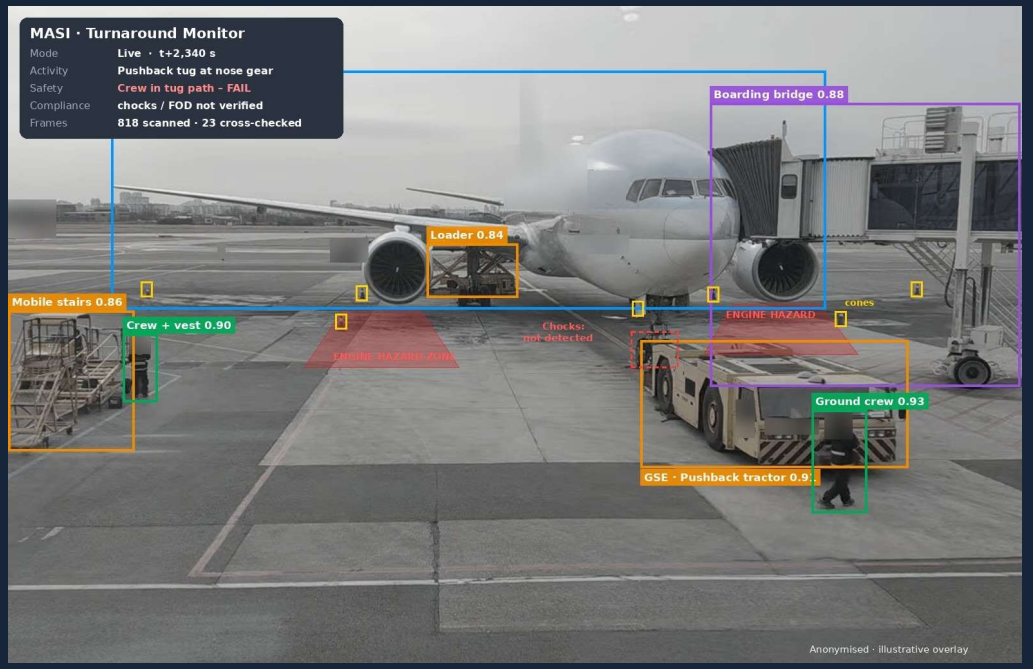
MASI©

Apron Management System

AI Turnaround Intelligence

Information for Airports, Ground Handlers, Airlines and Insurers

Safer, auditable and more efficient aircraft turnarounds: MASI watches every turnaround with AI, flags safety and compliance events in real time and documents each turnaround objectively – as evidence for operations, audits and risk assessment.



MASI analysis view of a real wide-body turnaround (anonymised, illustrative overlay)

1. MASI at a Glance

≈ 60 min	818	23	15	95–99 %
real turnaround analysed live	frames scanned, 0 detector errors	snapshots verified by a visual cross-check	analyses written during the turnaround	target accuracy after 8 weeks tuning

MASI – the Apron Management System with AI Turnaround Intelligence – turns apron cameras into a permanent, objective observer. It recognises aircraft, ground crew, vehicles and safety equipment, follows the turnaround step by step and writes a structured report that operations staff can read without technical knowledge.

Instead of occasional spot checks, every turnaround at every monitored stand is covered. Critical situations such as personnel in an engine danger zone or in the path of a pushback tug are flagged as they happen, compliance items such as chocks, cones and safety vests are checked automatically and bottlenecks in the process become measurable in seconds rather than estimated.

All results are stored as a time-stamped, versioned event record, and every statement is backed by two independent passes – the AI detector and a visual cross-check. This creates something that has been missing on the apron so far: objective evidence of what actually happened – for operational improvement, for audits and authorities, and for the assessment and handling of risks and claims.

MASI starts with a pilot on one or two stands, which can be operational within one to three months. The detection runs locally at the airport, so video does not have to leave the site.

2. The Challenge on the Apron

The apron is one of the most complex work environments in aviation. Within a short time window, many parties – handling agents, fuel suppliers, caterers, cleaning and maintenance staff – work around an aircraft with running systems, moving vehicles and heavy equipment. Ground damage and personal injuries on the apron are a well-known cost driver for airlines, handlers and their insurers.

