

An evidence-grounded atlas of AI use cases in air traffic management

Use-case profiling, clustering and preliminary assurance screening

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The interactive atlas, live in the browser
aic4atm-atlas.dev.sparsity-technologies.com

ABSTRACT · RESEARCH NEED

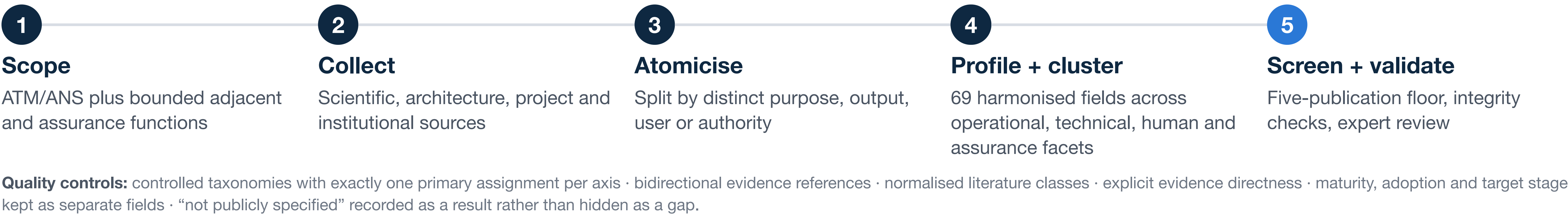
Fragmented evidence is hard to compare — and harder still to assure

AI applications in ATM are described across papers, projects and architecture repositories using inconsistent terminology, scope and maturity claims. AIC4ATM turns that evidence into a harmonised atlas of **atomic AI-enabled use case profiles**. Each profile connects operational purpose, technical mechanism, data, interfaces, human authority, maturity and assurance concerns to traceable sources, giving downstream risk and compliance work one technical baseline instead of a literature pile.

Research question: how can heterogeneous AI evidence become a consistent, reviewable foundation for aviation compliance analysis?

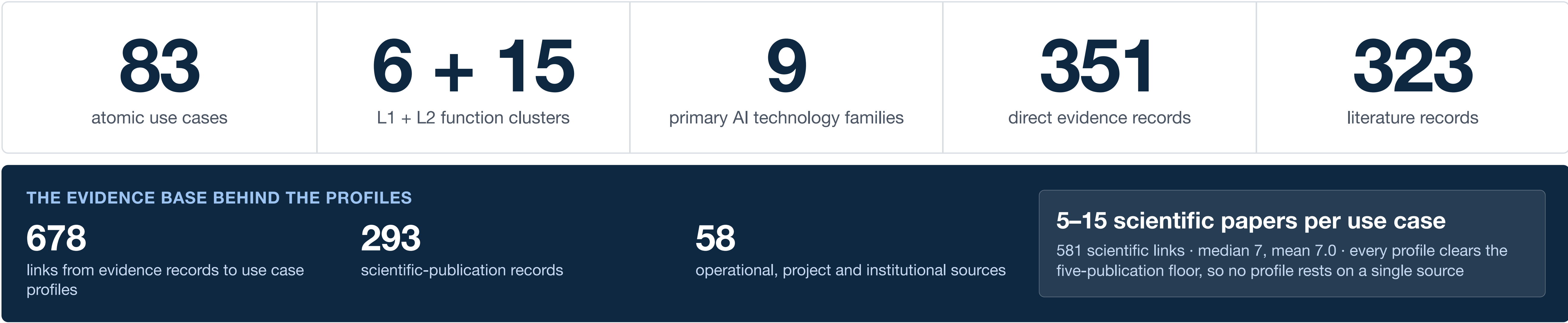
METHODOLOGY

A traceable pipeline from evidence to expert review



RESULTS

A scattered landscape turned into a comparable portfolio



FUNCTIONAL AND TECHNOLOGY CLUSTERING

Clustering reveals specialisation, not one generic AI landscape

Rows are primary ATM function clusters, columns primary AI technology families. Each use case is counted exactly once, so every cell is a number of atomic use cases.

