Maximizing Kuwait airport Safety from Runway to the Sky

New Kuwait Wind Shear Detection Systems Contribution to ICAO KPIs

LiDAR, X-band Radar, and LLWAS in the ASBU Performance Framework

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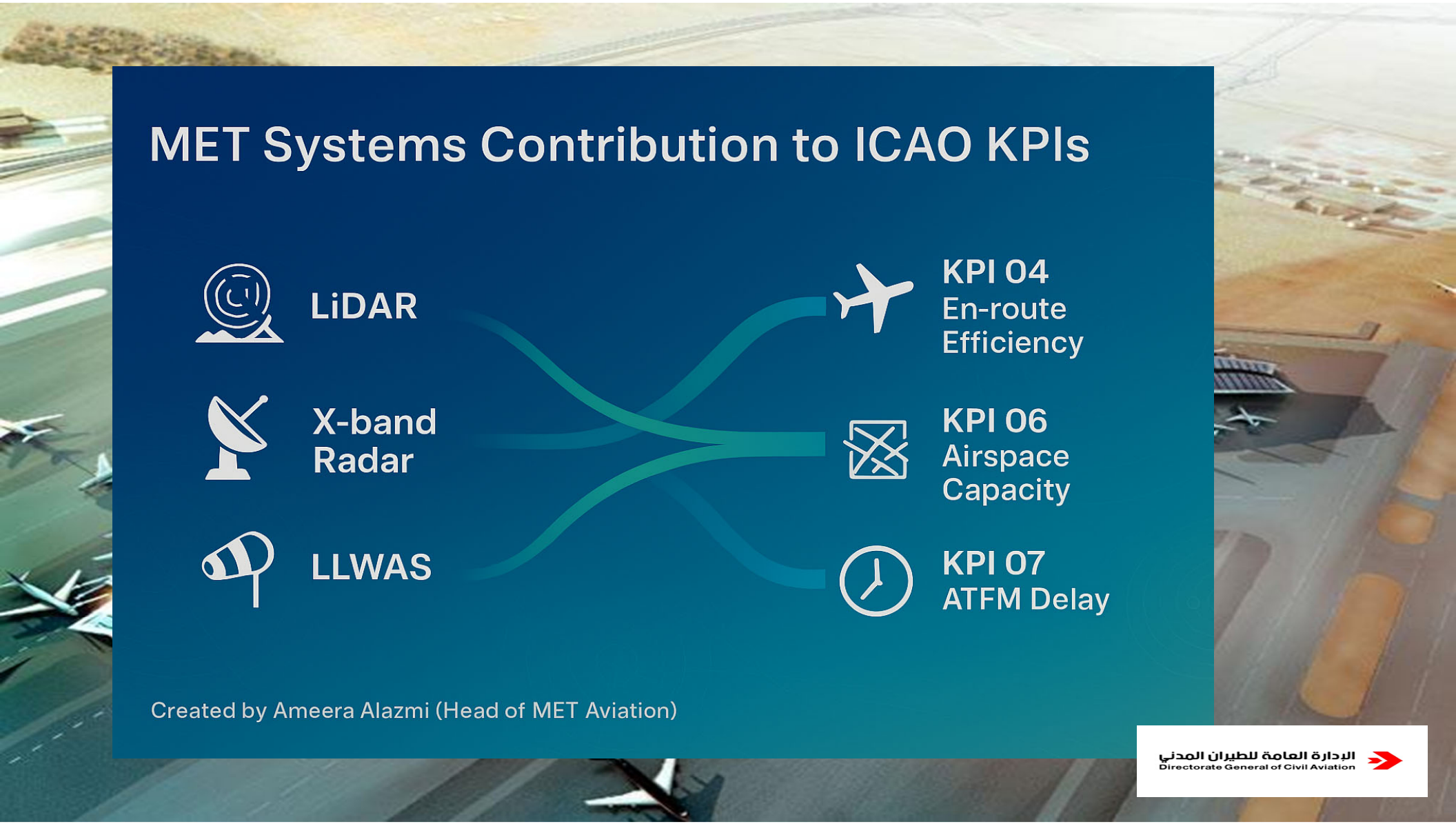
MET Systems Contribution to ICAO KPIs



Created by Ameera Alazmi (Head of MET Aviation)

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Introduction to Wind Shear

- Rapid change in wind speed/direction over short distance
- Dangerous during takeoff and landing
- Causes sudden loss of lift

