

THE WAVES ERASMUS MUNDUS JOINT MASTER DEGREE: EXPERIENCE AND IMPACT OF A EUROPEAN PROGRAMME IN ACOUSTICAL ENGINEERING EDUCATION

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Abstract

The Erasmus Mundus Joint Master Degree (EMJMD) WAVES – Waves, Acoustics, Vibrations, Engineering and Sound – is a two-year international Master's programme in Acoustical Engineering, approved for funding in 2019. Its main objective is to provide students with advanced scientific knowledge and engineering skills to address acoustic problems in academic and industrial contexts, responding to the demands of the global job market. To date, the EMJMD WAVES has graduated three cohorts, and a fourth is currently engaged in Master's thesis development. The programme is jointly implemented by four European higher education institutions – Aix-Marseille Université and École Centrale Marseille (France), Universidade de Coimbra (Portugal) and Universitat Politècnica de València (Spain) – supported by an extended network of 20 associated academic and 26 industrial partners, enabling a fully integrated, mobility-based curriculum promoting high-level transversal competences. Aligned with contemporary societal and economic challenges, the curriculum combines strong foundations in core acoustics with emerging topics, addressing areas such as architectural acoustics, environmental noise, ultrasound-based monitoring and noise and vibration control in transport. The experience of the first cohorts demonstrates the capacity of Erasmus Mundus joint

degrees to foster excellence, innovation and harmonisation in European acoustics education, preparing graduates for doctoral studies or immediate industrial employment.

Keywords: *acoustical engineering education, Erasmus Mundus, joint master degree, international mobility, curriculum design*

1. INTRODUCTION

Higher education in acoustics in Europe is rich but fragmented. A large number of institutions offer Master-level programmes in the field (e.g. [1]), yet these are generally organised around a dominant theme (e.g. vibroacoustics, sound insulation and architectural acoustics, signal processing, non-destructive testing or musical acoustics) so that the range of competences required of a modern acoustical engineer is rarely found within a single curriculum. Until 2019, no programme in acoustics had been approved under the Erasmus Mundus action of the European Union, whose Joint Master Degrees support fully integrated study programmes delivered by international consortia of higher education institutions, with scholarships attracting excellent students worldwide.

The EMJMD WAVES became the first Erasmus Mundus Joint Master Degree in Acoustics, approved for funding in July 2019 and implemented by a consortium of four institutions, in three cities: the Universidade de Coimbra (UC, Portugal), the Universitat Politècnica de València (UPV, Spain, campus of Gandia), and, in Marseille (France), the Aix-Marseille Université (AMU) together with the École Centrale Marseille (ECM). The design of the programme, and the difficulties overcome in setting up a joint degree across three national higher education

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systems, were described by the authors at the time of its launch [2]. When that work was written, however, no student had yet enrolled: the first cohort was admitted only in September 2021, one year later than planned, owing to the mobility restrictions imposed by the COVID-19 pandemic.

The present paper is the follow-up of that early contribution, written from the opposite vantage point: four editions of the programme have now been run, three cohorts have graduated and the fourth is currently completing its Master's thesis semester. The paper briefly recalls the structure of the programme (Section 2), presents the operational evidence accumulated over the four editions (recruitment and internationalisation, academic outcomes, thesis placements and graduate destinations, in Section 3), and discusses the lessons learnt (Section 4). It closes with the way these lessons informed the design of the renewal proposal, the EMJM WAVES+, recently submitted for funding under the Erasmus+ programme (Section 5).

2. THE EMJMD WAVES PROGRAMME

2.1 Consortium and objectives

WAVES is a two-year, 120 ECTS international Master's programme, fully taught in English, awarding multiple national Master degrees complemented by a joint Diploma Supplement that describes the complete training path. It is built upon three previously existing accredited national Master programmes of the partner institutions, coordinated into a single joint curriculum. The programme is supported by an extended network of Associated Partners (higher education and research institutions worldwide) and Industrial Partners, which contribute to promotion, advising, guest lectures, internships and Master's thesis hosting.

