DIGIWIND

D3.1
OUTLINE DIGIWIND STUDY PROGRAMMES AND COURSES 12/2024

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Abstract	This report establishes a detailed outline of the curricula for the DigiWind specialised education programmes and courses.
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DigiWind

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Executive summary

The purpose of this document is to establish a detailed outline of the curricula for the DigiWind specialised education programmes (SEPs) and courses leveraging the mapping of existing courses carried out in the Knowledge bank survey (WP2). The report details the development of new M.Sc. and master courses in DigiWind, including information about learning objectives, core elements, the timing of courses and means of delivery.

DigiWind aims to offer 20 SEPs, of which 6 are new and 14 are enhanced. The SEPs contain 105 DigiWind courses equivalent to 544.5 ECTS credits, a 24% increase over the originally promised 440 credits. This increase in DigiWind credits represents an increased ambition by the DigiWind consortium.

Development, execution and assessment: The course content will be produced, and the M.Sc. and master courses will be executed for at least two cycles. Quality assessment after each cycle will ensure that improvements are made between the cycles.

Cross-sharing and accessibility for learners: The DigiWind project aims to exploit synergies by cross-sharing courses between the HEI partners and maximise the accessibility of the DigiWind SEPs and courses. The consortium aims to achieve this using any of the following instruments: 1) Student exchange agreements between DigiWind HEIs with the option of "virtual mobility", 2) An official list at each DigiWind HEI home institution detailing which courses at host institution are automatically accepted into specific DigiWind study programs at home institution. 3) Double Degrees (e.g. European Wind Energy Master), 4) University networks like Enhance and EuroTeQ Alliances.

Dissemination: The SEP curricula will be published via the DigiWind virtual campus, the project's dissemination channels, and the HEI partners own portals.

Administration, KPI tracking and data management: The developed M.Sc. and master courses will be formally integrated in the DigiWind SEP locally at the partners and bilaterally between the partners. The new DigiWind degrees will be formally established leveraging the HEI partner's student administration systems tracking of enrolments, numbers of completed ECTS, and degrees. Administrative procedures will be put in place for cross-sharing, accessibility and KPI reporting.

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Funded by the European Union

Definitions, Acronyms and Abbreviations

Acronym/ Abbreviation	Title
MSc	Master of Science study programme
Masters	Masters programme
KPI	Key performance indicator
LLL	Life long learning
SEP	Specialised education programme
HEI	Higher education institution
ECTS	European Credit Transfer and Accumulation System
WP	Work Package

1 Introduction

The purpose of this document is to establish a detailed outline of the curricula for the DigiWind Specialised Education Programmes (SEPs) leveraging the mapping of existing courses carried out in WP2. The outline details the development, execution and assessment of DigiWind SEPs and courses, including information about funding criteria, KPI tracking, cross-sharing and accessibility for learners, pre-requisites, learning objectives, core elements, teaching and assessment methods, dissemination, timing, means of delivery and risk management. The partners responsible for the implementation of the MSc and Masters study programmes in DigiWind are given in bold in Table 1.

Table 1 DigiWind partners, HEI partners in bold

Participant Number	Participant organisation name	Short name	Country
1	**Danmarks Tekniske Universitet**	**DTU**	**DK**
2	**Technische Universiteit Delft**	**TUD**	**NL**
3	**Norges Teknisk-Naturvitenskapelige Universitet**	**NTNU**	**NO**
4	**Technological University of the Shannon: Midlands Midwest**	**TUS**	**IE**
5	**Politechnika Gdanska**	**PG**	**PL**
6	Universitetet i Oslo[1]	CCSE	NO
7	F6s Network Ireland Limited	F6S	IE
8	WHIFFLE BV	WHIF	NL
9	Cadpeople A/S	CADP	DK
10	Irish Manufacturing Research Company Limited By Guarantee	IMR	IE

[1] Since the Grant Agreement stage one partner, CCSE, has left the project. The other HEI partners cover the deficit in SEPs and courses.

