INFORMATICS EUROPE

Informatics for engineers: what European curricula guarantee, and what they miss

Informatics Skills as a Foundation for Multiple Disciplines

Skills Working Group · method, evidence and results of the first phase: UPM in full and a pilot of 17 degrees at 9 universities in 5 countries

Workshop · Wednesday 28 October 2026 · Agustín Yagüe - Ernestina Menasalvas – Universidad Politécnica de Madrid

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Outline

Background	The Digital Decade targets and this year’s work
Competences and profile	The taxonomy, where it comes from, and how required levels were set
Method and confidence	Rating, sample, validation, European evidence review, sensitivity
Results	Shared gaps, by area, by university, what works, electives, regulation
Conclusions and discussion	What informatics departments can do, phase 2, your questions

By 2030 Europe wants a digitally skilled workforce and digitally transformed businesses

Skills

At least 80% of adults with basic digital skills; 20 million ICT specialists, with convergence between women and men

Business

75% of enterprises using cloud, AI or big data; over 90% of SMEs with at least basic digital intensity

Infrastructure

Gigabit connectivity and 5G for all, 10,000 climate-neutral edge nodes, 20% of world semiconductor production

Public services

All key public services online, electronic health records and digital identity for every citizen

Engineers are the ones who will deploy cloud, AI, data and IoT in industry, infrastructure and agriculture, and drive the twin green and digital transition.

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Our question: are European engineering degrees preparing graduates for the 2030 targets?

1
Define
A taxonomy of informatics competences:
14 fields,
76 subfields

2
Require
The level each engineering area needs, from regulation and sector sources

3
Measure
All engineering degrees at UPM:
39 degrees,
415 course guides
International
17 degrees
1189 course guides

4
Compare
A European pilot: 9 universities, 5 countries, 17 degrees

5
Validate
A second, blind rater re-scores every pilot course

The focus is what **every** graduate is guaranteed, not what a motivated student could pick in electives.

The taxonomy follows CS2023 knowledge areas, plus a field of applied digital skills

Field	Closest reference
1 Foundations	CS2023 MSF, AL
2 Programming	CS2023 SDF, AL, FPL
3 Software engineering	CS2023 SE
4 Computer engineering	CS2023 AR, SF, SPD
5 OS and distributed	CS2023 OS, PDC
6 Networks	CS2023 NC, SPD
7 Cybersecurity	CS2023 SEC

Field	Closest reference
8 Data and info systems	CS2023 DM; IS2020
9 Artificial intelligence	CS2023 AI
10 Graphics, interaction	CS2023 GIT, HCI
11 Web and mobile	CS2023 SPD
12 Applied computing	Domain applications
13 Computing and society	CS2023 SEP
14 Applied digital skills	DigComp 2.2; AI Act art. 4

Defined by the study team for the UPM analysis. The mapping is indicative: it lets an informatics department read the results in its own curriculum language.

14 fields and 76 subfields, aligned with CS2023 and the ACM CCS

Field	Subfields	Where it comes from
1 Mathematical and theoretical foundations	1.1 Discrete mathematics · 1.2 Logic · 1.3 Statistics and probability · 1.4 Numerical methods · 1.5 Theory of computation · 1.6 Formal languages and automata	CS2023: Mathematical and Statistical Foundations; basic engineering training
2 Programming and algorithms	2.1 Programming fundamentals · 2.2 Data structures · 2.3 Algorithms and complexity · 2.4 Object-oriented programming · 2.5 Programming paradigms · 2.6 Language processors	CS2023: Software Development Fundamentals, Algorithmic Foundations, Programming Languages
3 Software engineering	3.1 Requirements engineering · 3.2 Software design and architecture · 3.3 Verification, validation and testing · 3.4 Software quality · 3.5 Project management · 3.6 Agile methodologies and DevOps	CS2023: Software Engineering; SWEBOK v4
4 Computer engineering	4.1 Computer technology and structure · 4.2 Computer architecture · 4.3 Embedded systems · 4.4 Real-time systems · 4.5 Robotics · 4.6 Control and automation	CS2023: Architecture and Organization, Specialized Platform Development
5 Operating systems and distributed computing	5.1 Operating systems · 5.2 Concurrency · 5.3 Parallel and high-performance computing · 5.4 Distributed systems · 5.5 Cloud computing	CS2023: Operating Systems, Parallel and Distributed Computing
6 Networks and communications	6.1 Computer networks · 6.2 Internet and protocols · 6.3 Mobile and wireless networks · 6.4 Internet of things · 6.5 Network and systems administration · 6.6 Quantum communications	CS2023: Networking and Communication; 6.6: Quantum Europe Strategy (EU)
7 Cybersecurity	7.1 Information security · 7.2 Cryptography · 7.3 Network and systems security · 7.4 Auditing and forensic analysis · 7.5 Post-quantum cryptography and cryptographic migration	CS2023: Security; ECSF (ENISA); 7.5: NIST FIPS 203-205 and EU PQC roadmap

Own taxonomy, built from the topics of courses with computing content. Fields 1-13 follow the CS2023 knowledge areas (ACM, IEEE-CS, AAAI) and the ACM CCS 2012; field 14 covers applied use in engineering. In coral, the 3 quantum subfields added on 15-10-2026.

14 fields and 76 subfields, aligned with CS2023 and the ACM CCS

Field	Subfields	Where it comes from
8 Data and information systems	8.1 Databases · 8.2 Data warehouses and business intelligence · 8.3 Big data · 8.4 Data mining · 8.5 Enterprise information systems · 8.6 E-commerce	CS2023: Data Management; ACM CCS: Information systems
9 Artificial intelligence	9.1 Machine learning · 9.2 Knowledge representation and reasoning · 9.3 Agents and multi-agent systems · 9.4 Natural language processing · 9.5 Computer vision · 9.6 Bio-inspired computing · 9.7 Generative AI	CS2023: Artificial Intelligence; 9.7: EU AI Act
10 Graphics, multimedia and interaction	10.1 Computer graphics · 10.2 Visualization · 10.3 Virtual and augmented reality · 10.4 Video games · 10.5 Multimedia · 10.6 Human-computer interaction	CS2023: Graphics and Interactive Techniques, Human-Computer Interaction
11 Web and mobile technologies	11.1 Web development · 11.2 Semantic web · 11.3 Web services · 11.4 Mobile applications	CS2023: Specialized Platform Development (web and mobile)
12 Applied computing	12.1 Geographic information systems and remote sensing · 12.2 Scientific computing · 12.3 Computer-aided design · 12.4 Bioinformatics · 12.5 Applied quantum computing	ACM CCS: Applied computing; 12.5: Quantum Europe Strategy (EU)
13 Computing, business and society	13.1 Ethics and legal aspects · 13.2 ICT business management · 13.3 History of and introduction to computing	CS2023: Society, Ethics and the Profession
14 Digital skills applied to engineering	14.1 Data analysis with Python, R or similar · 14.2 Professional use of generative AI tools · 14.3 Simulation, modelling and digital twins · 14.4 Task automation and scripting · 14.5 Cyber hygiene and personal data protection	DigComp 2.2; WEF Future of Jobs 2025; EU AI Act, art. 4

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The analysis covers 11 engineering areas and 39 UPM degrees

2 Aeronautical
UPM degrees
School of Aeronautical and Space Engineering

5 Agricultural
UPM degrees
School of Agricultural, Food and Biosystems Engineering

2 Architecture
UPM degrees
Schools of Architecture (ETSAM) and Building (ETSEM)

1 Sport sciences
UPM degree
Faculty of Physical Activity and Sport Sciences (INEF)

3 Forestry
UPM degrees
School of Forestry Engineering and Natural Environment

2 Geomatics
UPM degrees
School of Surveying, Geodesy and Cartography Engineering

1 Civil
UPM degree
School of Civil Engineering

5 Mining
UPM degrees
School of Mining and Energy Engineering

8 Industrial
UPM degrees
ETSII and ETSIDI schools

2 Naval
UPM degrees
School of Naval Engineering

8 Telecommunication
UPM degrees
ETSIT and ETSIST (telecommunication schools)

9 universities
5 countries
1189 course guides

Each area has its own required-level profile (1-5) for the 76 computing subfields. Each degree is assigned to the closest area.