The central objective of the programme is to train generalist acoustical engineers with a triple proficiency (theoretical, numerical and experimental) able to design, characterise, model and understand acoustical systems and devices across the broad spectrum of the discipline. Rather than specialising in one narrow branch, the EMJMD WAVES graduates are prepared to move between the application areas that structure the professional market of acoustics: building and room acoustics, environmental and transportation noise, electroacoustics and audio, ultrasound-based monitoring and non-destructive evaluation, underwater acoustics, and acoustic materials and metamaterials. This range, combined with compulsory intra-European mobility and multinational recognition, is what distinguishes the EMJMD WAVES within the international offer of acoustics education.

2.2 Curriculum and mobility scheme

The curriculum is organised in four semesters of 30 ECTS each, with the three teaching semesters hosted by the institution whose scientific specialisation best serves the corresponding stage of the training (Figure

1). The first semester, in Coimbra, is oriented towards engineering applications, with emphasis on building acoustics, vibrations, acoustic and energetic building rehabilitation, sustainable acoustic materials, computational modelling and experimental measurement techniques. The second semester, in Gandia, strengthens the fundamentals and opens the range of the discipline, into room acoustics, psychoacoustics, electroacoustics, ultrasound and underwater acoustics, simulation techniques and sound processing. The third semester, in Marseille, is devoted to advanced specialisation in topics such as environmental acoustics, acoustic imaging, aero-vibroacoustics, nonlinear dynamics, waves in continuum media and metamaterials. The fourth semester is entirely dedicated to the Master's thesis, carried out as an internship of four to six months in a research laboratory or a company, anywhere in the world, among the consortium institutions, its partners or other host organisations.



Figure 1. EMJMD WAVES students' mobility scheme.

Course units are grouped in five categories (fundamentals, methods, applications, advanced topics and additional key competencies, including language courses and transferable skills), a shared taxonomy that keeps the multi-institutional progression coherent. Three structuring events frame each edition: the Welcome and Integration Week in Coimbra, which opens the academic year, supports the practical integration of a highly international cohort and levels academic prerequisites, the annual Summer School in Gandia, at the transition between the first and second year, which brings students together with researchers, alumni and industrial partners, and the Master's Thesis Defenses and Graduation Ceremony, at the end of the fourth semester, in Marseille.

2.3 Governance, quality assurance and degrees

The programme is steered by a Consortium Committee (project leadership and the local coordinators of the four institutions), supported by a Pedagogical Committee, a Communication Committee, an Internal Quality Committee including elected student representatives, and an external Advisory Board with representatives of academia, industry and alumni, which meets every two years. Student selection is a joint procedure: each application is assessed by two reviewers from two different partner institutions against a common evaluation grid, and the ranked lists are consolidated in a joint selection meeting and submitted to the Education, Audiovisual and Culture Executive Agency (EACEA) for approval.

Since the teaching and assessment take place in institutions using different national grading scales, marks obtained at each partner are converted into a

common scale through an equivalence table agreed by all partners, based on the ECTS credit transfer and grading principles [3], allowing an integrated reading of each student's performance along the mobility path. Quality assurance combines anonymous student questionnaires at the end of each semester and for individual course units, the reports of the local quality bodies of each institution, and the external appraisal of the Advisory Board, in line with the Standards and Guidelines for Quality Assurance in the European Higher Education Area [4]. Upon completion, graduates receive the national Master degrees of the institutions, together with the joint Diploma Supplement.

3. FOUR COHORTS OF EXPERIENCE

3.1 Recruitment and internationalisation

Since its first call, the programme has attracted more than 650 applications for its four intakes, corresponding to an overall selectivity of roughly 10%. Across the four editions, 70 students were admitted (Table 1). The admitted students come from 35 nationalities, spanning all continents, with 70.6% originating from countries outside the European Union and the Erasmus+ programme countries, and 29.4% from the EU and programme countries. Women represent 35.3% of the students, a proportion that reflects the structural imbalance of the physics and engineering fields from which candidates come, and which the joint selection procedure deliberately seeks to attenuate by weighting gender diversity and geographical balance. The large majority of students (86.8%) held Erasmus Mundus scholarships, with 13.2% being self-funded.

Table 1. Students admitted and graduated per edition of the EMJMD WAVES. Non-completions in the three concluded editions correspond to three withdrawals and one transfer to the following edition.