2 Scope, criteria and key performance indicators

2.1 Scope and definitions

The scope of this report (D3.1) and DigiWind WP3 covers Master of Science (MSc) programmes, Masters degree programmes, and courses delivered in these programmes by the Higher Education Institutions (HEIs) participating in DigiWind (see Figure 1). MSc degrees require attendance at the university campus and/or via virtual campus facilities, which will be available within DigiWind. Masters degrees are self-paced online and part-time degrees. The pre-requisite for taking both degrees is a BSc degree in a relevant field, defined by the HEIs.

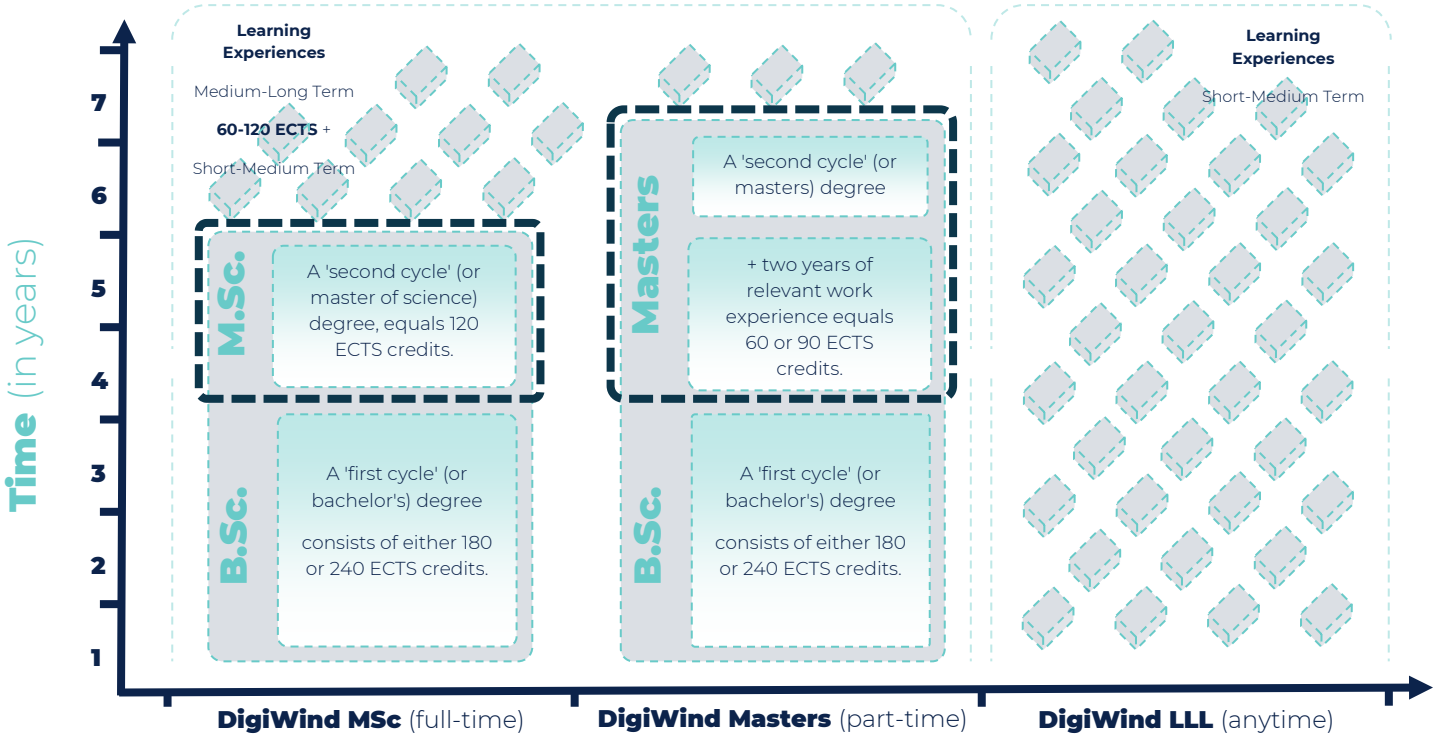

Figure 1 Specialised education programmes (SEPs) in DigiWind. The dashed dark-lined boxes indicate the scope of deliverable D3.1.