Yet the monitoring of these processes is still largely manual. What is observed and recorded depends on who is on duty and how busy they are. As a result, monitoring is subjective, because each observer applies different standards. Reactive, because problems are usually noticed only after a delay or an incident; incomplete, because short deviations are missed and expensive, because audits tie up qualified staff.

For risk management the consequence is serious: after an incident, it is often unclear whether chocks were in place, whether cones marked the hazard area or whether personnel were inside an engine danger zone. Statements contradict each other, and objective evidence is missing.

The analysis in Chapter 4 shows how quickly such questions arise: in an ordinary one-hour turnaround at a contact stand, MASI documented seven moments in which personnel were close to the engine, the nose gear or moving ground equipment.

3. How MASI Works

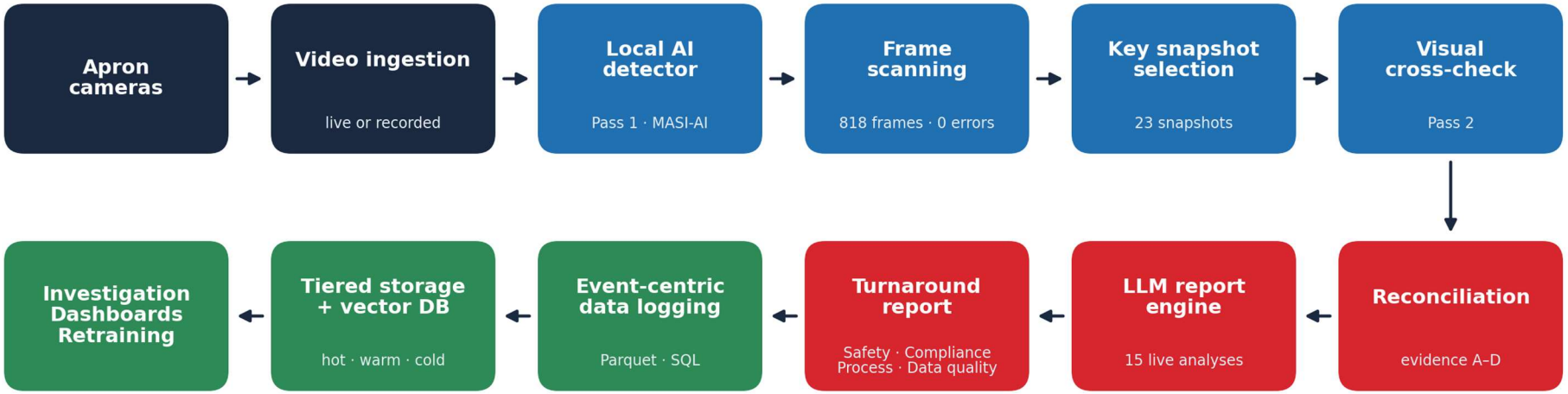


Figure 1 – From apron camera to report, investigation and continuous improvement

MASI uses existing or newly installed apron cameras. A local AI detector scans the video frame by frame and recognises the aircraft, ground crew and safety vests, baggage carts, belt loaders, stairs and boarding bridges, tugs and pushback tractors, fuel, catering, lavatory and potable-water trucks, ground power units, passenger buses, wheel chocks, safety cones, visual docking guidance systems, jet blast and foreign object debris (FOD). Additional object types can be trained for airport-specific needs.

From thousands of frames, MASI selects the few key snapshots that carry the relevant information. Each snapshot is checked a second time by an independent visual cross-check. A reconciliation step compares both passes object class by object class and gives every finding an evidence level – from corroborated by both passes to seen by only one of them. Only then does the AI report engine, a large language model, write the turnaround report: what actually happened, timeline, safety, compliance, process optimisation and data quality.

Every detection is aggregated into events and stored with time stamps, model version and configuration. This event record can be searched and analysed at any time – for a single incident as well as for trends across months and years. In live mode, MASI writes updated analyses while the turnaround is still running.

Because the image analysis runs locally, raw video does not need to leave the airport, and data protection requirements (anonymisation, retention periods, access rights) can be implemented according to local rules.