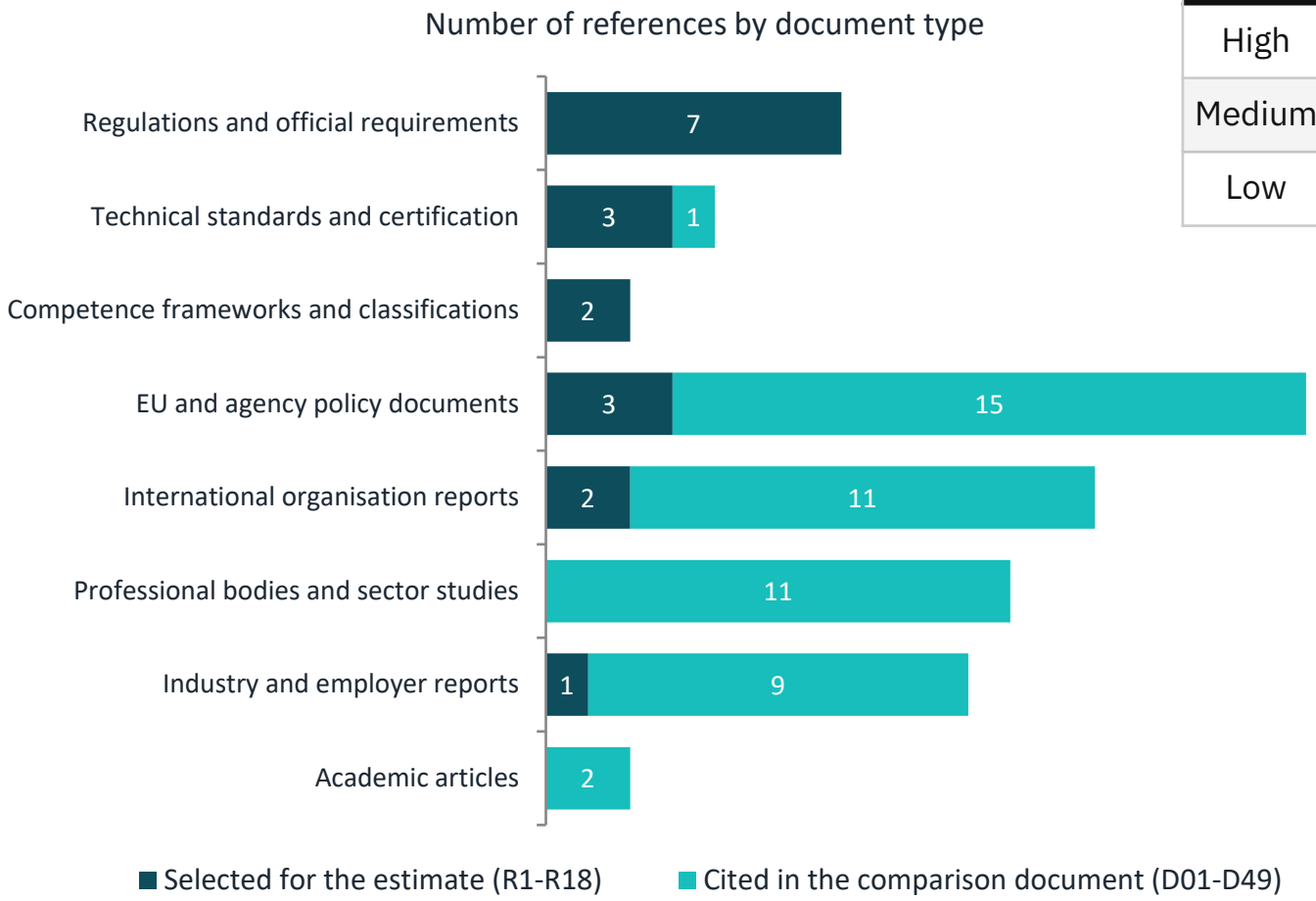
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Binding rules set the high-confidence levels; reports and studies set the rest

Document type	What it contributes	Examples	Refs
Regulations and official requirements	Competences a rule makes compulsory (confidence H)	CIN orders (BOE 2009), EU AI Act, NIS2, Machinery Regulation, EASA Part-IS, BIM procurement plan, EUDR	**7**
Technical standards and certification	Requirements for certified systems (confidence H)	DO-178C via FAA AC 20-115D, IACS UR E26/E27, NIST FIPS 203-205, IMO MASS Code	**4**
Competence frameworks and classifications	Common vocabulary of digital skills	DigComp 2.2 (JRC), ESCO (European Commission)	**2**
EU and agency policy documents	Direction of digital transformation by sector	Digital Decade, Quantum Europe Strategy, EU post-quantum roadmap, JRC construction, EASA AI Roadmap, IMO digitalisation	**18**
International organisation reports	Evidence of skills demand	WEF Future of Jobs 2025, OECD AI skills, FAO precision agriculture, ITU 5G	**13**
Professional bodies and sector studies	Skill gaps reported by each profession	AIAA, SERC, LeaderSHIP (shipbuilding), CECIMO, Lantra, Future Skills Centre	**11**
Industry and employer reports	What employers hire for	McKinsey (digital twins, IIoT), Autodesk/Dodge (BIM), STL Partners, EY, Michael Page	**10**
Academic articles	Peer-reviewed evidence	BIM uptake in AEC degrees (2026); geospatial technologies in plantation forestry	**2**

Plus the NecesidadesInformaticaActuales document itself: 8 rating blocks (Doc-A to Doc-H) used as a second, independent assessment. Full list in the References sheet.

Eight types of documents, 67 references, support the required-level matrix



Grade	Meaning	Share of levels*
High	A regulation or official requirement demands it	12%
Medium	Sector or employer evidence; exact level estimated	21%
Low	Expert judgement without a specific source	67%

1 Estimate

Level 1-5 per subfield and area, backed by 18 selected references

2 Contrast

Compared with informatic skills required: 8 rating blocks citing 49 references

3 Weigh

Confidence H when a regulation or standard requires it, M for reports, L for expert judgement

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Each area needs a different profile; applied digital skills are common to all