ATM function cluster	Predictive / forecast	RL / control	Knowledge / hybrid	Speech / language	Anomaly / monitoring	Optimisation / decision	Computer vision	AI eng. / data	Not specified	Total
Network & airspace	10	0	0	0	0	4	0	0	0	14
Flight & traffic	10	8	4	0	6	1	0	0	2	31
Airport & surface	0	2	1	0	0	2	6	0	0	11
ATM information, communication & surveillance	4	0	1	8	0	0	0	0	1	14
Human performance & operational support	2	0	2	1	1	0	0	0	1	7
Safety, security & AI lifecycle	1	0	1	0	1	0	0	3	0	6
Total	27	10	9	9	8	7	6	3	4	83

fewer    more use cases · totals are not on the colour scale

29 of the 54 possible combinations are **unoccupied**. An empty cell is not evidence that a mechanism cannot serve a function — it is a prompt to ask whether the pairing is genuinely inapplicable, an evidence gap, or a naming boundary worth challenging.

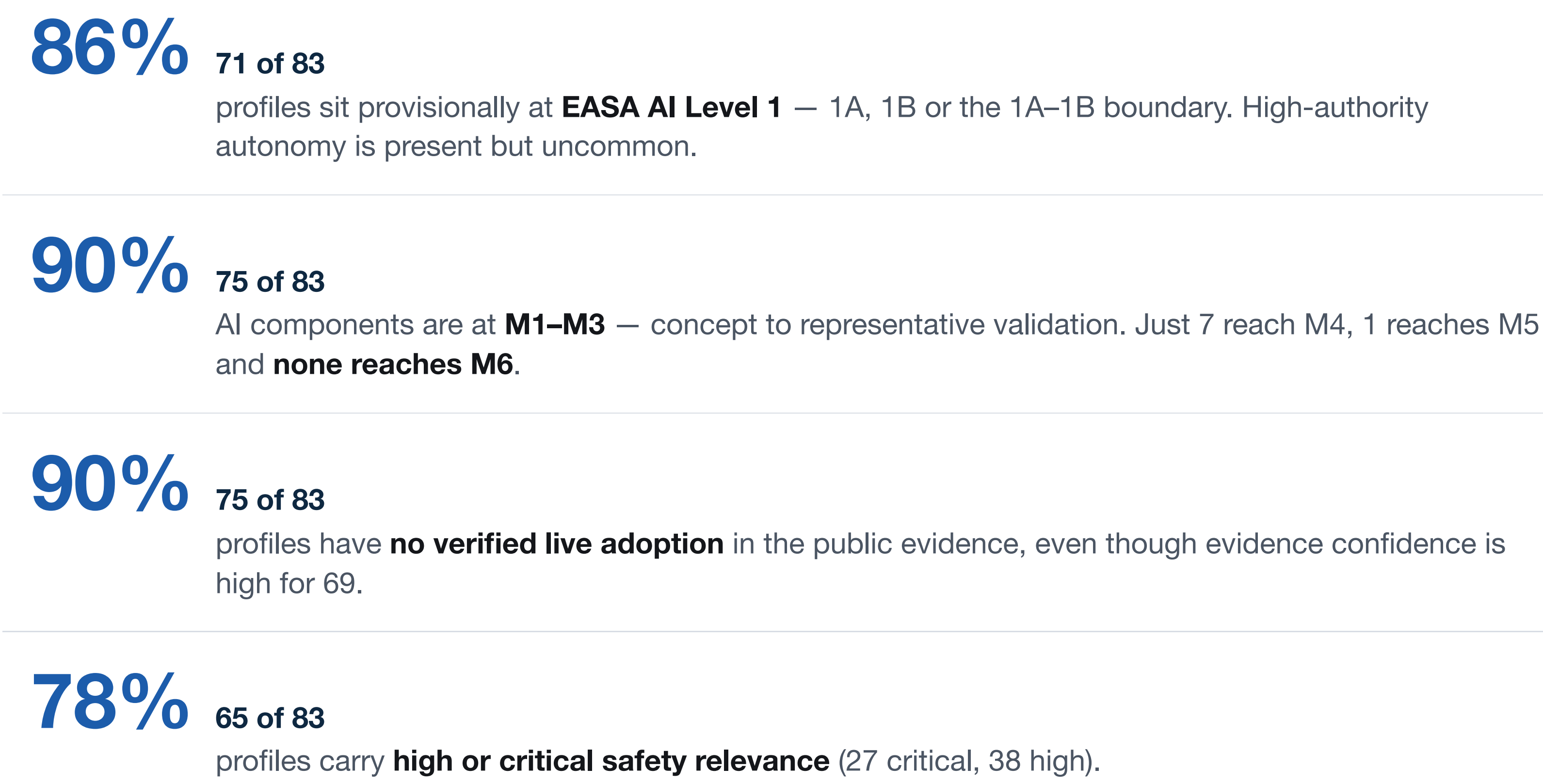
Predictive AI is the backbone
20 of 27 predictive use cases sit in network/airspace or flight/traffic management — anticipation and situation assessment, not control.