Definitions new and enhanced courses and SEPs in DigiWind:

- New: The course/SEP did not exist in the HEI catalogue before 2024 and qualifies the criteria given in Section 2.2.
- Enhanced: The course/SEP exist in the HEI catalogue before 2024 and qualifies the criteria given in Section 2.2.

Definitions of hybrid, online and in situ delivery in DigiWind:

- Hybrid delivery: Students can access the learning materials digitally and synchronously participate in learning activities either in situ or online. Students can participate in in-situ assessment or remote assessment if necessary.
- Online delivery: Students can access digital learning materials for the complete course and participate in synchronous or asynchronous online learning activities. Students must participate in remote assessment.
- In situ delivery: Students can access digital learning materials for the complete course and participate in learning activities in situ. Students participate in assessment in situ.

2.2 Criteria for DigiWind study programmes and courses

The HEI partners in DigiWind have agreed on criteria for project participation and funding. These criteria are aimed at maximising the intended outcomes of the project. A DigiWind SEP or course given by one or more of the DigiWind HEI partners, must satisfy the following competence and administrative criteria (a-e):

Competence criteria:

a. The SEP or course gives competence within digitalisation (advanced digital skills) and/or energy systems (domain areas).

b. The SEP or course promotes computational thinking in its courses and/or aims to enhance or further develop digital pedagogy and digital dissemination.

Administrative criteria:

c. The SEP awards an accredited MSc or Masters degree upon its successful completion.

d. The SEP and course information will be accessible through the DigiWind platform.

e. Necessary student data (according to DigiWind deliverable D1.3 Data Management Plan [1]) in courses and SEPs are transferred between DigiWind HEIs.

A typical DigiWind SEP may comprise many different courses; some of these courses will be granted status and funding as enhanced or new DigiWind courses. Granting status as a DigiWind SEP or course is performed on a case-by-case basis in agreement with DigiWind cross-coordination team DTU and HEI partners. Digital skills and domain areas are detailed in section 3.3.1.

2.3 Key performance indicators for DigiWind study programmes and courses

The key performance indicators (KPIs) for DigiWind SEPs and courses are given in Table 2. The SEPs listed in section 3.1 (Table 4) and DigiWind courses count toward these KPIs. The KPIs are measured regularly throughout the project period, starting in M18.

Table 2 KPIs for DigiWInd SEPs and courses

Target group	Call Fiche Metric	Target	Means of verification
Students	**KP3.1:** HEIs offering new programmes[2]	5	*MS3.1* *(M18, first measurement)*
	KP3.2: Applications to the programmes[3] (DTU: 200, TUD: 200, NTNU: 200, TUS: 200, PG: 200)	1,000	*MS3.1* *(M18, first measurement)*
	KP3.3: Students enrolled in the programme[3] (DTU: 180, TUD: 180, NTNU: 180, TUS: 180, PG: 180)	900	*MS3.1* *(M18, first measurement)*
	KP3.4: Students who have successfully completed the education programme(s) in the time foreseen by the action[3] (DTU: 120, TUD: 120, NTNU: 120, TUS: 120, PG: 120)	600	*MS3.2* *(M36, first measurement)*
	KP3.5: People who received a degree after the successful completion of the full education programme[3] (DTU: 120, TUD: 120, NTNU: 120, TUS: 120, PG: 120)	600	*MS3.2* *(M36, first measurement)*
	KP4.1: People who received a certification after the successful completion of the DigiWind (online) courses[4]	10,000	*D4.3* *(M18, first measurement)*

[2] Includes new programmes established in DigiWind as well as enhanced programmes (i.e., existing programmes enhanced in DigiWind with study lines or courses addressing key capacity areas).
[3] To be split according to gender, age, educational background, country of origin.
[4] Includes all courses, which are offered *online* in DigiWind, either as part of M.Sc. or Master programmes or as self-standing LLL modules and by HEIs as well as private sector entities.