Field	Agri	Forestry	Civil	Archit.	Indust.	Aero	Naval	Mining	Telecom	Sport	Geomat.
1 Mathematical and theoretical foundations	2.3 (1/6)	2.3 (1/6)	2.5 (2/6)	2.0 (1/6)	3.0 (2/6)	3.0 (3/6)	2.7 (2/6)	2.7 (2/6)	3.7 (4/6)	1.8 (1/6)	2.5 (2/6)
2 Programming and algorithms	2.5 (1/6)	2.5 (1/6)	2.5 (1/6)	2.0 (0/6)	3.3 (3/6)	3.5 (4/6)	2.7 (1/6)	2.5 (1/6)	**4.2** (5/6)	1.5 (0/6)	3.2 (3/6)
3 Software engineering	2.5 (1/6)	2.5 (1/6)	3.0 (1/6)	2.8 (1/6)	3.8 (4/6)	**4.5** (5/6)	3.8 (4/6)	3.2 (2/6)	**5.0** (6/6)	1.5 (0/6)	3.2 (1/6)
4 Computer engineering	2.8 (2/6)	2.2 (0/6)	2.2 (0/6)	2.0 (0/6)	**4.3** (4/6)	**4.5** (6/6)	**4.0** (4/6)	3.5 (4/6)	**4.5** (5/6)	1.2 (0/6)	2.2 (0/6)
5 Operating systems and distributed computing	2.0 (0/5)	2.2 (0/5)	2.8 (2/5)	2.4 (1/5)	3.4 (2/5)	3.8 (3/5)	3.4 (2/5)	3.0 (2/5)	**4.6** (5/5)	1.2 (0/5)	2.8 (1/5)
6 Networks and communications	2.7 (2/6)	2.5 (2/6)	2.3 (1/6)	2.2 (1/6)	3.2 (2/6)	3.3 (2/6)	3.2 (2/6)	2.8 (2/6)	**4.5** (5/6)	1.8 (1/6)	3.0 (2/6)
7 Cybersecurity	2.4 (0/5)	2.2 (0/5)	2.4 (0/5)	2.4 (0/5)	3.6 (2/5)	3.8 (3/5)	3.6 (2/5)	3.0 (1/5)	**4.6** (5/5)	1.4 (0/5)	2.2 (0/5)
8 Data and information systems	3.7 (4/6)	3.3 (2/6)	3.0 (2/6)	2.8 (2/6)	**4.0** (5/6)	3.3 (4/6)	3.3 (3/6)	3.5 (4/6)	**4.2** (5/6)	2.5 (0/6)	3.2 (3/6)
9 Artificial intelligence	2.7 (2/7)	2.7 (2/7)	2.7 (2/7)	2.9 (1/7)	3.6 (3/7)	3.3 (2/7)	3.1 (2/7)	3.1 (2/7)	3.9 (5/7)	2.0 (0/7)	2.9 (2/7)
10 Graphics, multimedia and interaction	2.5 (1/6)	2.7 (1/6)	3.3 (3/6)	3.8 (4/6)	3.2 (3/6)	3.5 (4/6)	3.3 (4/6)	3.2 (3/6)	3.2 (2/6)	2.8 (1/6)	3.2 (3/6)
11 Web and mobile technologies	2.2 (0/4)	2.2 (0/4)	2.5 (0/4)	2.5 (0/4)	3.0 (1/4)	2.2 (0/4)	2.5 (0/4)	2.2 (0/4)	**4.2** (3/4)	2.0 (0/4)	**4.0** (3/4)
12 Applied computing	3.2 (2/5)	3.0 (2/5)	3.2 (3/5)	3.0 (3/5)	3.0 (2/5)	3.4 (3/5)	3.2 (2/5)	3.2 (3/5)	3.2 (2/5)	1.4 (0/5)	3.2 (3/5)
13 Computing, business and society	2.3 (1/3)	2.3 (1/3)	2.3 (1/3)	2.3 (1/3)	2.7 (1/3)	2.3 (1/3)	2.3 (1/3)	2.3 (1/3)	3.3 (2/3)	2.7 (1/3)	2.3 (1/3)
14 Digital skills applied to engineering	**4.2** (5/5)	**4.2** (5/5)	**4.2** (5/5)	3.8 (4/5)	**4.6** (5/5)	**4.6** (5/5)	**4.2** (5/5)	**4.6** (5/5)	**4.6** (5/5)	3.6 (3/5)	**4.4** (5/5)

Cell: mean required level of the field (1-5) and, in brackets, subfields with level ≥ 4 out of the total. Coral ≥ 4.5 · amber 4.0-4.4 · grey 3.0-3.9 · white < 3.

EU law confirms seven weak levels; ESCO is silent on advanced informatics

Area	Competence (level)	European basis
Mechanical	Verification and testing (4)	Machinery Reg. Annex III 1.2.1; CRA Annex I
Mechanical	Software quality (4)	Machinery Reg. Annex III 1.2.1; CRA Annex I
Mechanical	Embedded systems (5)	CRA art. 2(1), Annex I; Machinery Reg. 1.1.9
Mechanical	Real-time systems (5)	Machinery Reg. 1.2.1, control systems
Mechanical	Internet of things (5)	CRA art. 2(1); Data Act art. 3(1)
Mechanical	Generative AI (4)	AI Act art. 4, AI literacy
Agricultural	Control and automation (4)	Machinery Reg. 1.2.1, farm machinery

68 checked, 7 upgraded

To medium, not high: the law makes the competence relevant; the exact level is still an estimate

ESCO

Engineer profiles list CAD and drawing software; no IoT, ML or cloud. Frameworks lag behind practice

PART 1

Analysis process

From course guides to a gap per subfield, degree and area

Agustín Yagüe - Ernestina Menasalvas – Universidad Politécnica de Madrid - October 2026

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One method for every institution keeps the results comparable

What is offered

1 Collect

Course guides from each institution website, in English, French, Italian, Dutch or Romanian.

2 Rate

NotebookLM rates each guide 1–5 on 76 subfields with the multilingual prompt (Institut Agro: Claude, same criteria)

3 Type

Basic, compulsory or elective from the guide or the programme structure

What is required

4 Profile required

Required level of the matching UPM area: Aeronautical, Industrial, Civil, Agricultural among others

GAP

5 Gaps

Required − guaranteed coverage: critical, moderate, covered, over-coverage

Critical gap
Required ≥ 4 and guaranteed coverage ≤ 2

Moderate gap
Required level exceeds coverage by 1 or more

Covered
Coverage within one level of the requirement

Over-coverage
Coverage exceeds the requirement by 2 or more

Guaranteed coverage = highest rating among basic and compulsory courses (what every graduate gets).

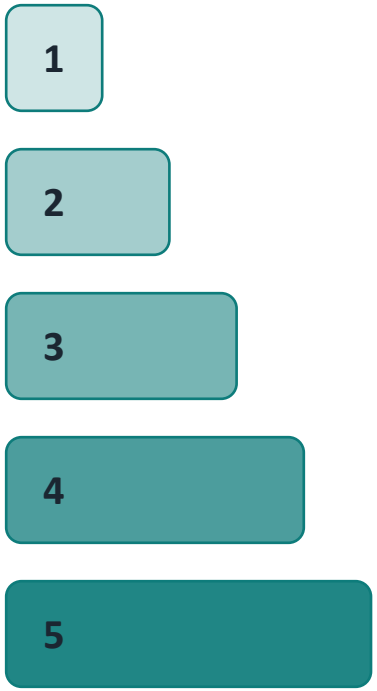
2.1

Example. Programming fundamentals (2.1) required at level 4. If the best basic or compulsory subject only rates 2, the gap is 2 and it is classified as a critical gap, even if an elective rates 5 for those students who picks elective courses.

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Coverage is measured twice: what every student gets and what is on offer

Rating scale per guide and subfield



1 — Not present

2 — Brief mention, under 10% of the subject

3 — One or more sections, introductory

4 — At least a full unit, usually with practice

5 — Core of the subject

Guaranteed coverage

Highest rating of the subfield among basic and compulsory subjects. This is what every graduate receives, and the gap is computed against it.

Potential coverage

Highest rating including electives: what a student could reach.

Equivalent ECTS

Σ (rating − 1) / 4 × ECTS of the subject. A 5 in a 6-ECTS subject counts 6.

PART 2

Obtained results across areas

Where the gaps concentrate and which ones every degree shares

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Digital skills for everyday engineering work are the most widespread gap

39

degrees from 14 schools

415

course guides rated on 76 subfields

36/36

degrees with a critical gap in professional use of generative AI

1. **Cross-cutting gaps:** Generative-AI use (36 of 36 degrees), cyber hygiene and data protection (35), IoT and enterprise systems (32), data mining and machine learning (30).