Edition	Enrolled	Graduates	Status
1st (2021–23)	17	16	completed
2nd (2022–24)	13	12	completed
3rd (2023–25)	18	16	completed
4th (2024–26)	22	–	in progress
Total	70	44	

This recruitment profile confirms the global attractiveness of the Erasmus Mundus format: an intake limited to a small number of students per nationality produced markedly multicultural cohorts, which students themselves consistently identify as one of the most transformative dimensions of the programme. At the same time, the low share of European students and the strong dependence on Erasmus Mundus scholarships emerged as structural fragilities, further discussed in Section 4.

3.2 Academic outcomes

The three concluded editions admitted 48 students, of whom 44 graduated (the non-completions corresponding to three withdrawals and one transfer to the following edition) a very good performance for a programme requiring students to move across three national higher education systems in four semesters. After conversion of all partner marks into the French and Portuguese 0–20 scales, the final classification of the full 120 ECTS programme averages 15.4 (standard deviation close to 1.0; individual values between 12.5 and 17.7), with no failures recorded among students who completed the programme. The distribution of final grades concentrates in the Good to Very Good bands (approximately 61% and 23% of graduates, respectively), and the cohort averages show a slight upward trend along the three editions (14.9, 15.5 and 15.7).

3.3 Master's theses and placements

Sixty-seven Master's theses have been carried out or are currently in progress over the four editions. Their host institution distribution (Table 2) is an indicator in itself: about half of the theses took place in a business environment and half in academic or research environments, in line with the double vocation — scientific and engineering — of the programme. The thesis topics cover the full spectrum of the curriculum, from underwater acoustics and acoustic imaging to room acoustics, electroacoustics, railway-induced vibrations, building sound insulation and acoustic metamaterials. Several theses gave rise to scientific publications, and a significant fraction of graduates continued to doctoral studies.

Table 2. Master's theses by type of host institution (four editions, including ongoing placements of the fourth edition).

Host institution type	Number	Share
Consortium (full) partners	15	22%
Associated Partners	4	6%
Industrial Partners	10	15%
Other research laboratories	16	24%
Other companies	22	33%
Total	67	100%

A more critical reading of Table 2 is also instructive: while 48% of the theses were hosted by companies, only 15% took place in Industrial Partners of the consortium itself, the majority of business placements being found in other companies, frequently through the students' own initiative. This gap between the formal network and its effective use is one of the clearest lessons of the first funding period.

3.4 Graduate destinations and alumni feedback

In December 2025, after the graduation of the third cohort, the consortium ran a dedicated alumni survey adapted from the Erasmus Mundus Association's



Graduate Impact Survey [5], obtaining a response rate of 75%, well above typical alumni survey returns. The overall appreciation is high: about 95% of respondents declared themselves very or quite satisfied with their EMJMD WAVES studies, and around 84% considered the programme had prepared them well for the job market. Concerning destinations, more than 50% of the graduates are working in the acoustics sector and about 25% are pursuing doctoral studies; almost 20% of the graduates secured their current position directly through the fourth-semester internship. Among the professional placements reported for the first six months after graduation, the large majority were located in the European Union, suggesting that the programme retains in Europe a substantial part of the talent it recruits mostly from outside Europe. Two acoustics-related start-up companies have been created so far by EMJMD WAVES alumni.

The survey also collected frank criticism, which converged on four lines: an imbalance of workload and level of demand between semesters, with the third semester perceived as overloaded and strongly research-oriented; an insufficient mathematical preparation for that semester, not fully built up in the first year; articulation and communication failures between institutions, with teachers occasionally assuming prior knowledge the students had not acquired; and an insufficient offer of internships and career support through the consortium's own industrial network. These criticisms do not contradict the globally positive assessment, but they delimit precisely the improvement agenda addressed in the renewal.

4. LESSONS LEARNT

Four main lessons emerge from the operational evidence and the alumni feedback. The first concerns curriculum balance and progression: in a joint programme assembled from pre-existing national curricula, the workload and the level of mathematical demand must be actively harmonised across semesters and institutions, and the heterogeneous backgrounds of an internationally recruited cohort require deliberate levelling mechanisms from the very start (a role the Welcome and Integration Week progressively assumed, with refresher sessions on mathematics and scientific programming).