4. Case Study: A Real Turnaround Analysed

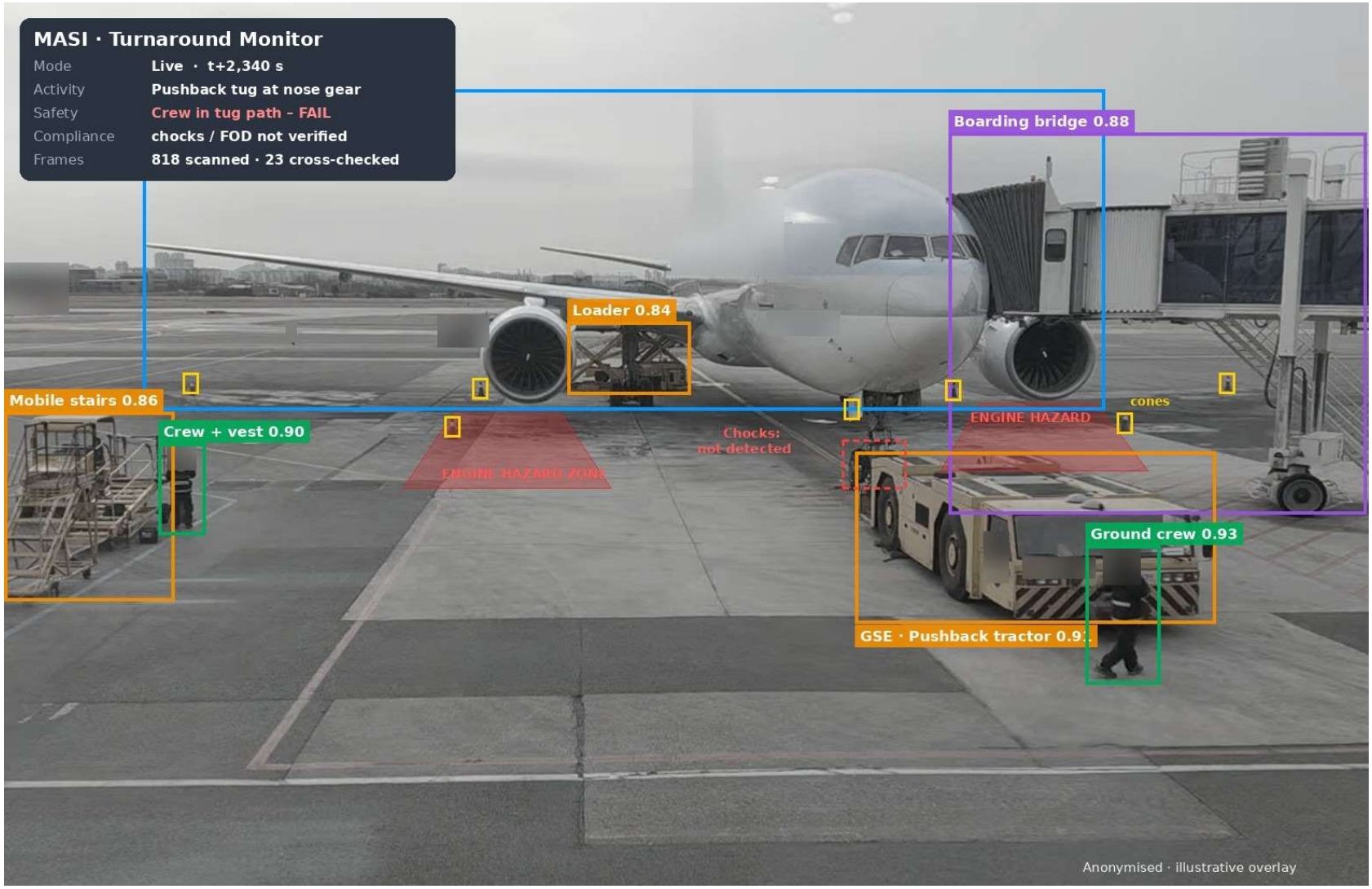


Figure 2 – Frame from the analysed turnaround, anonymised (livery, persons and vehicle markings blurred). The overlay illustrates the MASI detection classes; boxes and scores are representative.

