; UPBs and the ANLs focus groups each comprised three invited focus group participants along with three JEDI members not including the moderator. The academics involved in different focus groups were current or previous representatives of agencies or entities that serve to the objectives of the JEDI Project.

2.3 Data Analysis

Data was analysed using thematic analysis [51], which helps researchers to explain participants' experiences and realities by means of their spoken or written discourse, leading to identifiable themes of collected data. The phases of thematic analysis are described as familiarisation with the data, creating the initial codes, forming the themes, revising the themes, describing the themes, and creating the final report [52]. In the current study, each focus group interview was transcribed and analysed searching for main themes that intersect focus groups along with observations, perceptions and experiences that might have been articulated by only one participant. The emerging themes were supported by participants direct utterances to contribute to reliability of the data.

3. Findings

The thematic analysis of data from three focus group meetings conducted with the participation of universities and students (USs), unions and professional bodies (UPBs) and accreditation agencies and national leaders (ANLs) revealed four overarching themes: label and degree, quality assurance and accreditation, added value, promotion and recognition and long-term vision. The details of the themes are discussed below.

3.1 Label and Degree

Despite confusions about the difference between a label and a degree by the participants, a joint degree was characterized by all focus groups as a single certification offering a clear framework for qualification recognition whereas a label was considered complementary focusing on different types of criteria and delivered alongside the diploma of the degree. As noted by one of the USs, *". . . a label might certify some additional competencies to a qualification but doesn't constitute a qualification itself"*. It was emphasized that the significance of labels varies among universities; while top-tier institutions may not prioritize them, others striving for higher recognition may find them more valuable. Compared to a national degree, a label was viewed as an opportunity to value soft skills and multilingualism as well as facilitating the recognition of cross-disciplinary knowledge, which is coherent within the European educational system. The discussions in the focus groups suggested that a label is considered more complex to establish its presence in society.

This perspective seemed grounded in obstacles related to joint degrees, which, as discussed in all focus groups, required significant legislative changes. Specifically, USs mentioned finding joint degrees difficult to implement and these difficulties were attributed by the focus groups involved in the study to differences in national regulations, as well as requirements ranging from varying programme lengths and type and duration of mobilities to specific regulations regarding diplomas. As reported by one of the ANLs, *"I mean, we as an institution, we don't want to implement joint programs in the sense as the European Commission understands them, because they are just bureaucratic monsters"*. They emphasized the need for flexibility and adaptation in joint programmes suggesting the need to compromise or adjust regulations to accommodate collaborative efforts to find common ground so that graduates are enabled to work in

regulated professions across different countries. This view was supported by UPBs with specific emphasis on the need to homologate degrees to meet local requirements. They also mentioned viewing it complex to harmonize curricula between different universities and countries while maintaining transparency for employers across all Europe. Here, transparency was described as providing clear information about an engineer's degree, skills, and competencies especially important when assessing potential hires and prioritized in this context. One of the UPBs stated, *"the biggest goal you can achieve with a joint degree, to offer more transparency and mobility across Europe"*. UPBs suggested that a balance between standardization and flexibility in qualification frameworks would be a solution to ensure simultaneous transparency across Europe.

3.2 Quality Assurance and Accreditation

The participants involved in UPBs and ANLs focus groups seemed to put more emphasis on quality assurance and accreditation. In this scope, UPBs mentioned the complementarity between EUR-ACE and the proposed JEDI Label as a good option for quality assurance. EUR-ACE would stand for disciplinary competences identifying professional attributes of an engineer, and JEDI would signify European and human skills such as international experience and proficiency in European languages. As one UPB put it, "*Professional attributes are more or less covered in EUR-ACE criteria and JEDI label will guarantee some language skills, for example, some mobility skills, some capacity to work with the international groups of people*."

The participants also emphasized significant variability in accreditation criteria across countries and the need for flexibility and innovation in accreditation processes. The discussion by ANLs offered suggestions for the accreditation process for the Joint European Degree Label in engineering education ranging from self-evaluation by universities with oversight from accreditation agencies to accreditation at the alliance level. ANLs also proposed that the label could be made separate from a joint degree. This could be achieved through applying the label's requirements with a composition of courses, such as micro-credentials or European Education Pathways. While ANLs gave priority to the relationship between accreditation, quality assurance, and lifelong learning suggesting how accreditation processes can ensure the quality of educational offerings through supporting lifelong learning initiatives, USs put more emphasis on maintaining the quality of the programmes. Accordingly, they mentioned the need to update the criteria enabling it to evolve with time to sustain

the quality of the label. As put by one of the USs, "*I think, it should be a system which is open for revisions and improvements because this is how the quality assurance works*".