The second lesson concerns inter-institutional coordination: mobility-based programmes need systematic transfer of information between consecutive host institutions (on syllabi actually covered, on the prerequisites profile of each cohort and on practical arrangements), well before each mobility period. Where this transfer relied on informal contacts, gaps appeared; the mechanisms that worked were those that had been formalised.

The third lesson is that a formal industrial network does not automatically translate into placements: protocols must be converted into a regular, catalogued and timely offer of internships and thesis topics, and into structured career support, otherwise students bear the burden of finding their own business placements.

The relative success of placements obtained through the network where partner engagement was strong confirms that the instrument works when actively managed.

The fourth lesson concerns recruitment and sustainability: the applications have been predominantly non-European and the programme is strongly dependent on Erasmus Mundus scholarships, with self-funded participation so far limited. Broadening the European recruitment base and the self-funding capacity is a condition for the long-term sustainability of any joint programme of this kind beyond the EU funding period, a challenge that is structural to the Erasmus Mundus model rather than specific to the EMJMD WAVES.

5. FROM EMJMD WAVES TO EMJM WAVES+: THE RENEWAL

These lessons directly informed the design of the renewal proposal, the EMJM WAVES+ (Waves, Acoustics, Vibrations, Engineering and Sound Plus), submitted in February 2026 under the Erasmus+ programme, having recently passed the evaluation phase and is proceeding to start grant preparation. The renewal is not a fresh start but a set of targeted improvements grounded in the evidence of the first funding period, with three structural changes.

First, the consortium is enlarged with the Norwegian University of Science and Technology (NTNU, Trondheim), a targeted reinforcement adding recognised strength in engineering acoustics, signal processing, environmental and marine acoustics and numerical modelling. Second, the third semester bifurcates into two parallel specialisation tracks with equal numbers of study places (in Marseille, oriented towards wave propagation in complex media, nonlinear dynamics, acoustic imaging and metamaterials, or in Trondheim, of more applied engineering orientation, with specialisations in acoustics of the built environment or marine acoustics) responding to the demand for greater specialisation choice while preserving the common first year. Third, the coordination of the consortium moves from Aix-Marseille Université to the Universidade de Coimbra, which hosts the first semester and constitutes the natural academic and administrative entry point of the students, concentrating admission, enrolment and visa coordination at the coordinating institution.

The remaining lessons are addressed by dedicated measures: a rebalanced second-semester course structure and reinforced hands-on components in the first semester; systematic pre-mobility briefings and the sharing of each cohort's prerequisites profile between institutions; an expanded network of 20 Associated Partners and 32 Industrial Partners with formalised commitments, complemented by new Graduation and Employability Workshops associated with the thesis defences; strengthened quality assurance, with mid- and end-of-semester surveys and a periodic alumni survey; incentives to self-funded participation, including tuition-fee waivers for non-scholarship



holders; and the intention to prepare, after the first EMJM WAVES+ cohort, a Joint Diploma to replace the multiple national degrees, building on the national accreditation of the full programme already obtained by two of the partners. It should be honestly noted that several of these mechanisms are new or were only partially tested during the EMJMD WAVES, so that their effectiveness remains a well-founded expectation of the consortium rather than a verified result.

6. CONCLUSIONS

Four editions of the EMJMD WAVES provide a substantiated answer to the question of whether an Erasmus Mundus joint degree can foster excellence, innovation and harmonisation in European acoustics education. The evidence is positive: a highly selective and genuinely global recruitment; near-complete graduation with consistently good academic performance across three national grading systems; Master's theses distributed in balance between academic and business environments; and graduates who are largely employed in the acoustics sector or pursuing doctoral studies, with high reported satisfaction. The programme demonstrated that institutions with different academic cultures can deliver a coherent, fully integrated curriculum through structured mobility, joint governance and harmonised assessment.

The experience also showed where the model is fragile (curriculum balance across institutions, conversion of industrial networks into effective placements, European recruitment and financial sustainability), and the consortium chose to treat this evidence as a design resource: each major decision of the EMJM WAVES+ renewal responds to an identified lesson of the first funding period. In this sense, the main impact of the programme may extend beyond its own graduates: it offers a documented case of how a joint European curriculum in acoustical engineering can be built, evaluated and renewed on the basis of its own operational evidence.

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