4.1 The observed turnaround

The input was a video of a complete turnaround of a large commercial aircraft (wide-body) at a contact stand with jet bridge. MASI followed it in live-monitor mode for 1 h 9 min until the video ended; the analysed observation window covers 3,595 seconds – almost exactly one hour (t+490 s to t+4,085 s). MASI scanned 818 frames without a single detector error, verified 23 key snapshots with the visual cross-check and wrote 15 analyses during the session – without any manual input.

Figure 3 shows the activity timeline. The aircraft is on stand for the whole window and the jet bridge is connected to the forward door for most of the turnaround. Belt loaders work at the cargo holds for about 54 minutes and ground crew are active throughout. From t+1,620 s a pushback tug stands at the nose gear for 30 minutes – the detector had labelled it a fuel truck, the cross-check corrected this. Seven safety signals are marked, three of them with status FAIL.

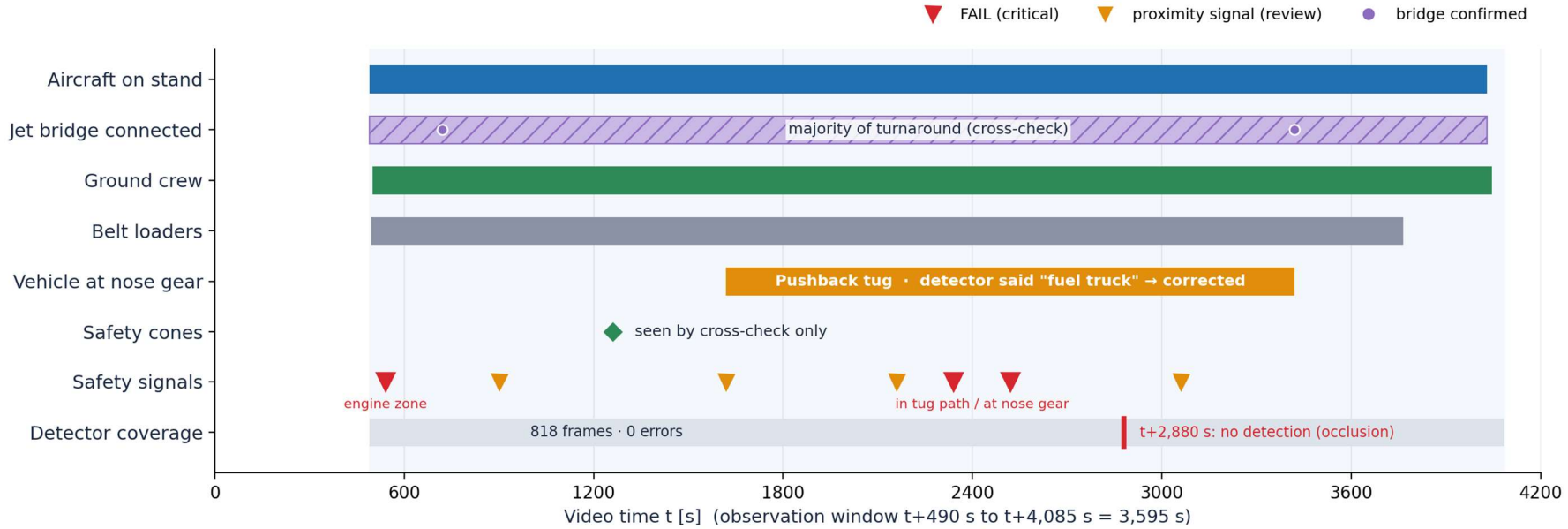


Figure 3 – Activity timeline of the observed turnaround, reconstructed from the MASI event record

4.2 Results: Safety, Compliance and Process Optimisation

Each row states what was measured, when, how much, with which evidence and what it means. Critical – verify = potentially dangerous situation (report status FAIL) requiring an immediate check; Review SOP = situation to be checked against the stand procedure; Confirmed = compliant or expected behaviour documented; Corrected = detector misclassification caught by the visual cross-check; Detection gap = object present in the images but not yet recognised reliably by the untuned detector – a calibration task, not an operational violation; Not determinable = the available data do not support a statement either way. Evidence levels: A = corroborated by detector and cross-check; B = contested between the two passes; C = detector only; D = cross-check only.