2. **Area-specific gaps:** Regulated competences are not guaranteed: software assurance in aeronautics, ship cyber-resilience in naval, machinery cybersecurity in industrial.

3. **Electives hide part of the gap:** Several subfields reach 4–5 only in electives (statistics, robotics, CAD, ML): guaranteed coverage stays at 1–2.

Applied digital skills are missing everywhere

17

degrees at 10 institutions in 5 countries, 1,189 course guides

4

subfields are critical gaps in all 17 degrees: IoT, enterprise systems, generative-AI use and cyber hygiene

12 / 17

degrees guarantee programming fundamentals at the required level: the shared strength

1. **Shared gap:** Generative-AI use and cyber hygiene are critical in all 17 European degrees, as in 44 and 37 of the 44 UPM degrees. Computer vision, databases, machine learning and visualisation follow (14–16 of 17).

2. Most critical gaps in aeronautical (37.5 vs 31–34), second most in industrial (33.6 vs 23–34); mid-table in civil (16 vs 12–21) and agricultural (16.4 vs 11–21).

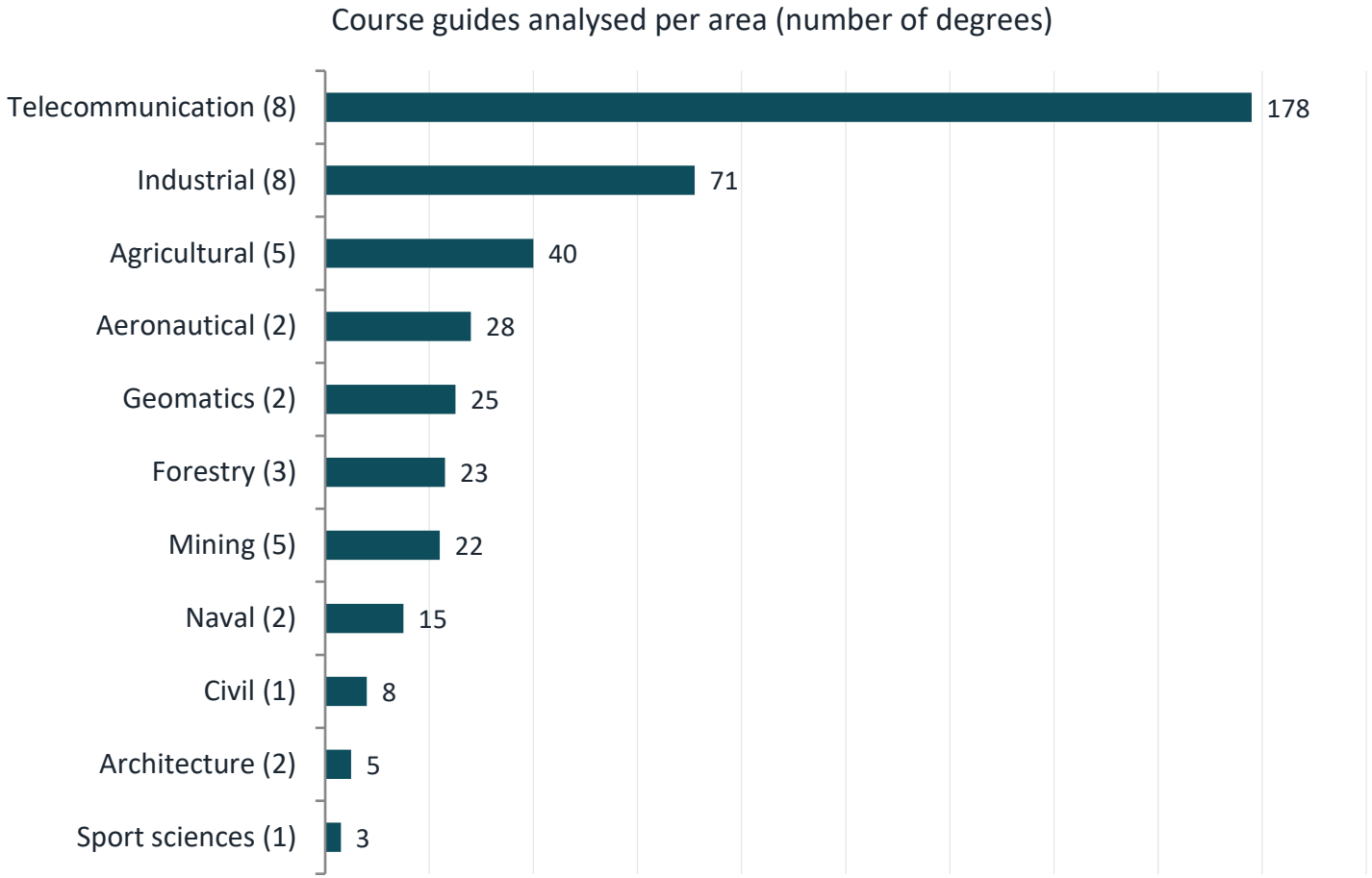
3. **What the best do:** Compulsory computing early and for everyone (INSA, PoliMi, Wageningen), and applied data, AI and control taught inside the discipline (TU Delft, Wageningen).

UPM in full, plus 17 degrees from 9 universities in 5 countries

Country	Technical university	Degrees	Green (agronomic) degree
Spain	UPM	39 · all areas	5 agronomic, 3 forestry (in UPM)
Netherlands	TU Delft	Aero, Mech, Civil	Wageningen · Biosystems Eng.
Italy	Politecnico di Milano	Aero, Mech, Civil	Univ. of Milan · Sustainable Agriculture
United Kingdom	Imperial College London	Aero, Mech, Civil	Harper Adams · Agricultural Eng.
Romania	UT Cluj-Napoca	Mech, Civil	USAMV Cluj · Agricultural Machinery
France	INSA Rennes	Mech, Civil	Institut Agro Rennes-Angers

1,115 pilot courses reviewed from official study guides (2025-26 or latest). None of the five technical universities offers agronomy or forestry, so each country's green degree comes from its reference agricultural university.

The sample covers 11 reference areas, but some are too small to judge (UPM)



Large samples

Telecommunication (178 guides, 8 degrees) and Industrial (71, 8) give robust patterns.

Small samples

Architecture & Building (5 subjects) and Sport sciences (3) leave about 29 subfields without data.