Computer vision is airspace
All 6 computer-vision use cases are concentrated in airport and surface operations, where the sensing problem actually lives.

Language work is about the voice loop
8 of 9 speech and language use cases support ATM information, communication and surveillance.

MAJOR FINDINGS

Evidence is broad; demonstrated operational maturity is not



Authority and demonstrated maturity run in opposite directions.

No profile assessed above Level 1B has reached M4 or beyond, and **every one of the 8 profiles at M4+ is a pure information-augmentation (1A) function**. The same high-authority profiles carry more open assurance questions — 3.89 of the six screening indicators on average, against 2.76 for Level 1.

The reading is **not** that high-authority AI is unsafe. It is that the functions raising the hardest oversight, fallback and responsibility questions are precisely those with the least operational evidence today — **a window in which compliance mechanisms can be designed rather than retrofitted**.

ONE PROFILE, MULTIPLE LENSES

UC-001 · 4D trajectory prediction

Function

Flight and traffic management

Technology

Predictive and forecasting AI

Authority

Provisional EASA AI Level 1A

Maturity

M3 · Representative operational validation

Adoption

No verified live adoption

Evidence

15 scientific publications + 1 operational source

Assurance focus: domain shift across sectors, uncertainty communication, training-data traceability and ODD coverage. Ownership, monitoring and fallback are **not publicly specified** — as they are for most of the portfolio.

80/83

depend materially on effective **human oversight**

62/83

raise **opaque logic**

58/83

raise **cyber exposure**

28/83

raise **sensitive data**

8/83

raise **high autonomy**

5/83

raise **adaptive or online learning**

Screening indicators across the portfolio. No profile raises zero and none raises all six; the distribution peaks at three. Indicators are counted, **never summed into a risk score**.

CONCLUSION

The atlas makes AI use cases comparable without conflating publication volume, maturity, deployment or approval.

It is a defensible starting point for expert validation, component decomposition, risk mapping and the AIC4ATM compliance engine. Provisional EASA AI levels, maturity assessments and screening fields are **analytical classifications — not approvals, certification findings or legal conclusions**, and an evidence link does not imply deployment or independent replication.

Next: expert review → study-quality appraisal → component decomposition → compliance traceability graph → risk and obligation mapping

Selected references: [1] AIC4ATM D1.1 — ATM AI Use Cases Atlas v6.0.2 (2026). [2] EASA Artificial Intelligence Roadmap 2.0 (2023). [3] EASA AI Concept Paper, Issue 2 (2024). [4] SESAR 3 JU / EUROCONTROL, FLY AI Report (2020). [5] Regulation (EU) 2024/1689 (AI Act).

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