#	Observation (what MASI measured)	Time window	Measured value	What it means	Rating
SAFETY Is anyone or anything exposed to a hazard?					
S1	Personnel in an engine danger zone – walking in the active apron area near the aircraft nose and engine	t+540.01 s	Evidence A · status FAIL	Engine danger zone entered. In live operation MASI raises an alert immediately; whether engine or APU were running is verified from engine status and the stored key frame.	Critical – verify
S2	Personnel directly in the path of the pushback tug and under the fuselage	t+2,340.02 s	Evidence A · status FAIL	Most serious finding of the turnaround: staff stand exactly where the tug would move. Real-time alert and review with the handling agent.	Critical – verify
S3	Personnel close to the nose gear and the pushback tug	t+2,520.02 s	Evidence A · status FAIL	Same hazard three minutes after S2 – a recurring pattern around the nose gear, not a single outlier.	Critical – verify
S4	Personnel close to the aircraft and active / heavy ground support equipment (GSE)	t+900.02 s, t+1,620.02 s, t+2,160.02 s	3 cross-check signals	Work next to GSE is part of every turnaround, but the frequency makes this a candidate for a stand-specific proximity rule and alert threshold.	Review SOP
S5	Person standing in the apron vehicle manoeuvring area	t+3,060.02 s	1 cross-check signal	Person in a GSE driving lane – to be checked against the traffic rules of the stand.	Review SOP
S6	Jet blast	Detector only	4 detections, 0 confirmed (Evidence C)	Not corroborated by the visual cross-check and therefore not reported as an event – the two-pass logic prevents a false alarm.	Not determinable
S7	Foreign object debris (FOD) on stand	Full window	Never detected · status UNKNOWN	Either no FOD or a blind spot – cannot yet be confirmed automatically. Camera angle and FOD class are tuned in the pilot.	Not determinable
S8	Emergency egress obstructions	Full window	Status UNKNOWN	No evidence on egress paths in the data; requires a defined egress zone per stand.	Not determinable
COMPLIANCE Are the required procedures visibly followed?					
C1	Jet bridge connected to the forward door	Majority of the window (e.g. t+720.02 s, t+3,420.02 s)	Confirmed by cross-check (A)	Passenger access via the bridge is documented. Door alignment according to ICAO Annex 14 / EASA ADR cannot yet be assessed from the image data.	Confirmed

#	Observation (what MASI measured)	Time window	Measured value	What it means	Rating
C2	Jet bridge as a detector class	Full window	2 detector hits ("boarding bridge")	The bridge is visible for almost an hour but hardly recognised by the detector – the main calibration item of this camera view.	Detection gap
C3	Passenger stairs	Full window	152 detections; 1 confirmed, 2 refuted (Evidence B)	Contested between the two passes – no reliable statement on whether stairs were in use. Calibration item for the pilot.	Detection gap
C4	Safety cones and their placement per aircraft type	Seen at t+1,260.02 s	Cross-check only (Evidence D)	Cones are present but not recognised by the detector; whether their placement matches the aircraft type cannot yet be assessed.	Detection gap
C5	Wheel chocks	Full window	Not detected in either pass	Chock compliance cannot be proven automatically until the chock class is calibrated for this camera view.	Detection gap
C6	PPE of ground crew (high-visibility vests, hearing protection)	Full window	Crew: 212 detections (A); PPE status UNKNOWN	Ground crew is documented reliably, but PPE compliance cannot yet be verified per person. Vest and hearing-protection classes to be trained.	Not determinable
C7	Baggage reconciliation	–	Status UNKNOWN	Not visible in video; requires integration with the baggage / departure control system.	Not determinable
PROCESS OPTIMISATION Where is time lost in the turnaround?					
P1	Aircraft on stand, baggage carts on stand from the start	t+490.02 → 4,030.01 s	3,540 s (≈ 59 min); 577 / 282 detections (A)	Aircraft present for the whole observation window; baggage equipment in place immediately.	Confirmed
P2	Belt loaders active at the cargo holds	t+495.02 → 3,765.02 s	3,270 s (≈ 54.5 min); 404 detections (A)	Baggage and cargo handling run through almost the entire turnaround.	Confirmed
P3	Ground crew active between aircraft, belt loaders and baggage carts	t+500.02 → 4,045.02 s	3,545 s (≈ 59 min); 212 detections (A)	Crew activity is documented across the full window.	Confirmed
P4	Vehicle at the nose gear: detector "fuel truck" → cross-check "pushback tug"	t+1,620.02 → 3,420.02 s	1,800 s (30 min); 573 detections, refuted 8×, confirmed 0× (Evidence B)	No fuelling can be confirmed in this turnaround – the earlier "fuelling bottleneck" was a misclassification. A 30-minute tug presence is a candidate for GSE idle-time analysis.	Corrected
P5	Further services: ground power unit, catering, lavatory, potable water, passenger bus	Detector only	19 / 4 / 9 / 1 / 3 detections (Evidence C)	Plausible, but not confirmed by the cross-check – not used for conclusions until the classes are calibrated.	Not determinable
P6	Milestones: first / last bag, door close, passenger flow, GSE idle time, deviation from schedule	–	No milestone timestamps	Added in the pilot through milestone classes and integration of schedule data (AODB); then deviations become measurable KPIs.	Not determinable