Provisional

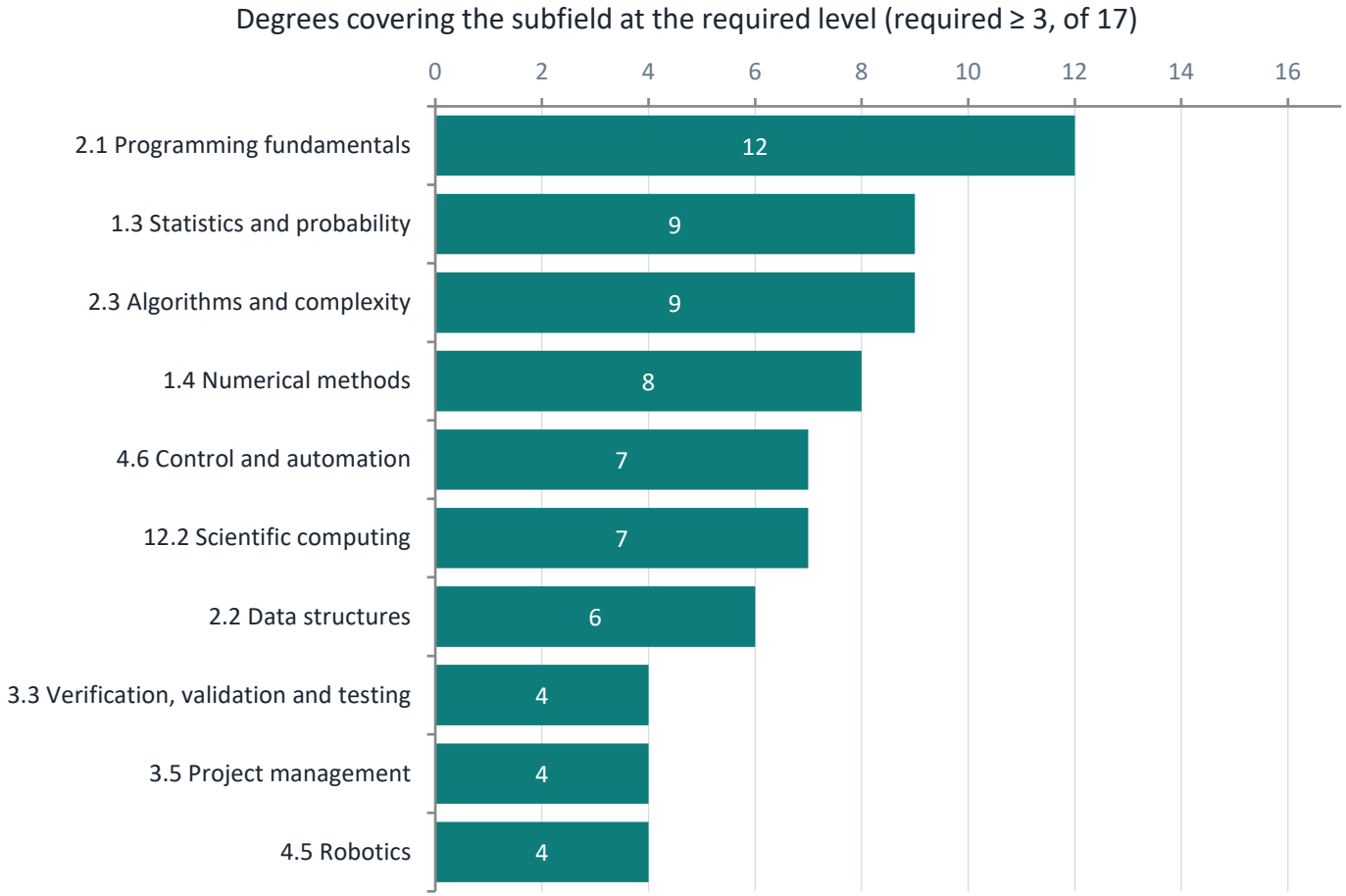
Forestry: subject type missing in the export, so only potential coverage can be used.

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Seventeen degrees from nine institutions, each compared with the matching UPM profile

Area (UPM profile)	Institution	Country	Degree	Guides	Data caveat
Aero	Imperial	UK	MEng Aeronautical Engineering	60	Type missing in 29 of 60 guides
Aero	PoliMi	IT	BSc Aerospace Engineering	30	16 study-plan courses without guide
Aero	TU Delft	NL	BSc Aerospace Engineering	25	Compulsory core only
Mech/Ind	INSA Rennes	FR	Ingénieur Génie Mécanique et Automatique	135	Complete programme
Mech/Ind	UT Cluj	RO	BSc Manufacturing Engineering	85	75 of 85 lack fields 6-14
Mech/Ind	Imperial	UK	MEng Mechanical Engineering	87	11 guides without type
Mech/Ind	PoliMi	IT	BSc Mechanical Engineering	15	8 of 15 without type
Mech/Ind	TU Delft	NL	BSc Mechanical Engineering	18	Compulsory core only
Civil	INSA Rennes	FR	Ingénieur Génie Civil et Urbain	159	Complete programme
Civil	Imperial	UK	MEng Civil Engineering	48	Type missing in 23 of 48
Civil	UT Cluj	RO	BSc Civil, Industrial and Agricultural Buildings	37	Sheets mostly 2019-20
Civil	TU Delft	NL	BSc Civil Engineering	20	Small sample
Civil	PoliMi	IT	BSc Civil Engineering	10	7 of 10 without type
Agri	Wageningen	NL	BSc Biosystems Engineering	43	Some rows missing in export
Agri	Institut Agro	FR	Ingénieur agronome, cursus Rennes	354	Rated by Claude; S6-S7 missing
Agri	Harper Adams	UK	BEng (Hons) Agricultural Engineering	21	Fields 6-10 rated for 5 of 21
Agri	USAMV Cluj	RO	BSc Exploitation of Machinery and Installations for Agriculture and Food Industry	42	Partial: 19 rated guides

The classic computational core is covered: programming, statistics, numerics and control

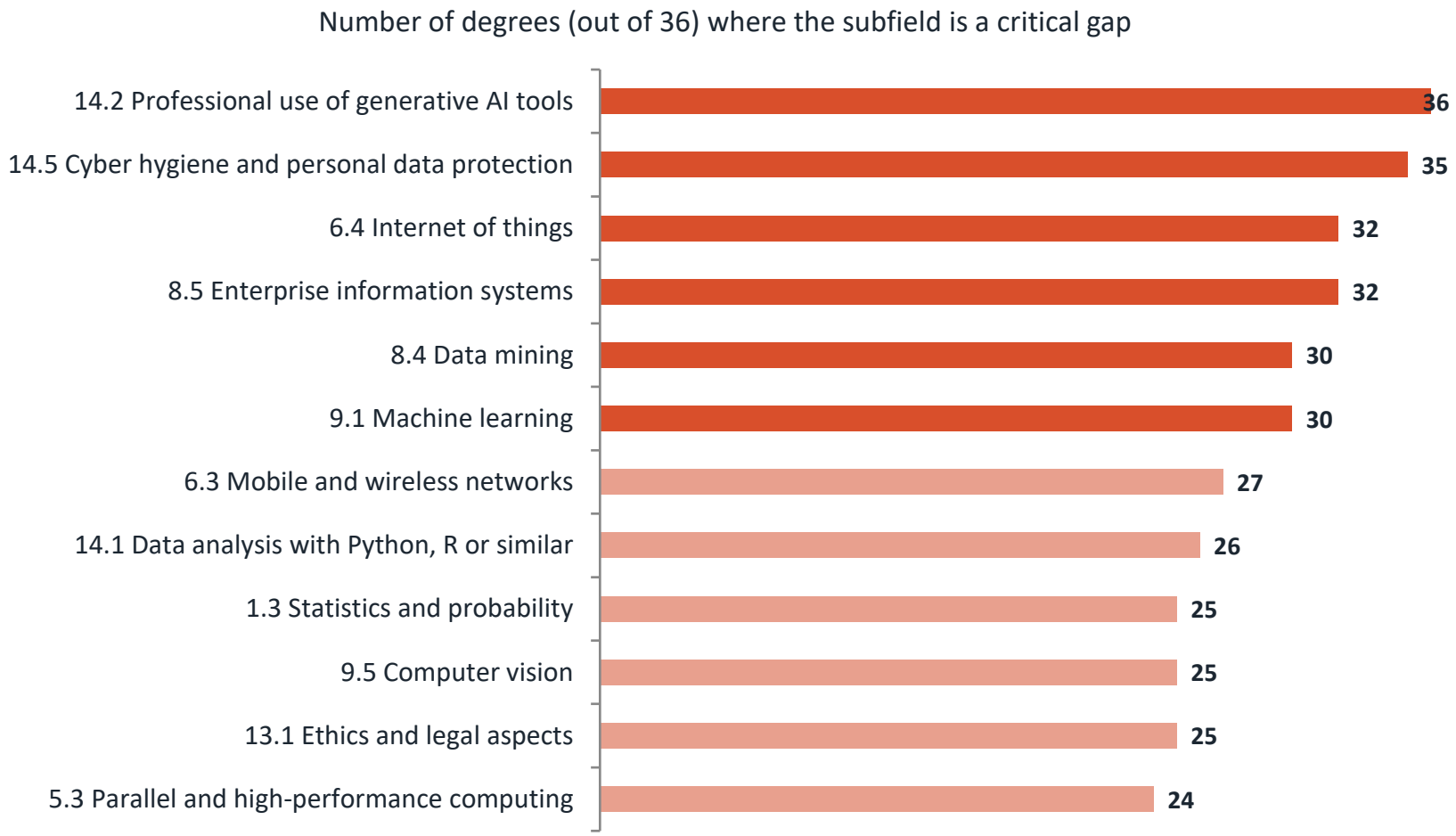


1. **Programming:** covered in 12 of 17 degrees, often by one compulsory first-year course (PoliMi Informatica, INSA, Wageningen).