3.3 Added Value, Promotion, and Recognition

The participants in the USs focus group discussed the attractiveness of a label for students to differentiate their degree from other degrees. This idea emphasized the importance of proper integration into the job market and promotion. For universities, obtaining a label helps to differentiate themselves, making their programmes more attractive to students and enhancing their job market prospects. Like USs, the UPBs placed particular emphasis on professional mobility and recognized quality assurance across Europe as part of added value. Additionally, multilingualism (UPBs and ANLs), global European citizenship (UPBs), increased student mobility (ANLs) and increased HEI prestige (USs and UPBs) have been mentioned as potential added values of a label by the participants of focus groups. As asserted by one of the USs,

> "I can see a positive impact in the sense that we might increase the European dimension or international dimension of our study programmes and that this whole discussion might foster this somehow, making international mobility on the European level and perhaps even multilingualism becoming even more the norm than they are right now."

USs and ANLs seemed to question the position of the EUR-ACE label, expressing concerns about its recognition and promotion despite its widespread use. As reflected by one of the ANLs, "*I think EUR-ACE is not good enough known, well known*". This generates doubts about the potential impact of a new label in the European Higher Education Area. Accordingly, the question about means to quickly raise awareness about a new label was discussed. USs agreed that companies did not seem to be very aware of the existence of labels despite their potential benefits for their future workforce. This view was also reinforced by UPBs, one of whom stated,

> "Often, it's not easy to know what's the benefit between a student who comes from one educational programme or from the other educational programme, but if you have positive experiences with students from one educational programme, you tend to search for those students if you need a new workforce for your company."

The USs also emphasized that the label will be successful only if it is considered by relevant stakeholders as meaningful. Therefore, one of the USs argued, "*we have to bring the companies on board, let's say, to explain to them what we are doing and how this could be useful for them*". They contended that involving companies and non-governmental

organizations as stakeholders to provide input about competencies expected from the future workforce as well as offering some opportunities as part of labelled joint degrees will add more value. In this context, different kinds of incentives such as grant programmes and specific internships can be used. Increasing the number of institutions offering programs with the label will enhance its visibility and value.

3.4 Long Term Vision

While the necessity for the EU to take immediate actions to avoid potential risk of being imposed standards by foreign or private institutions is raised as a concern, overall, there is consensus on the need for a step-by-step approach to implementing changes in European higher education. This includes proper evaluation, consideration of national regulations, and collaboration between universities, governments, EU institutions, student bodies, and professional representatives. As put by one of the USs,

> "If we can really establish a good structure, if we can put the framework in the correct banners and if we can work really together efficiently, we can cooperate, we can establish these joint programs with the involvement of different stakeholders".

ANLs stressed the importance of building upon existing frameworks like the Bologna process. The move to a Joint European Degree or even to a European Degree in the sense as introduced by EC in January 2024 and in the Blueprint for a European Degree in March 2024 [38] should be done maintaining, at least for a period, the corresponding national degrees. As discussed by the USs, in this regard, a Joint European Degree Label could be considered a first step toward harmonizing the European Higher Education Area, which is articulated as a challenging task by both the USs and ANLs.

A secondary pattern in the data underlined the need for an integrated European framework for engineering education, which, according to UPBs, would respond to the need for transparency and alignment with employer expectations. In this context, ANLs highlighted the comprehensiveness and stability of existing European frameworks for engineering education. In addition to facilitating mobility within the European and global job markets, they underscored the importance of positioning European engineering education as a global leader, particularly in areas like green transition and ecological sustainability collectively perceiving that a European framework can enhance the attractiveness of European education for non-European students. The participants also stated seeing value

in promoting European identity and multilingualism, which can benefit both incoming and outgoing students. As explained by one of the respondents,

> "The notion of a European label is also something that could then have interesting benefits for students who then go on to the international job market and promote themselves as European students, other than French students, Italian students, Swedish students."

Within this scope, there was specific emphasis on the role of European university alliances in driving innovation and collaboration in higher education. ANLs advocated that alliances can lead the way in developing joint programmes and proposing solutions to regulatory challenges. The path being initiated with the labels and European Degrees is an opportunity to strengthen the sense of belonging to European alliances and the networks they create among universities to foster a sense of "more Europe". This is considered as a pathway for the transformation of European Higher Education Area towards becoming a reference model.

4. Discussion

The results of this study showed that the stakeholders' perspectives revealed a certain number of fundamentals that seem to be agreed upon and deserve to be emphasized to understand the main challenges and opportunities related to the design, the implementation, and the impact of Joint European Degrees in Engineering, technology, and science-oriented education and a specific label. These stakeholders provided useful and up-to-date perspectives that put a strong emphasis on technical, regulatory, and academic features, which made its global European deployment difficult and its success uncertain while suggesting latent prospects that will contribute to the harmonization of the EHEA.