3 Outline of DigiWind programmes and courses

This section outlines the planned DigiWind SEPs and courses, timing, cross-sharing, accessibility, content and development. Table 3 gives an overview of the planned SEPs and courses in the project, compared to the stated target in the proposal stage. DigiWind aims to offer 20 SEPs, which contain 105 DigiWind courses equivalent to 544.5 ECTS credits, a 24% increase over the originally promised 440 credits. This increase in DigiWind credits represents an increased ambition by the DigiWind consortium. As detailed in section 3.4, there are risks and uncertainties associated with some of the SEPs and courses in M12 of the project. This is unavoidable in the legal and organisational context within which the DigiWind HEIs operate. However, the HEI partners and coordination team are aware of these uncertainties and have designed planned actions and contingencies to minimise the risk.

Table 3 Overview D3.1 (M12) planned Specialised Education Programmes (SEPs) and courses from Higher Education Institutions (HEIs) in bold, numbers in parenthesis represent SEPs and courses stated in DigiWind grant agreement. Dash (-) indicates no number reported.

HEI	New SEPs	Enhanced SEP	New Courses No. / ECTS	Enhanced Courses No. / ECTS	Total Courses No. / ECTS
DTU	1 (0)	5 + EWEM[5] (3 + EWEM[5])	5 / 25 (12 / 45)	8 / 50 (4 / 30)	13 / 75 (16 / 75)
TUD	-	5 + EWEM[5] (3 + EWEM[5])	2 / 6 (- / 21)	17 / 64 (- / 43)	19 / 70 (- / 64)
NTNU	0 (1)	3 + EWEM[5] (3 + EWEM[5])	2 / 15 (3 / 23)	20 / 142.5 (18 / 128)	22 / 157.5 (21 / 151)
TUS	3 (2)	-	13 / 65 (8 / 40)	5 / 25 (2 / 10)	18 / 90 (10 / 50)
PG	2 (2)	1 (0)	16 / 81 (20 / -)	17 / 71 (10 / -)	33 / 152 (- / 100)
CCSE	-	-	-	0 / 0[6] (3/ 21)	0 / 0[6] (3 / 21)
ALL	6 (5)	14 (10)	38 / 192 (- / 164)	67 / 352.5 (- / 276)	105 / 544.5 (- / 440)

[5] European Wind Energy Master (EWEM) is a Double Degree program shared by DTU, NTNU and TUD.
[6] Since the Grant Agreement stage one partner, CCSE, has left the project. The other HEI partners cover the deficit in course number and ECTS credits.

3.1 DigiWind MSc and Masters SEPs

The planned enhanced and new SEPs are listed in Table 4. DigiWind aims to offer 20 SEPs, of which 6 are new and 14 are enhanced. Some courses developed in DigiWind are part of more programmes than those shown in the list; the list of DigiWind programmes may be updated by milestone MS3.1 (M18), June 2025. Curricula are in place for the DigiWind SEPs, which will be open for registrations by the academic year 2025/2026.

Table 4 New and enhanced SEPs for DigiWind

HEI	SEP	Track/profile	Status
DTU	MSc Wind Energy (**new**)	Digitalisation	Ready acad. year 2025/2026
	MSc Sustainable Energy Systems (**enhanced**)	Digital Energy Systems	Ready acad. year 2025/2026
	MSc Sustainable Energy Technologies (**enhanced**)	Wind Energy	Ready acad. year 2025/2026
	MSc Wind Energy (**enhanced**)	All existing specialisations	Ready acad. year 2025/2026
	Master Wind Energy (**enhanced**, online)	Not applicable	Ready acad. year 2025/2026
	MSc European Wind Energy Master, EWEM (**enhanced**)	Rotor Design	Ready acad. year 2025/2026, uncertain status for 2026/2027 as stated by EWEM coordinators
		Wind Farms and Atmospheric Physics	
TUD	MSc Aerospace Engineering (**enhanced**)	Aerodynamics and Wind Energy	Ready acad. year 2025/2026
		Aerospace Structures and Materials	
	MSc European Wind Energy Master, EWEM (**enhanced**)	Rotor Design	Ready acad. year 2025/2026, uncertain status for 2026/2027 as stated by EWEM coordinators
		Electrical Power Systems	
	Sustainable Energy Technology (**enhanced**)	Electrical Energy	Ready acad. year 2025/2026
	Systems and Control (**enhanced**)		Awaiting final confirmation
	Electrical Engineering (**enhanced**)	Electrical Power Engineering	Ready acad. year 2025/2026