2. **Maths for engineers:** statistics, numerical methods and scientific computing are covered in 7–9 degrees.

3. **What is missing is newer:** data infrastructure, AI, cloud and security, which entered engineering practice after most curricula were designed.

Generative-AI use and cyber hygiene are critical gaps in almost every degree



What they share

- Applied digital skills (14.x) needed by any engineer, regardless of area
- The data-to-decision chain: IoT, data mining, machine learning, computer vision
- Professional context: ethics, data protection and enterprise systems

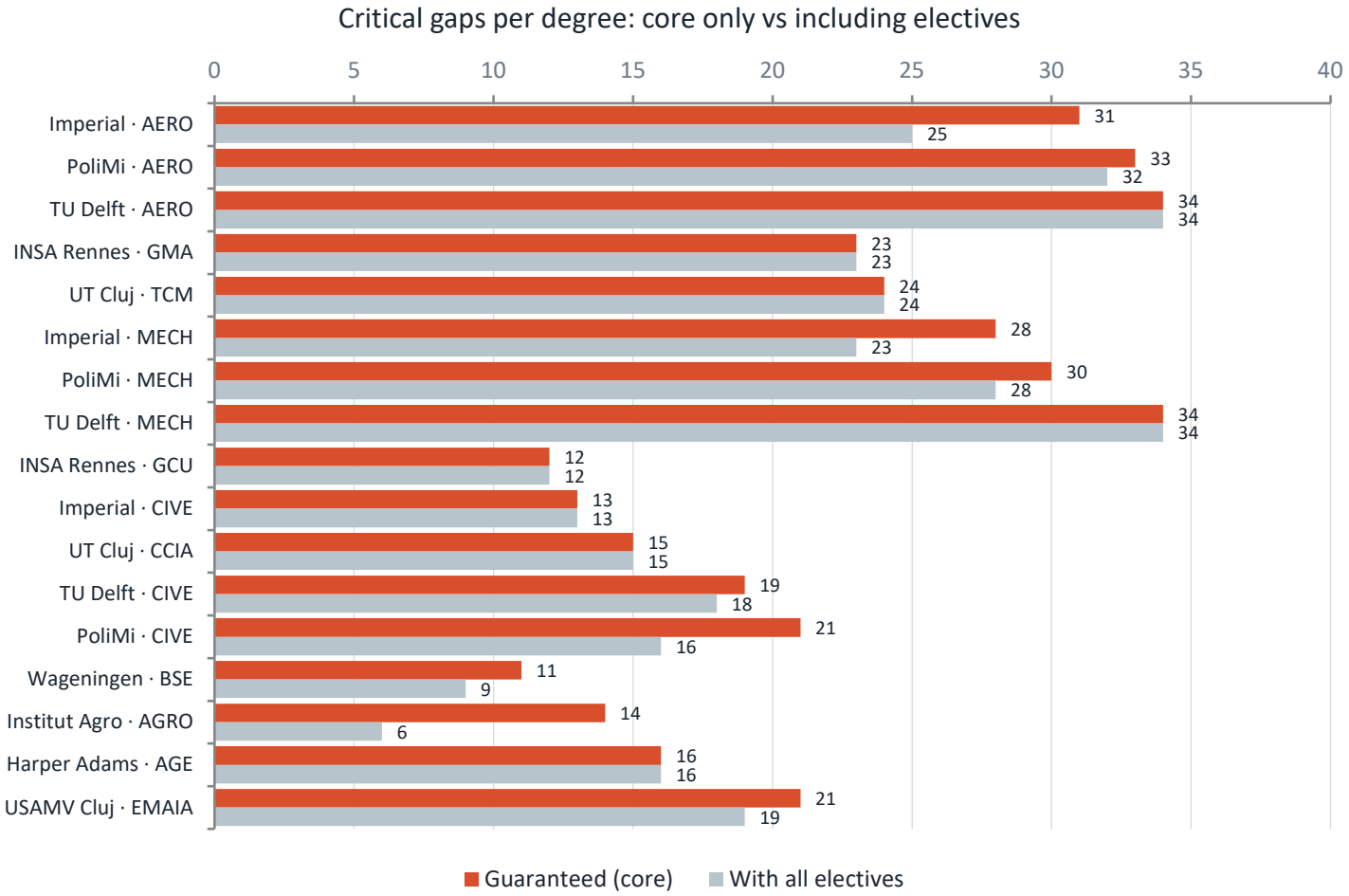
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Data, AI and digital skills concentrate the critical gaps in every area

FIELDS	Imperial AERO	PoliMi AERO	TU Delft AERO	INSA Rennes GMA	UT Cluj TCM	Imperial MECH	PoliMi MECH	TU Delft MECH	INSA Rennes GCU	Imperial CIVE	UT Cluj CCIA	TU Delft CIVE	PoliMi CIVE	Wagen. BSE	Inst. Agro AGRO	Harper A. AGE	USAMV Cluj EMAIA
1. Maths & theory	1	1	1					2			1		2				
2. Programming	1	1	2			2		3				1			1		1
3. Software eng.	3	5	5	3	1	3	4	4	1			1					1
4. Computer eng.	5	3	5			3	3	2							2	1	2
5. OS & distributed	3	3	3	2	2	2	2	2	2	2	2	2	2				
6. Networks	2	2	2	2	2	2	2	2	1	1	1	1	1	2	2	2	2
7. Cybersecurity	3	3	3	2	2	2	2	2									
8. Data & info systems	4	4	4	4	5	5	5	5	1	2	2	2	2	4	3	4	4
9. Artificial intelligence	2	2	1	3	3	3	3	3	2	2	2	2	2		1	2	2
10. Graphics & interaction	4	3	3	3	2	3	3	3	2	3	2	3	3		1	1	1
11. Web & mobile				1	1	1	1	1									
12. Applied computing	1	1	2		1		1	2		1	1	2	3	1	1	2	2
13. Computing & society		1	1				1				1	1	1	1			1
14. Digital skills	2	4	2	3	5	2	3	3	3	2	3	4	5	3	3	4	5

Number of critical gaps per field and degree. Columns grouped by area: aeronautical, industrial/mechanical, civil, agricultural (fewest gaps first). Empty = none.