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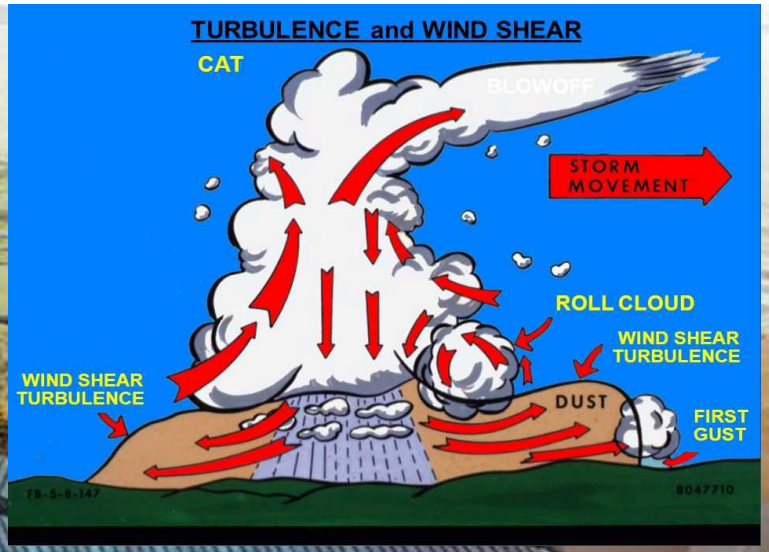
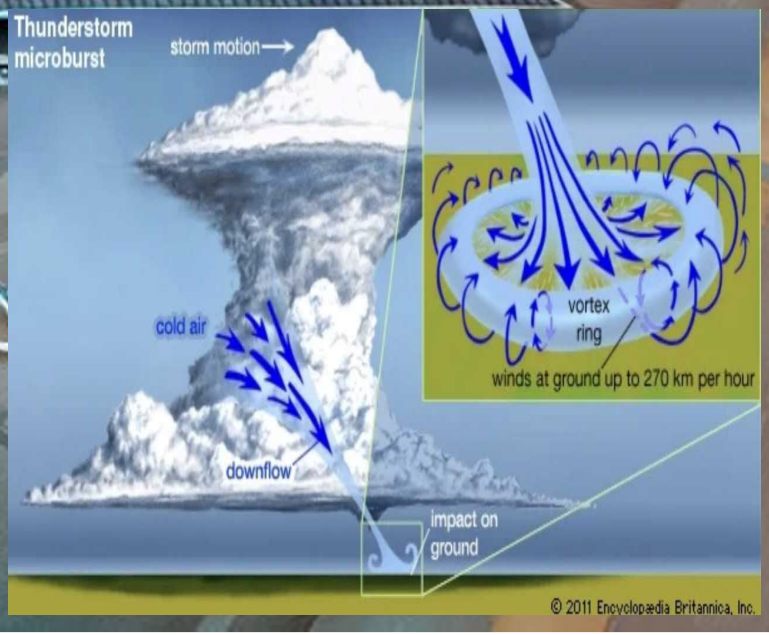
X-Band Radar Overview

- Uses short wavelength (~3 cm) for high-resolution precipitation detection
- Detects wind shear & microbursts inside rain/storms
- Limitations: cannot detect clear-air shear; signal may attenuate in heavy rain





Doppler LiDAR Overview

- Uses laser pulses to measure wind speed from aerosol backscatter
- Detects clear-air wind shear and wake turbulence
- Best in dry, aerosol-rich conditions
- Limitations: reduced performance in rain, fog, or clean air

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Low-Level Wind Shear Alert System (LLWAS)

- Ground-based network of anemometers around runway
- Detects wind shear near surface
- Provides fast alerts to Air Traffic Control
- Limitation: cannot detect wind shear aloft

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Integrated System Architecture
1. X-Band Radar detects shear in storms
2. Doppler LiDAR detects shear in clear-air
3. LLWAS confirms near-surface shear
4. Data fused into one alert sent to ATC and pilots
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Benefits of the Integrated Approach

- All-weather readiness
- Reduced false alarms
- Vertical + horizontal wind coverage
- Improved pilot decision-making

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Kuwait MET New Systems Contribution to ICAO KPIs

Summarize the contribution of advanced Kuwait MET New systems (LiDAR, X-band Radar, and LLWAS) to selected ICAO Key Performance Indicators (KPIs).