Several sources of divergence can be identified: the existence or non-existence of professional bodies linked to certain training courses and diplomas, the diversity of accreditation processes [53], the time and type of mobilities [54], the arrival and impact of new players in the field of higher education [55, 56], and the development of new forms of certification such as badges [57, 58]. These divergences may act as influencing factors that prevent its expected development. Accordingly, several fundamental obstacles can be pinpointed as accentuated by the stakeholders. The first of these is the difficulty, as things stand, of developing joint degrees for the simple reason that the set of constraints to be met for each degree is a unique case that is an exception to the standard arrangements of the set of partners and its respective roles, and

therefore does not enable higher education players to develop generic processes. The second is the interest and enthusiasm aroused by the idea of building a European higher education area. The different levels of prestige and notoriety of the HEIs can make it feasible. However, when it is clearly stated that harmonizing in the EHEA is key to convergence, the UPBs are not converging in regulated professions at European levels to ensure the deployment of such Joint degrees or European degrees in engineering. The third point is the heterogeneous interest and impact of developing a label. The benefits society can expect from a system of European labels and, even more so, European diplomas are undoubtedly certain. HEIs would benefit in terms of attractiveness, visibility and reputation, students in terms of openness to new opportunities and employability, and employers in terms of legibility of qualifications and development opportunities within the European Union. Also, the label as a complementary document could serve as a promotional support of European values, soft skills, cross disciplinary knowledge. From this point of view, as indicated in the previous analysis, the impact of a diploma is unanimously considered stronger than that of a label. Accordingly, the JEDI project proposes that a Joint European Degree Label could be conceived as a building block in the establishment of Joint European Degrees in the long run. However, two main questions are still open: who will assess and deliver the label to ensure harmonization, flexibility, and transparency, and which level of bureaucracy will be necessary? The final point is undoubtedly the difficulty of the task involved in achieving a European degree. While there is a consensus on the need to evolve the current framework while maintaining confidence in existing diplomas, the nature and scope of the changes to be envisaged are undoubtedly not fully shared.

There is unanimity that industry-oriented skills should be the essence of the curricula of future joint European degrees in engineering. The emergence of technologies 4.0 and the new paradigm like Society 5.0 require new competencies and skills. This demand aligns with contemporary trends in engineering education which advocate for a curriculum that is responsive to the changing dynamics of the workforce and technological advancements [59]. Literature suggests that such integration enhances employability and ensures that educational institutions remain relevant and competitive in a globalized educational landscape [24]. In this regard, the European Degree can play a key role in strengthening Europe's technological competitiveness by fostering cross-border innovation and advanced research collaborations. By creating a more integrated and prestigious academic framework, it helps reduce dependence on external technologies and promotes self-sufficiency. To fully realize this potential, attracting top talent from around the world is essential. This global influx of expertise will drive Europe's leadership in cutting-edge technology development.

The other main insight is relative to the increased need for curricular flexibility/agility [60, 61] and agile accreditation processes adapting to Europe's diverse educational landscapes and societal needs. Cutting-edge technologies strongly impact and constantly transform industrial needs and society's way of living and communicating. The accreditation frameworks must evolve in unison with the European strategy to accommodate diverse pedagogical models and learning outcomes that transcend traditional academic boundaries [44]. Accreditation is a confidence-building tool that guarantees the value of diplomas. It can also be a means of developing a common model. This approach is supported by evidence suggesting that flexible accreditation standards can facilitate new innovations in programme delivery and educational content, thereby enhancing the quality and relevance of Joint European Degrees in engineering [62].

The added value of joint European degrees in engineering is quite relevant for all stakeholders as a support for fostering increased student mobility, enhancing institutional prestige, and promoting a pan-European identity. These benefits are key to constructing a more integrated and competitive European Higher Education Area in engineering, technology, and science. The Council of the European Union has endorsed a recommendation and resolution to establish a joint European degree label, aiming to enhance the global appeal and competitiveness of EU higher education. This initiative seeks to facilitate transnational cooperation among universities, offering students a unified qualification recognized across the EU. The Council's decision marks a significant step towards the potential introduction of a joint European degree by 2029, aligning with broader efforts to strengthen European higher education [63].