NTNU	MSc Electric Power Engineering (**enhanced**)		Ready acad. year 2025/2026
	MSc Energy and Environment (**enhanced**)	Electrical energy technology and smart grids	Ready acad. year 2025/2026
	MSc Marine Technology (**enhanced**)	Marine Structures	Ready acad. year 2025/2026
		Marine Machinery	
	MSc European Wind Energy Master, EWEM (**enhanced**)	Electrical Power Systems	Ready acad. year 2025/2026, uncertain status for 2026/2027 as stated by EWEM coordinators
		Offshore Engineering	
TUS	Master Electrical Power Systems (**new**)	Energy Systems	In accreditation, launch planned for March 2025
	Master Wind Energy Systems (**new**)	Wind	In planning, launch due in May 2025
	Master Smart Energy Systems (**new**)	Energy Systems	Planned for development Q4 2025
PG	MSc Smart Renewable Energy Engineering (**new**)	Smart Wind Energy Engineering	In planning, scheduled to run in the fall semester of 2025.
	MSc Ships and Offshore Structures (Okręty i konstrukcje morskie) (**enhanced**)	Design and Construction of Marine and Offshore Power Systems	Ready acad. year 2025/2026
	Master Digital Competence in Wind Energy Engineering (**new**)		In planning, scheduled to run in 2025.

3.2 Cross-sharing, accessibility and dissemination in DigiWind SEPs and courses

The DigiWind project aims to exploit synergies by cross-sharing courses, learners and educators between the HEI partners and maximise the accessibility of the DigiWind SEPs and courses. The consortium aims to achieve this using any of the following instruments:

1. Student exchange agreements between DigiWind HEIs (in situ attendance), the option of “virtual mobility” will be incorporated in

these agreements, when possible, to enable remote access and registration to DigiWind courses.

2. An official list at each DigiWind HEI home institution[7] detailing which courses at host institution are automatically accepted into specific DigiWind study programs at home institution.
3. Double Degrees (e.g. European Wind Energy Master),
4. University networks like the Enhance network[8] (NTNU, TUD, PG) and EuroTeQ network[9] (DTU). Course catalogues from DigiWind HEIs will be distributed through the information network of these alliances.

DigiWind endeavors to lower the barriers to student exchange by mitigating financial constraints to the extent possible by the HEI-level regulations. This is done by:

1. Granting DigiWind scholarships and fee waivers (WP5 DigiWind).
2. Via existing exchange agreements, which lower the cost of student exchange by exempting students from certain registration fees.
3. Via «Virtual mobility» option in exchange agreements which reduces registration fees, the need for travel and other expenses. Students get remote access to hybrid or online courses.

The DigiWind SEPs and courses will be disseminated widely to attract potential students. The SEP curricula will be published via the DigiWind virtual campus, the project's dissemination channels, relevant university network platforms and the HEI partners' own portals.

3.3 DigiWind course content, development, delivery and timing

The course content will be developed according to section 3.3.1 and 3.3.2. The M.Sc. and master courses will be executed for at least two cycles, see section 3.3.3 for means of delivery and section 3.3.4 for timing. Quality assessment after each cycle will ensure that improvements are made between the cycles.

3.3.1 Course content - domain areas and digital skills

In section 2.2. the competence criteria state that a DigiWind course must give competence within digitalisation (digital skills) and/or energy systems (domain areas). The DigiWind knowledge bank deliverable D2.1 [2] provides input regarding the demand for advanced digital skills, gaps in the current education offers, and preferred training formatslæ.

[7] Home institution is the institution in which the student is enrolled.
[8] https://enhanceuniversity.eu/
[9] https://euroteq.eurotech-universities.eu/

The focus of DigiWind courses and SEPs is to ensure that students who have finished the program have the necessary domain and digital skills to thrive in the wind industry of tomorrow. The necessary domain areas were mapped as part of the knowledge bank survey [2], shown in Table 5. The knowledge bank survey revealed that the domain areas are generally covered in existing HEI courses. It was thus decided to shift the focus to enhancing courses, particularly in terms of their delivery format (i.e., from in situ to online or hybrid), instead of developing new courses. This is reflected in the decrease in the number of new courses and increase in the number of enhanced courses in Table 3 compared to the grant agreement.