Electives close only a few gaps, and only for the students who choose them



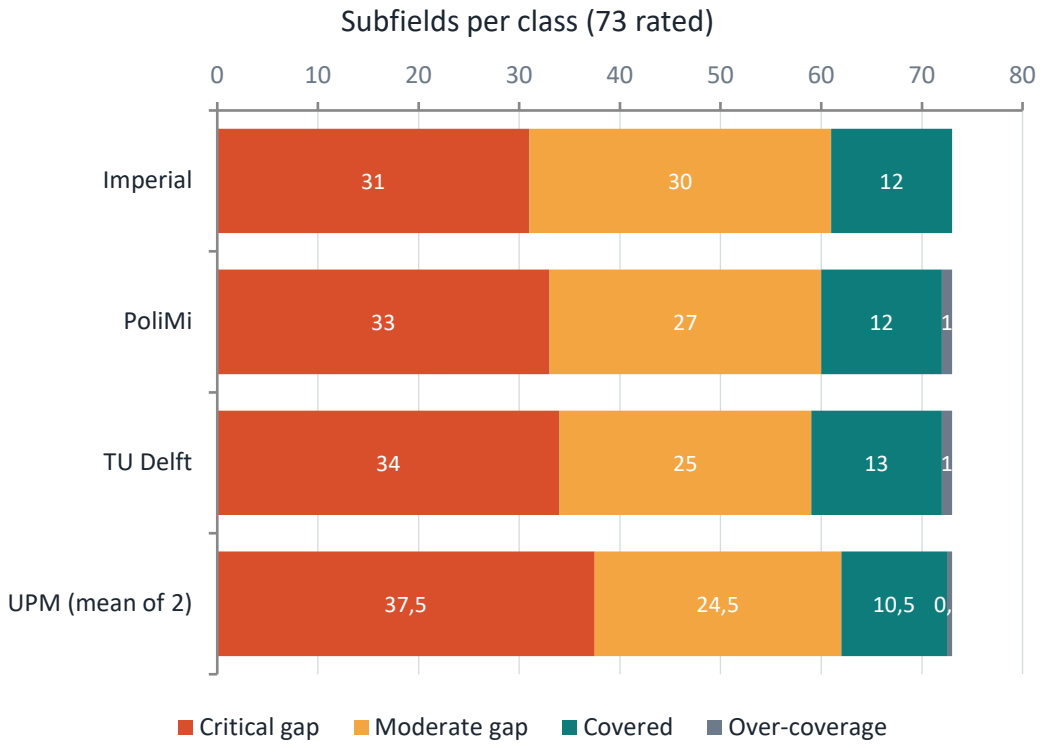
1. **Largest drops:** Institut Agro 14 → 6 (M2 specialisations), Imperial aeronautical 31 → 25 and mechanical 28 → 23, PoliMi civil 21 → 16.

2. **Little or no change:** TU Delft, INSA, UT Cluj and Harper Adams (0–1): their data are mostly compulsory courses.

3. **Same pattern at UPM:** statistics, Python/R, embedded systems and CAD reach 5 only in electives.

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No aeronautical degree guarantees software assurance; 25 subfields are critical in all three



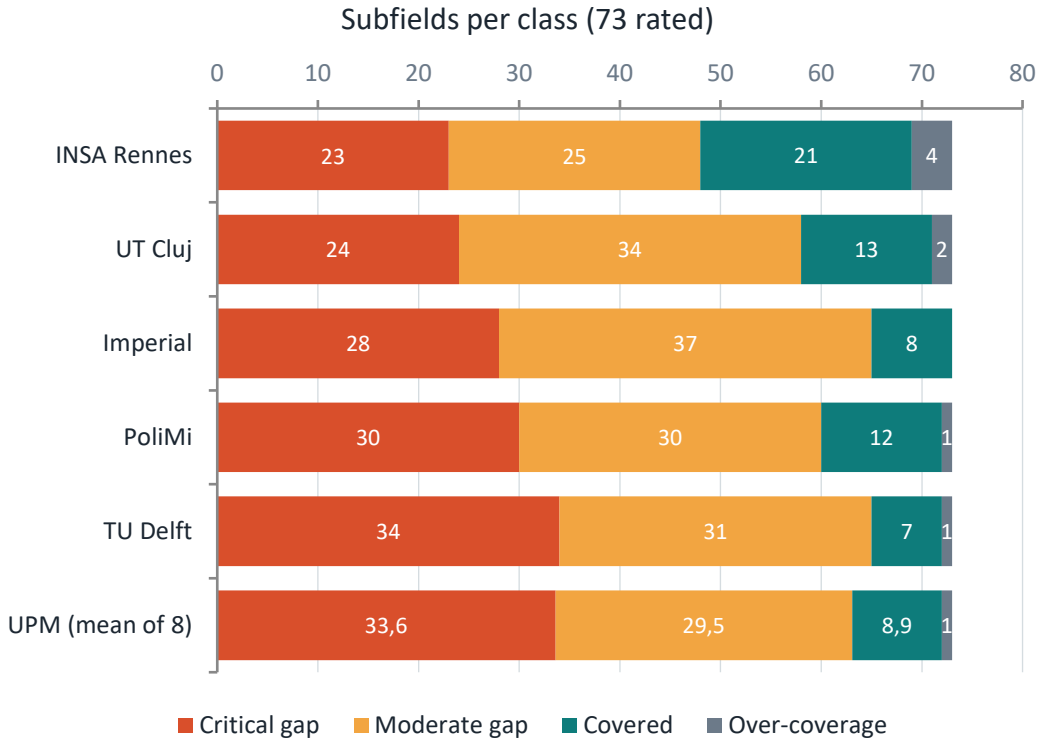
Main UPM critical gaps	Req.	Imperial	PoliMi	TU Delft
3.3 Verification, validation and testing	5	**2**	**1**	**2**
3.4 Software quality	5	**2**	**1**	**1**
4.4 Real-time systems	5	**1**	**1**	**1**
7.3 Network and systems security	5	**1**	**1**	**1**
12.3 Computer-aided design	5	**4**	**4**	**2**
10.6 Human-computer interaction	5	**1**	**1**	**1**

Guaranteed coverage in each European degree; colour = class (coral critical, amber moderate, teal covered).

Takeaway UPM's certification-driven gaps (DO-178C, EASA Part-IS) are shared by every European degree. Learn from TU Delft: statistics and machine learning at 5 in the core. Imperial and PoliMi guarantee CAD at 4.

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INSA shows that embedded systems, robotics and databases fit in a mechanical core