4.3 What the results tell us

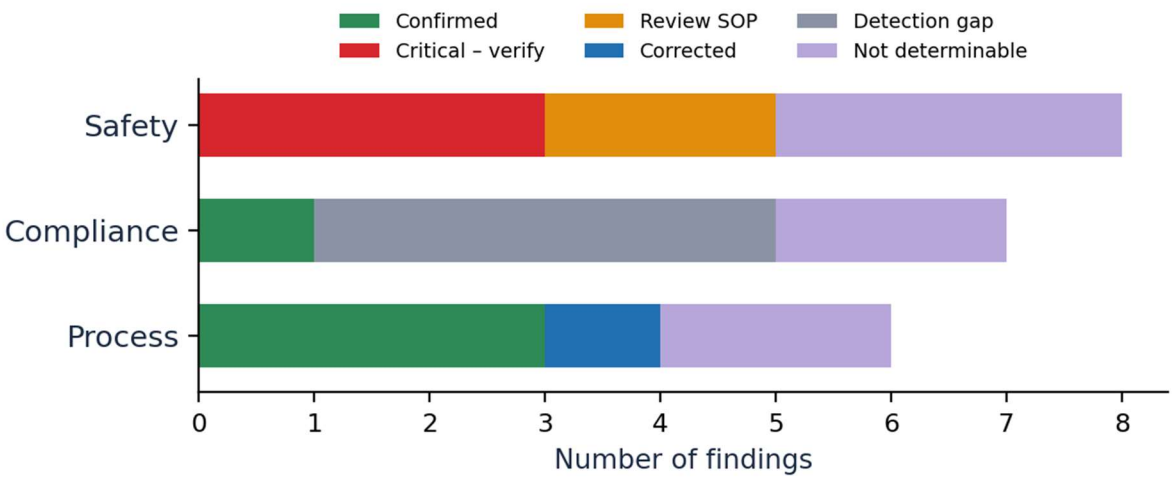


Figure 4 – Findings per area, by rating

Safety. Three situations reach status FAIL: personnel walking near the engine at t+540 s, standing directly in the path of the pushback tug and under the fuselage at t+2,340 s, and close to the nose gear at t+2,520 s. Four further signals show staff next to heavy ground equipment or in the vehicle lane. In live operation MASI would raise an alert at each of these moments, and the stored key frame shows who was where – objective evidence instead of recollection. Jet blast, by contrast, was seen only by the detector and not confirmed, so MASI does not report it as an event.