Table 5 DigiWind domain areas from survey

Domain areas - Engineering R&D	**Domain areas - Technical**
Resource assessment	Wind turbine O&M
Wind farm development	Turbine installation
Layout optimization	Transport & Logistics
Asset management	Health & Safety
Wind farm control	Production/assembly
Grid management	Electric installation
Markets & revenue	…
Wind turbine design	
Lifetime and reliability assessment	
Instrumentation	
Materials and component design	
Manufacturing and process engineering	
Weather forecasting	

Table 6 List of digital skills categories used in the Knowledge Bank, with survey ranking results

Digital skills categories	**Knowledge bank survey ranking**
Numerical analysis, simulation, optimisation, modelling tools	1
Scientific programming and software development	2
Machine learning, deep learning and data science	3
Data engineering, semantics, interoperability and quality assurance	4
Generative AI and Large Language Models	5
Advanced digital tools for research and innovation communication	Lower rankings
Robotics and autonomous systems	
IoT, sensors technology, Extended Reality	
Blockchain technology and applications	
Cyber security	
Cloud computing	
Others	
High Performance Computing (HPC) and CPU and GPU applications	

The main takeaways from the knowledge bank survey [2] informed the digital skills to be included in the DigiWind course development for the next generation of wind and energy systems education:

1. Digital skills are fundamental skills, in line with the role of mathematics.
2. Programming and software development skills are essential.

The industry professionals asked in the survey underlined the need to teach digital skills and domain knowledge together to achieve relevant learning outcomes. The focus of DigiWind courses is mainly the top 5 advanced digital skills on demand by industry as presented in DigiWind knowledge bank, D2.1 in Table 6. In general, the digital skills in the planned courses (Table 7) align with the needs reported by the knowledge bank survey: the top 3 skills in planned DigiWind courses match the ranking one to one; the last 2 skills are close in ranking, although not a direct equivalent.

Table 7 Digital skills covered in planned courses, D2.1 knowledge bank survey results in parenthesis.

Digital skill in planned DigiWind courses	**No. Courses**	**Percentage of total no. courses[10]**	**Ranking planned courses**
Numerical analysis, simulation, optimisation, modelling tools	59	62%	1 (1)
Scientific programming and software development	30	32%	2 (2)
Machine learning, deep learning and data science	9	9%	3 (3)
High Performance Computing (HPC) and CPU and GPU applications	3	3%	4 (-)
Data engineering, semantics, interoperability and quality assurance	1	1%	5 (4)

3.3.2 New and enhanced course development and pedagogic level

New and enhanced courses in DigiWind will follow the model shown in Figure 2. In section 2.2. the competence criteria stated that the course must promote computational thinking in its courses and/or aim to enhance or further develop digital pedagogy and digital dissemination. Thus, DigiWind aims to increase the student's digital mindset and the quality of the digital pedagogy for hybrid/online courses. The work will be informed by the guidelines in the DigiWind Standard Operation Procedures [3].

[10] The sum of percentages exceeds 100% because some courses cover several skills.