The systems are evaluated against three ICAO-defined performance areas:

KPI 04 (En-route Efficiency), KPI 06 (Airspace Capacity), and KPI 07 (ATFM Delay).

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System	KPI 04 – En-route Efficiency (Flight planned distance vs ideal)	KPI 06 – Airspace Capacity (Max safe traffic volume)	KPI 07 – ATFM Delay (Avg delay per flight)
LiDAR	Detects turbulence & wind shear → enables shorter, more optimal trajectories during climb/descent.	Reduces uncertainty near terminal areas → ATC can maintain standard separation safely → increases throughput.	Early detection reduces go-arounds/diversions → fewer slot disruptions.
X-band Radar	High resolution weather detection → allows filing closer to ideal routes & efficient tactical rerouting.	Improves predictability of convective weather → minimizes unnecessary sector restrictions/closures.	Improves forecast accuracy → ATFM assigns realistic slots → fewer ground/airborne delays.
LLWAS	Alerts on sudden low level wind shifts → avoids extended SIDs/STARs or circuitous routings.	Supports continuous runway operations without frequent capacity reductions → sustains safe traffic flow.	Early alerts enable ATC to adjust runway usage/spacing → avoids cascading delays.

Summary

- KPI 04 (Efficiency): Systems allow flights to stay closer to the ideal trajectory.
- KPI 06 (Capacity): Systems reduce weather-driven uncertainty, enabling more traffic volume safely.
- KPI 07 (Delay): Systems improve predictability of capacity, reducing average ATFM delays.

Together, these MET systems provide a measurable improvement in operational efficiency, capacity, and delay reduction, aligning with ICAO's ASBU performance framework.

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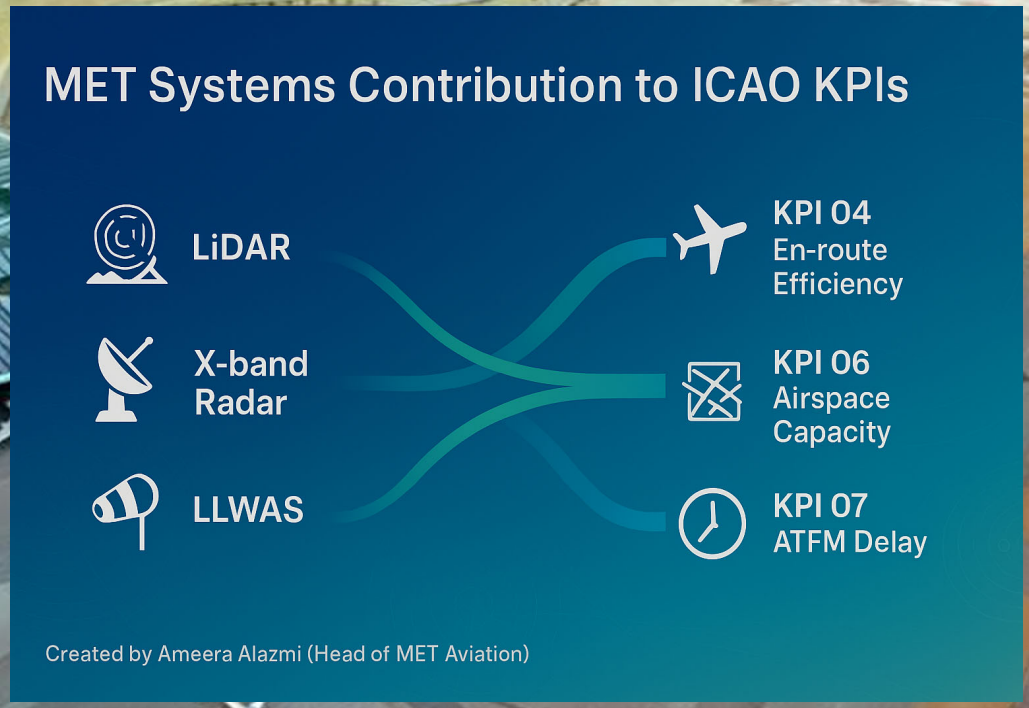
Conclusion

LiDAR, X-band Radar, and LLWAS provide significant contributions to ICAO performance objectives. They enable more efficient flight planning (KPI 04), help maintain or increase safe airspace capacity (KPI 06), and reduce ATFM delays by improving predictability and resilience (KPI 07). These systems collectively enhance both safety and efficiency in Kuwait air transport operations.



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