Compliance. The jet bridge connection is documented by the cross-check, but the detector hardly recognises the bridge; stairs are contested, cones are only seen by the cross-check, and chocks, PPE and FOD cannot yet be verified. These are detection gaps and open data points of an untuned model, not violations on the apron. They define the calibration work of the pilot, during which accuracy typically rises from 80–90 % to 95–99 % within eight weeks.

Process. Aircraft, belt loaders and ground crew are documented for almost the full hour. The most important process insight is a correction: the vehicle that a single-pass analysis had taken for a fuel truck is a pushback tug – there is no evidence of a fuelling bottleneck. Milestones such as first and last bag or door close are not yet derivable; they are added in the pilot together with schedule data, so that deviations from the planned turnaround become reliable KPIs for planning, staffing and service-level discussions.

Data quality. Of 36 reconciled object classes, 4 were corroborated by both passes (A), 2 were contested (B), 11 were seen by the detector only (C) and 19 by the cross-check only (D). The 17 snapshot verdicts show 4 full matches, 13 partial matches and no contradiction. The partial matches are driven mainly by the fuel-truck / pushback-tug confusion and the missing jet-bridge detection. MASI states this openly – every claim in the report can be traced back to a row of the machine-generated reconciliation table.

4.4 Why the second pass matters

An earlier single-pass analysis of a 6 min 40 s excerpt of the same video had interpreted the vehicle at the nose gear as a fuel truck, reported fuelling as the main bottleneck (46 % of the window) and flagged jet blast three times. The two-pass live analysis of the complete turnaround corrects this picture. The detector again labelled the vehicle "fuel truck" – 573 times – but the visual cross-check refuted this label eight times and never confirmed it: the vehicle is a pushback tug, and no fuelling can be confirmed. Jet blast was detected only four times by the detector and never corroborated, so it is no longer reported as a safety event.

Item	Earlier single-pass analysis	Two-pass live analysis (reference)
Scope	6 min 40 s excerpt; 8,175 frames; 6 key frames	Complete turnaround; 3,595 s window; 818 frames; 23 snapshots cross-checked
Vehicle at the nose gear	"Fuel truck" – fuelling as main bottleneck (184 s = 46 %)	Pushback tug; "fuel truck" label refuted 8×, confirmed 0× – no fuelling evidence
Jet blast	3 flags, rated critical	4 detector hits, not corroborated – not reported
Stairs and bridge	Simultaneous use, rated "Review SOP"	Stairs contested (1 confirmed, 2 refuted); jet bridge confirmed by cross-check
Safety focus	Jet blast	Personnel near the engine, in the tug path and at the nose gear (3× FAIL)
Traceability	Report based on key frames	Every claim traceable to the machine-generated reconciliation table

Instead, the cross-check brought the safety-relevant situations to light: personnel near the engine, in the path of the pushback tug and directly at the nose gear. For operators, auditors and insurers this is the decisive point – MASI does not report what a single model believes, but what two independent passes can support, and it says openly where the evidence ends.

5. Safety & Risk: What MASI Means for Insurers and Risk Managers

Prevention

Risks on the apron arise in short moments – a person in an engine danger zone, a person in the path of a pushback tug, a vehicle approaching before chocks are set, debris left on the stand. MASI watches these moments continuously and can raise real-time alerts for engine danger zones, crew proximity to ground equipment, jet blast and FOD. The simple fact that turnarounds are documented objectively also changes behaviour: industry experience indicates a significant reduction of unsafe behaviour once continuous monitoring is in place.

Evidence and claims handling

If an incident occurs, MASI provides a time-stamped event record with key frames showing which vehicles, equipment and personnel were present, when each activity started and ended, and whether safety equipment was detected. Because every finding carries an evidence level from two independent passes, a single-model error – such as a pushback tug taken for a fuel truck – does not end up in the claims file. This accelerates the clarification of the course of events and of responsibilities between airline, handler and airport – and reduces the cost and duration of disputes.

Traceability and trust

Every analysis is stored with model version, configuration and run ID. A result can therefore be reproduced months later, exactly as it was produced. This is a prerequisite for using AI results as a basis for decisions, audits or claims.

Risk transparency over time

Aggregated over many turnarounds, the data show where and how often safety-relevant deviations occur – by stand, time of day, aircraft type or service provider. Operators can target their measures, and insurers gain a far better basis for risk assessment than occasional audits or incident statistics alone.