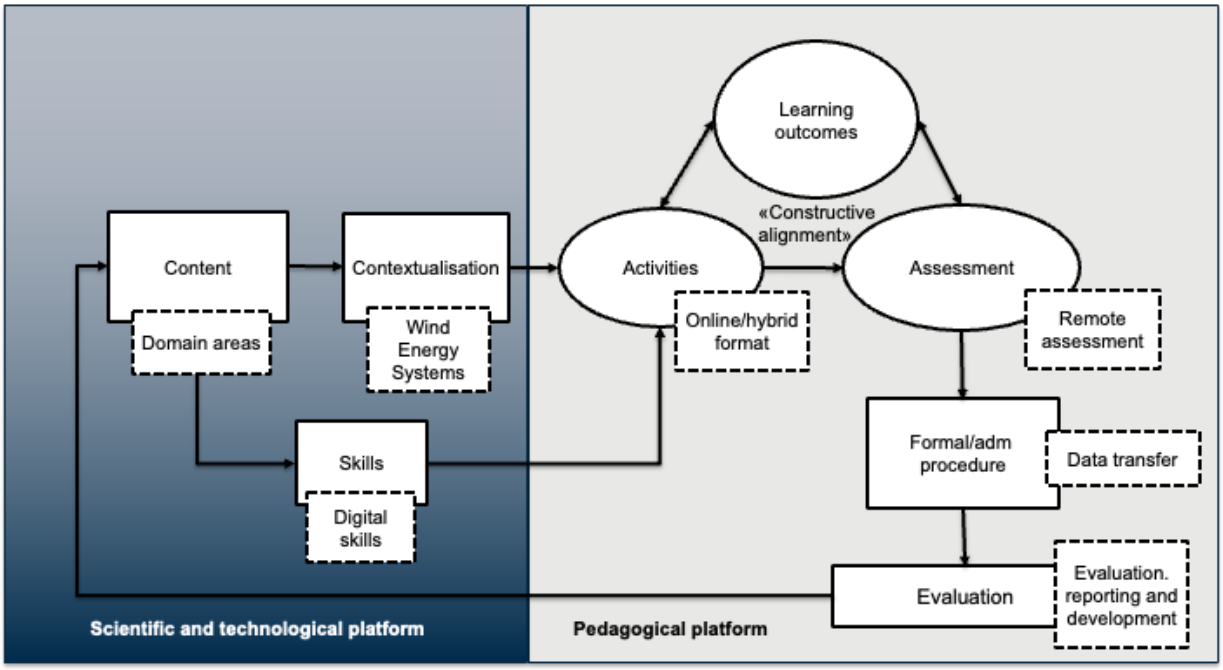

Figure 2 Model for developing and updating courses in DigiWind

3.3.3 Course delivery

The majority of DigiWind courses will be delivered in a hybrid or online format to maximise course accessibility for students at home institutions as well as for students at other institutions. The delivery follows the scheme in Figure 3.

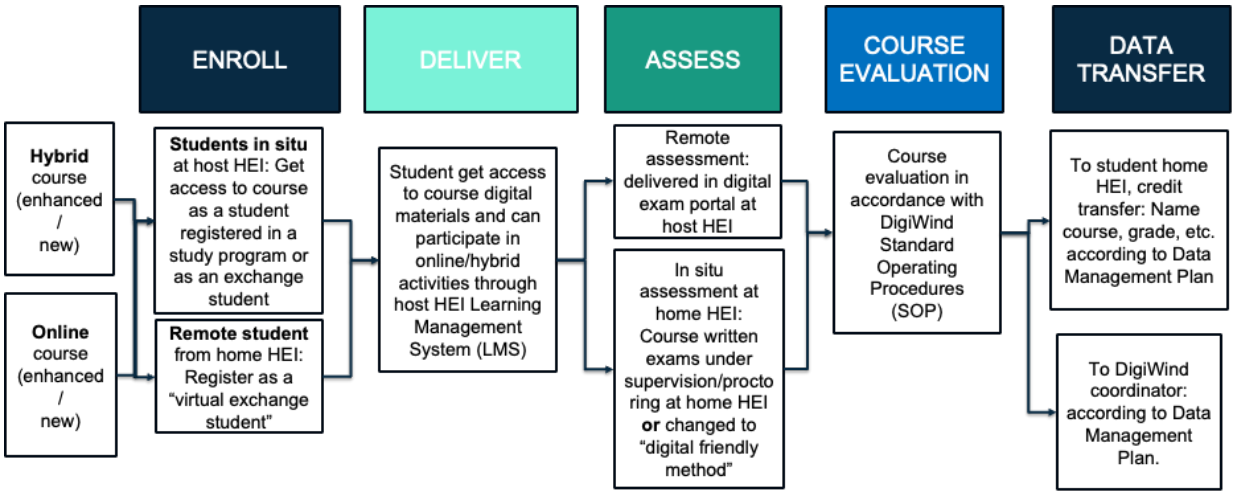

Figure 3 Proposed DigiWind delivery of online and hybrid courses

3.3.4 Course timing

The planned course timing is shown in Table 8. A first run of courses in the spring and autumn terms of 2025 will be used as an experience basis for the coming terms. The number of courses is increased once evaluation data of the first course batches are available.

