Luxair Threat and Error Management (TEM)

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The purpose of TEM is to provide a framework for pilots to manage and reduce safety risks present in their everyday flying.

TEM promotes a philosophy of anticipation and thinking ahead.

TEM incorporates 3 components:

- Threat management
- Error management
- Undesired aircraft state management.

Threat: Occurrences or events that increase the operational complexity:

- Occur outside of the influence of the flight crew (not caused by the crew)
- Require crew attention if safety margins are to be maintained
- Promote an opportunity for pilot error.

Environmental threats		Organisational threats	
(A)	weather: thunderstorms, turbulence, icing, wind shear, cross or tailwind, very low or high temperatures;	(A)	operational pressure: delays, late arrivals or equipment changes;
(B)	ATC: traffic congestion, ACAS RA/TA, ATC command, ATC error, ATC language difficulty, ATC non-standard phraseology, ATC runway change, ATIS communication or units of measurement (QFE/meters);	(B)	aircraft: aircraft malfunction, automation event or anomaly, MEL/CDL;
(C)	airport: contaminated or short runway; contaminated taxiway, lack of, confusing, faded signage, markings, birds, aids unserviceable, complex surface navigation procedures or airport constructions;	(C)	cabin: flight attendant error, cabin event distraction, interruption, cabin door security;
(D)	terrain: high ground, slope, lack of references or 'black hole';	(D)	maintenance: maintenance event or error;
(E)	other: similar call-signs.	(E)	ground: ground-handling event, de-icing or ground crew error;
		(F)	dispatch: dispatch paperwork event or error;
		(G)	documentation: manual error or chart error;
		(H)	other: crew scheduling event.

Table 1. Examples of threats (list is not exhaustive) ***EASA Part FCL - GM1 to Appendix 5 Integrated MPL training course***

Error: defined as flight crew actions or inactions that:

- Lead to a deviation from crew or organizational intentions or expectations;
- Reduce safety margins;
- Increase probability of adverse operational events on the ground or during flight.

Aircraft handling errors	(A)	manual handling, flight controls: vertical, lateral or speed deviations, incorrect flaps or speed brakes, thrust reverser or power settings;
	(B)	automation: incorrect altitude, speed, heading, auto throttle settings, incorrect mode executed or incorrect entries;
	(C)	systems, radio, instruments: incorrect packs, incorrect anti-icing, incorrect altimeter, incorrect fuel switches settings, incorrect speed bug or incorrect radio frequency dialled;
	(D)	ground navigation: attempting to turn down wrong taxiway or runway, taxi too fast, failure to hold short or missed taxiway or runway.
Procedural errors	(A)	SOPs: failure to cross-verify automation inputs;
	(B)	checklists: wrong challenge and response; items missed, checklist performed late or at the wrong time;
	(C)	callouts: omitted or incorrect callouts;
	(D)	briefings: omitted briefings; items missed;
	(E)	documentation: wrong weight and balance, fuel information, ATIS, or clearance information recorded, misinterpreted items on paperwork; incorrect logbook entries or incorrect application of MEL procedures.
Communication errors	(A)	crew to external: missed calls, misinterpretations of instructions, incorrect read-back, wrong clearance, taxiway, gate or runway communicated;
	(B)	pilot to pilot: within crew miscommunication or mis-interpretation.

Table 2. Examples of errors (list is not exhaustive) ***EASA Part FCL - GM1 to Appendix 5 Integrated MPL training course***

Undesired Aircraft State:

- Is a position, speed, attitude condition or configuration of an aircraft that clearly reduces safety margins
- Results from pilot errors, action or inaction.

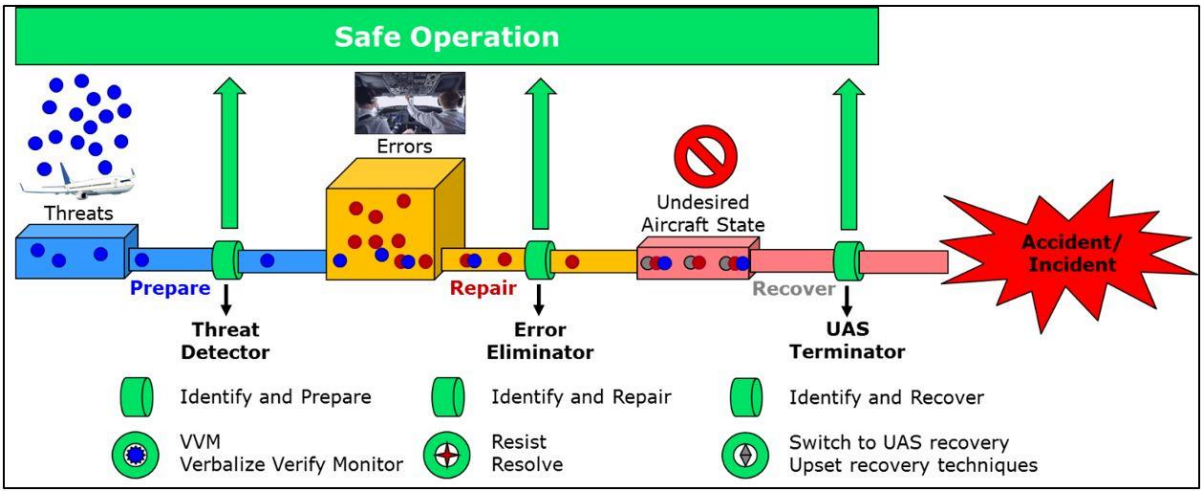
An aircraft upset due to a sudden technical malfunction can be seen as a latent threat. It will not be classified as an UAS if no pilot behaviour contributed to the upset.