Support for safety management

MASI supplies objective hazard and compliance data for the operator's Safety Management System – from hazard identification to the monitoring of the effectiveness of measures. It supports, but does not replace, the operator's own responsibility and procedures.

6. Benefits by Stakeholder

Airports gain a transparent view of stand utilisation and turnaround performance across all operators, can enforce FOD and SOP rules consistently and document safety on the apron towards authorities.

Airlines receive independent station performance and safety data for each turnaround, regardless of the handling agent, and can base service-level discussions on facts.

Ground handlers can prove their service quality objectively, recognise bottlenecks in their own processes and plan staff and equipment more precisely. Objective records protect them in disputes about damage and delays.

Insurers and risk managers obtain objective data for risk assessment, faster clarification of incidents, and a measurable effect of prevention measures on the insured risk.

Expected impact – indicative values

Improvement area	Indicative range	Comment
Safety incidents	~50 % less unsafe behaviour	Effect of continuous, objective monitoring
FOD / SOP compliance	Near-100 % enforcement	Every turnaround checked, not just samples
Departure delay reduction	20–25 %	Through early bottleneck detection
Ground delay reduction	3–6 minutes per flight	
Gate efficiency	+5 %	Better stand utilisation
Fuel / APU cost savings	~$1M per year	At a major station

Indicative estimates based on industry benchmarks; site-specific values are determined in the pilot phase.

7. Data Protection & Deployment Options

MASI can be operated locally, in the cloud or in a hybrid setup. In local mode, image analysis runs on servers at the airport; only key frames and structured data are processed further, and on-premise language models are available where required.

Faces and number plates can be anonymised, retention periods follow the applicable data protection rules (GDPR), and raw video is only kept for a short time – typically 7 to 30 days – while events and KPIs are stored long-term. Role-based access separates raw data from aggregated results, and all processing steps are logged.

Integration with existing airport systems, cybersecurity requirements and data residency are clarified at the start of every project and documented in the concept.

8. Getting Started

Pilot (1–3 months, 1–2 stands). MASI is installed on one or two stands, calibrated to local conditions and validated against manual observation. Detection gaps such as those shown in Chapter 4 are closed; accuracy typically rises from 80–90 % to 95–99 % within eight weeks. The pilot delivers the data for a site-specific business case. Indicative budget: $80k–$275k.

Rollout (3–12 months). Based on the pilot results, further stands are added and MASI is integrated into existing systems. For a 10-stand airport, the indicative Year-1 investment is about $560k, with ongoing operating costs of $80k–$150k per year. The AI computing itself costs only $3k–$13k per year for ten stands when a shared GPU is used.

Feasibility study (optional). For larger airports or complex environments we recommend starting with a feasibility study ($25k–$150k) covering requirements, camera coverage, integration and data protection.

Note: All values are planning estimates, not quotes. Actual costs depend on airport size, existing infrastructure, data policies and scope.

9. Frequently Asked Questions

Do we need new cameras?

Not necessarily. MASI works with existing apron cameras where the angle and resolution are suitable; missing coverage can be added at $3k–$15k per stand.

Does video leave the airport?

Not in local mode. Image analysis runs on site; data protection rules are configured per project.

How accurate is MASI?

Typically 80–90 % at the start and 95–99 % after about eight weeks of site-specific tuning. In addition, every finding is marked with an evidence level from two independent passes.

Can results be used as evidence?

Every result is stored with time stamps, key frames, model version and configuration, so it can be traced and reproduced.

How does MASI avoid false alarms?

Every finding is checked in two independent passes – the AI detector and a visual cross-check – and marked with an evidence level. Only corroborated findings are reported as facts; in the reference run this caught a pushback tug that the detector had labelled a fuel truck.

Does MASI replace our safety staff?

No. It supports them: staff focus on exceptions and alerts instead of routine observation.

How long until we see results?

The first reports are available during the pilot, which takes one to three months.

10. Contact

We would be pleased to show you MASI on your own apron footage or to scope a pilot with you.

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