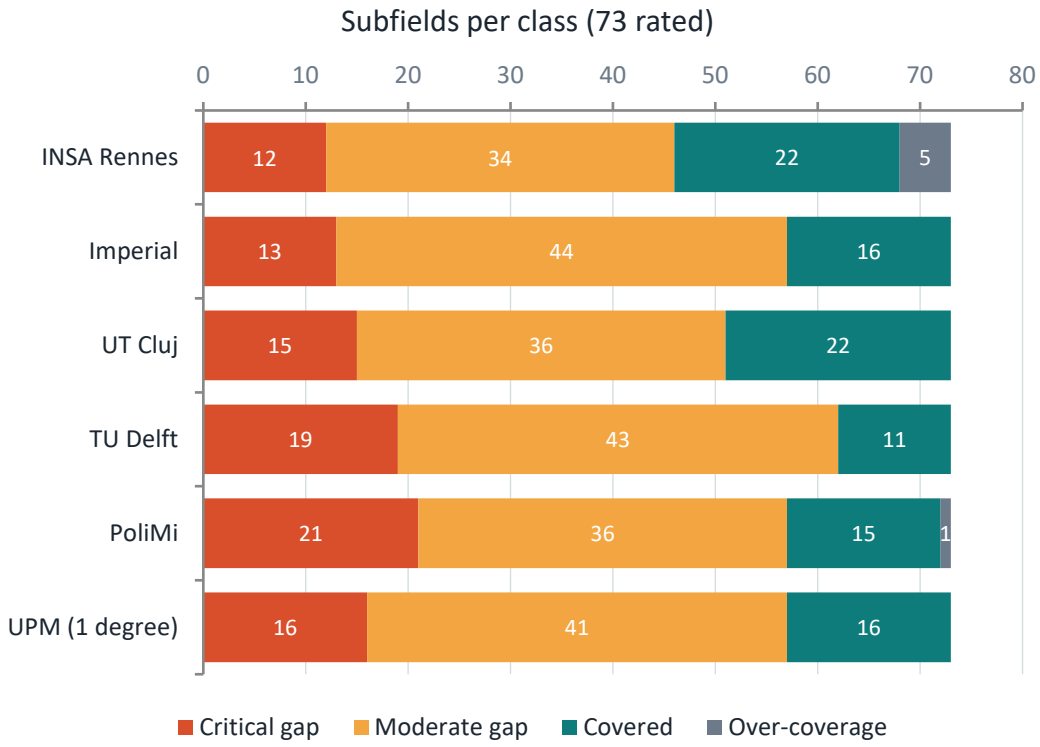


Main UPM critical gaps	Req.	INSA Rennes	UT Cluj	Imperial	PoliMi	TU Delft
7.3 Network and systems security	5	1	1	1	1	1
1.3 Statistics and probability	5	5	5	3	4	1
14.1 Data analysis with Python, R or similar	5	2	1	4	1	1
9.1 Machine learning	5	1	1	1	1	1
4.3 Embedded systems	5	5	3	1	1	1
4.4 Real-time systems	5	4	4	1	1	1

Guaranteed coverage in each European degree; colour = class (coral critical, amber moderate, teal covered).

Takeaway Network security (Machinery Regulation 2023/1230) and machine learning are critical everywhere. INSA and UT Cluj cover statistics at 5 and INSA embedded systems at 5, all gaps for every UPM industrial degree.

Statistics, CAD and project management, critical at UPM, are covered in several European cores



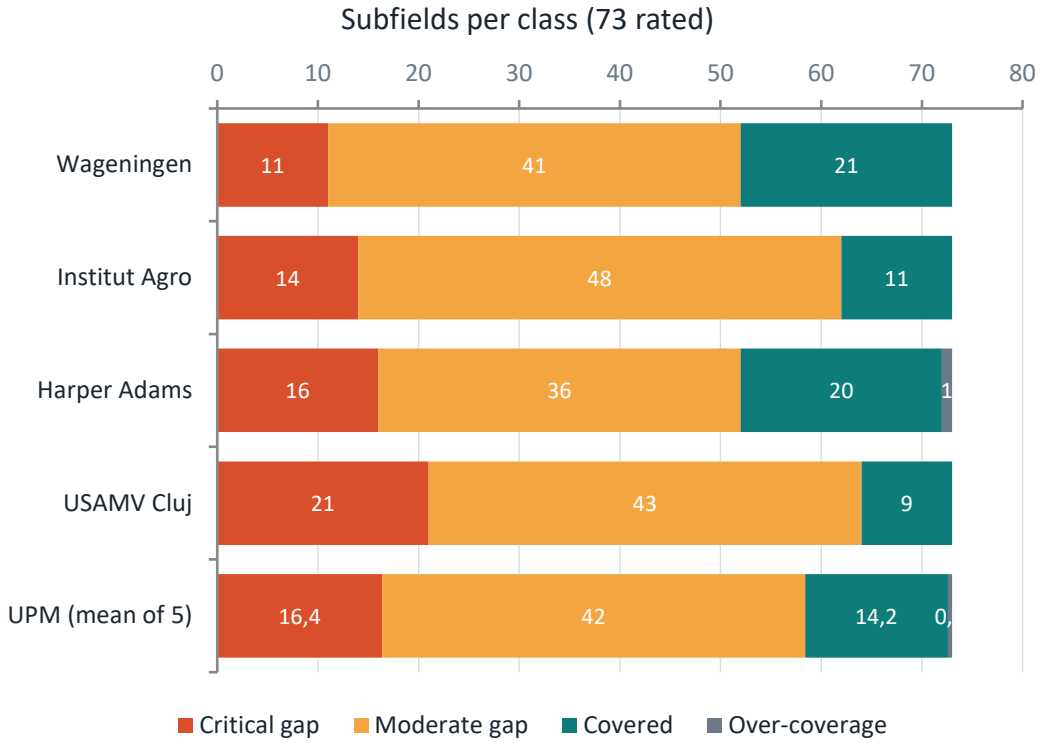
Main UPM critical gaps	Req.	INSA Rennes	Imperial	UT Cluj	TU Delft	PoliMi
12.3 Computer-aided design	5	4	4	5	2	1
3.5 Project management	5	1	5	3	1	5
1.3 Statistics and probability	4	5	5	1	5	1
8.1 Databases	4	5	1	1	1	1
9.1 Machine learning	4	1	1	1	1	1
10.3 Virtual and augmented reality	4	1	1	1	1	1

Guaranteed coverage in each European degree; colour = class (coral critical, amber moderate, teal covered).

Takeaway Statistics is covered at Imperial, TU Delft and INSA; project management at Imperial and PoliMi; CAD at UT Cluj. Machine learning and VR/AR are critical in every civil degree analysed.

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The precision-farming data chain is missing in Europe too; only Wageningen teaches vision



Main UPM critical gaps	Req.	Wageningen	Institut Agro	Harper Adams	USAMV Cluj
6.4 Internet of things	5	**1**	**1**	**1**	**1**
8.3 Big data	4	**1**	**2**	**1**	**1**
8.4 Data mining	4	**1**	**1**	**1**	**1**
9.5 Computer vision	4	**5**	**1**	**1**	**1**
14.2 Professional use of generative AI tools	4	**2**	**1**	**1**	**1**
14.5 Cyber hygiene and personal data protection	4	**1**	**1**	**2**	**1**

Guaranteed coverage in each European degree; colour = class (coral critical, amber moderate, teal covered).

Takeaway All six gaps shared by the UPM agricultural degrees are critical in every European degree, except computer vision at Wageningen (5). Learn from Wageningen: compulsory Python, robotics and machine vision.

Five actions follow from the comparison

1. **Shared digital-skills module:** generative-AI use, cyber hygiene and data analysis with Python or R for every engineering degree. They are gaps in all 17 European degrees and in 31–44 UPM degrees.

2. **Computing early and compulsory:** one first-year programming course in every degree, as at INSA, PoliMi and Wageningen.

3. **Move electives into the core:** statistics, Python/R, embedded systems and CAD already reach 5 in UPM electives; making them compulsory closes gaps at little cost.

4. **Area data chains:** IoT → big data → vision in agriculture; Industry 4.0 and OT security in industrial; software assurance and real-time systems in aeronautics.

5. **Review the profiles:** where no European degree meets a requirement (25 subfields in aeronautics), check the level against EUR-ACE and employers before treating it as a UPM-specific gap.

Read the comparison with four limitations in mind

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1 UPM profiles everywhere

Required levels come from UPM profiles built on Spanish regulations, not on each country's accreditation rules.

2 Uneven samples

From 10 guides (PoliMi civil) to 354 (Institut Agro); some samples cover only compulsory courses.

3 Missing types and rows

Course type is missing in many Imperial and PoliMi guides; some exports lack rating rows (UT Cluj, Harper Adams). Some course guides are having no details enough.

4 Different raters

All ratings by NotebookLM with the same prompt. Claude, same criteria: one-level differences are within the noise.

NEXT STEPS

Firm up the data, then turn the comparison into proposals

1 Complete

Confirm course types (Imperial, PoliMi) and re-export missing rows (UT Cluj, Harper Adams)

2 Extend

Add Germany and Finland, and the Università degli Studi di Milano guides already downloaded

3 Validate

Check the UPM profiles against EUR-ACE and a Delphi panel of employers

4 Propose

Draft the shared digital-skills module and per-area core changes for UPM

Thank you for your attention

Agustín Yagüe – agustin.yague@upm.es

Ernestina Menasalvas - ernestina.menasalvas@upm.es