In the field of training, higher education establishments are faced with a number of challenges, relating to the resources allocated to teaching, the diversification of the public for whom the establishments cater, the expectations of these publics and the needs of society, the need to forge links between teaching and research, etc. The entire higher education environment is set to evolve over the coming decade. The example of lifelong learning is an excellent illustration of this. The role of innovation and the nature of relations between HEIs and the economic and social fabric in the fields of training

and research are others. The status quo, however reassuring it may be, is not the way forward. The adaptation of HEIs is therefore a major challenge for the development of our societies and requires the definition and operationalization of new frameworks. The definition of state-specific frameworks, however simple, by limiting the possibilities for cooperation between institutions, can only lead to a weakening of public institutions in the medium term.

In this sense, the European Commission's proposal to introduce a European diploma sharing the same characteristics in all EU countries' legislation, and to make this diploma "superimposable" on national diplomas, opens up an extremely promising path, provided that the states seize this opportunity. The role of European alliances as laboratories, initiators, and drivers of these changes should be decisive [64]. Conversely, these changes show the importance and strategic interest of developing European alliances. European alliances are a solution to these challenges [65]. But creating European alliances without giving them the opportunity to develop and have recognized, at the right level, the skills they deliver through the granting of joint diplomas would be a major amputation of the functions that these establishments must perform.

This raises the question of the scope of joint diplomas, and the assessment procedures that will enable them to be accredited. The whole system of values established by the diplomas is based on trust, the cornerstone of which is a recognized accreditation system whose practices and orientations are clear, shared and controlled. EQAR's European approach is an attempt to provide a common framework for accreditation practices and processes. The difficulty of adopting this framework in all EU countries, and the difficulty of converging accreditation processes, is a further illustration of the scale of the task. The definition of a framework that is both flexible and guarantees a match between training courses and needs is a major challenge, and a prerequisite for the large-scale development of a European diploma.

Flexibility in assessment means giving institutions and students the latitude to define training paths that depart from the standardized training courses we are still familiar with. Flexibility can be controlled to the extent that learning outcomes are placed at the heart of the system. They set the limits of what is possible but leave the institutions – and to some extent the students themselves – a great deal of freedom in terms of how they acquire the knowledge and skills they need to acquire. The main advantage of this flexibility is to allow for a diversity of career paths. It is also, in a less obvious but decisive way, a means of acknowledging, at the heart of training courses, a simple reality: that training is not a course that ends with the award of a diploma, but a process that begins with higher education and continues throughout professional life.

4.1 Limitations and Future Work

The study's focus on a select group of stakeholders within the JEDI project limits the generalizability of the findings. While rich and informative, the gathered perspectives may not fully represent the broader spectrum of views across the entire EHEA. Also, while efficient, the virtual format of the focus groups might have influenced the depth and nature of the discussions. Additionally, the current limited number of joint European degrees in Europe and, consequently, of owners and partners that experienced such implementation may include a bias in the perspectives of the stakeholders.

Future research should aim to broaden the scope of stakeholder engagement to include a wider array of participants from different geographical, cultural, and institutional backgrounds. Longitudinal studies tracking the implementation and impact of joint degrees and labels over time would provide valuable insights into their efficacy and areas for improvement. Finally, exploring the influences of integration of emerging technologies and sustainability principles in the scope of joint degrees and labels in engineering education can further align these programmes with the evolving demands of the industry and society.

5. Conclusions

The JEDI project aims to study the potentialities and constraints of joint European degrees in engineering, technology and science through the lens of internal and external stakeholders as a means for successful development and implementation of a label prototype in the European higher education area. To gather valuable insights and to build a long-term vision of an integrated European framework for engineering education, three focus groups were organized with universities and students, unions and professional bodies, and accreditation agencies and national leaders. Four primary themes were identified: label and degree, quality assurance and accreditation, added value, promotion and recognition, and long-term vision. These themes demonstrate the complexity and multifaceted nature of implementing joint labels and degrees. There is a general acceptance that joint degrees and European degrees represent one strategic initiative for harmonizing European higher education through the delivery of a single and comprehensive certification. However, the existence of a label as an

additional certification of specific competencies, skills, multilingualism, cross-disciplinary knowledge, or other exclusive dimensions complicates the deployment process due to such root causes as the lack of clear definitions and frameworks to ensure mutual recognition and value across HEIs. The highlighted challenges, including legislative barriers and regulatory discrepancies, point to the necessity for harmonized policies and flexible regulations that can accommodate diverse educational contexts. Quality assurance and accreditation were deemed critical, with stakeholders advocating for a robust, transparent system that maintains high standards while allowing for innovation and diversity in engineering education. The study also drew some clear conclusions about the added value of a label since some HEIs consider it necessary to develop new joint academic degrees. In this regard, a label will increase the attractivity and prestige of some HEIs, and it can imply a guarantee for quality and global competitiveness of European engineering graduates and improve the potential employability of future alumni.

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