Aircraft handling	(A)	aircraft control (attitude);
	(B)	vertical, lateral or speed deviations;
	(C)	unnecessary weather penetration;
	(D)	unauthorised airspace penetration;
	(E)	operation outside aircraft limitations;
	(F)	unstable approach;
	(G)	continued landing after unstable approach;
	(H)	long, floated, firm or off-centreline landing.
Ground navigation	(A)	proceeding towards wrong taxiway or runway;
	(B)	Wrong taxiway, ramp, gate or hold spot.
Incorrect aircraft configurations	(A)	incorrect systems configuration;
	(B)	incorrect flight controls configuration;
	(C)	incorrect automation configuration;
	(D)	incorrect engine configuration;
	(E)	incorrect weight and balance configuration.

Table 3. Examples of undesired aircraft states (list is not exhaustive) ***EASA Part FCL - GM1 to Appendix 5 Integrated MPL training course***

The Luxair Threat and Error Management Concept incorporates Threats, Errors, Undesirable Aircraft States, and the management of these in a linear process, which could be imagined as a “TEM machine”.

The TEM Machine



The first part of the machine, or the first stage of the process (depicted in blue), takes account of threats that might materialize in an operation. These threats need to be identified and prepared for. If these identification and preparation are successful, if the “Threat Detector” of the machine is functional, the operation will become a safe operation again, even if facing a threat. For tools to make the “Threat Detector” fully functional, see the section “Managing Threats” below.
However, if the “Threat Detector” did not manage the threat effectively, the threat could induce a pilot error. In the TEM process, threats are represented by blue disks which can combine with a pilot error represented as a red disk.
However, not all errors result from preceding threats. Errors can also appear spontaneously (depicted as red disks).
The second part of the TEM process (depicted in yellow), is dealing with errors. Errors need to be identified and repaired. For this, the machine features an “Error Eliminator”, which can make the operation safe again. For tools to use as effective “Error Eliminators” see the section on “Managing Errors” below.
If an error succeeds to slip past the “Error Eliminator”, it potentially results in an Undesired Aircraft State”. The third part of the process (depicted in red) focuses on the management of these UASs. While an UAS is an extremely critical situation, it is important to understand that at this point, the pilot still has the ability to recover the situation.
So, at this stage, the Identification and Recovery of the UAS are required. The machine features an “UAS Terminator”, which is the last chance for a pilot to return to a safe operation. Should the UAS Terminator fail, an incident or accident will be the result. For tools to ensure that the “UAS Terminator” remains fully functional, see the section on “Managing Undesired Aircraft States (UAS) below.

Managing Threats

In order to manage threats effectively, it is crucial to identify threats and prepare accordingly. The following tools can be used for managing threats (list is not conclusive):

- Monitoring Shield
- Situation Awareness
- Communication
- Teamwork
- Threat Briefing
- Cabl3
- FOReDEC
- VVM (Verbalize, Verify, Monitor)

Managing Errors

Failure to manage a threat can lead to a flight crew error. However, there are also errors which are not directly connected to a threat, e.g. spontaneous errors or errors as part of an error-chain. Managing an error effectively requires identifying the error and repairing it. Tools for managing errors fall into two main categories:

- **Resist: Systemic countermeasures**, e.g.

  TCAS, SOP's, GPWS, Windshear Detector, Weather Radar, Autopilot, Warning Systems, checklists, briefings…

- **Resolve: Human Skills countermeasures**, e.g.

  Knowledge, Attitude, Experience,
  Monitoring, Teamwork, Workload management, Health…

Managing Undesired Aircraft States (UAS)

Failure to effectively manage an error will potentially lead to an undesired aircraft state. UAS is a transient state which can be recovered. If not recovered, then the result will be an incident or accident.
In order to manage an UAS effectively, the UAS needs to be identified and recovered. Tools available for the management of an UAS are:

- Recognize UAS
- Recover aircraft flight vector
- Switch rather quickly from error identification to UAS recovery
- Upset Prevention and Recovery Training and Upset recovery techniques.