Table 8 DigiWind course timing schedule, number of courses per term

	2025	2026	2027
Spring	30	49	49
Autumn	31	56	56

3.4 Study programme and course risk management

Europe hosts a significant diversity of framework conditions, regulations, decision-making and implementation processes that govern how HEIs operate[11]. This, in addition to the (geographical, administrative and regulatory) diversity of DigiWind HEI organisations as well as fluctuating HEI economy and strategic priorities, pose a risk for the proper execution of DigiWind SEPs and courses. To manage this risk, the DigiWind project has planned 24% more credits than the proposal statement, giving robustness towards risks and a greater likelihood of achieving our KPIs. The risk is mapped in phases for course execution, as shown in Figure 4 and Table 9. Phase 1 courses represent 58% of the total DigiWind courses and have a low expected uncertainty in execution. The remaining 42% of courses in Phase 2 are expected to have mid to high uncertainty in execution as of December 2024.

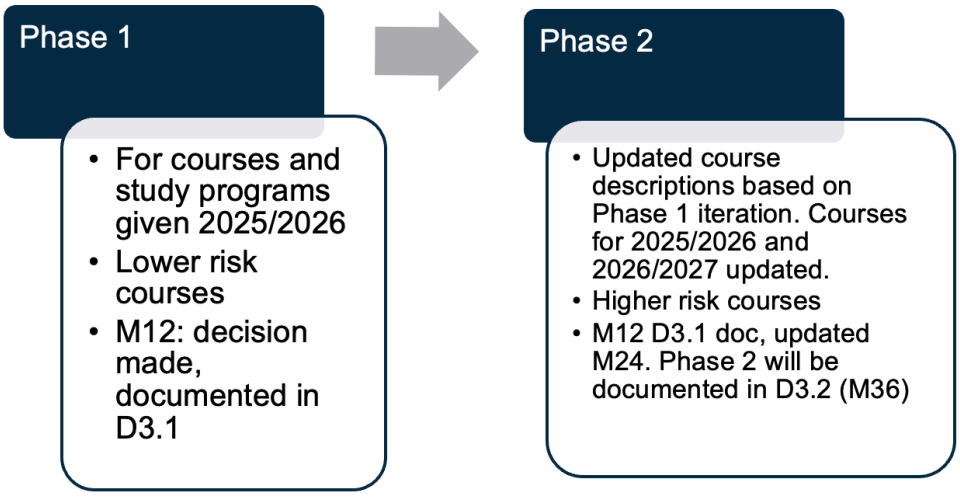

Figure 4 Phases course execution

[11] "Evolving models of university governance. The governance models of the European University Alliance", 2021, European University Association, https://www.eua.eu/downloads/publications/eui%20governance%20paper%20new.pdf

Table 9 Course uncertainty by DigiWind phase

Phase	No. Courses	Uncertainty level	Percentage of total no. Courses	Status
1	61	low	58%	Planned
2a	19	mid	18%	Final confirmation by April 2025, before M18
2b	25	mid/high	24%	Final confirmation by December 2025

Appendix

A.1 References and Related Documents

ID	Reference or Related Document	Source or Link/Location
1	DigiWind Data Management Plan	DigiWind Teams Channel WP1/Deliverables/D1.3
2	DigiWind Knowledge Bank	DigiWind Teams Channel WP2/Deliverables/D2.1
3	DigiWind Standard Operating Procedures	DigiWind Teams Channel WP2/Deliverables/D2.2
4	DigiWind Grant Agreement	DigiWind Teams Channel General/Project documents

A.2 Outline of the Curricula – List of SEPs and courses

GDPR-compliant file sharing service is used to access the comprehensive information sheet via https://digiwind.filecloudonline.com/url/wp3_sep_courselist, which consists of:

- MSc and Master study programs (SEPs)
- DigiWind WP3 Course List
- Analysis

in its segments. The description presented in the main body of this deliverable is deducted from this information sheet, which will be modified if/when needed and before being eventually published on the DigiWind virtual campus to open the SEPs for registrations, on M18 (MS3.1).