B - THREAT AND ERROR MANAGEMENT & AIRMANSHIP

Very few accidents are completely unavoidable. Catastrophic failure is a rare phenomenon in the gliding world and there is no 'new way to have an accident'. Yet accidents continue to happen, so we need systems to try to avoid them and deal with them when they occur.

There are many tools to help – some of which are very well explained in the CAA Skyway code. Recommend it to the trainees as essential reading.

Threat and error management needs to become embedded as a routine part of every pilot's preparation. From the instructor's perspective, understanding and awareness of common errors that trainees make will improve your ability to respond and prevent them escalating to an accident or incident.

Threat and Error Management (TEM)

The overarching objective of TEM is to provide a system for pilots to plan for and manage potential threats, errors, and undesired aircraft states. It can be summarised as:

- anticipation
- recognition
- recovery.

The key to anticipation is accepting that while something is likely to go wrong, you can't know exactly what it will be or when it will happen. In this sense, TEM training can be framed as 'defensive flying for pilots.'

Threats are defined as events that occur outside the influence of the pilot. (i.e. not caused by the pilot).
They increase the operational complexity of the flight and require attention and management, in order to maintain safety margins.

Put simply, threats come 'at' the pilot, while errors come 'from' the pilot.

Importantly, a mismanaged threat has the potential to induce a pilot error.

Threats (such as a defective winch cable joint), **errors** (such as a pilot failing to follow the correct launch failure procedure), and **undesired aircraft states** (such as a stall on the subsequent recovery) are events that pilots have to manage.

Examples of a threat could be crossing difficult terrain, deteriorating weather conditions, a winch or tow plane malfunction (e.g., lack of fuel), or other people's errors, such as pedestrians walking across a landing area.

Threats normally fall into three categories:

- Anticipated i.e. factors that you should be aware of in advance, such as a poor weather forecast, or high density of traffic such as in a gliding competition.
- Unanticipated i.e. cannot be specifically anticipated, but a good pilot will consider the possibility of them in advance e.g. a GPS failure.
- Latent threats such as external time pressure, fatigue, insufficient pilot skill, knowledge or poor attitude to safety.

Threats can also be considered in an organisational context, for instance clubs accepting poor flying standards or a poor safety culture would be a latent threat to safe operations.

It may help to consider two main areas of threats

- Environmental threats, such as weather, terrain or aircraft traffic
- Organisational or operational issues such as aircraft malfunctions and ground issues such as distractions, equipment or maintenance issues.

See examples below.

Gliding clubs can help manage organisational threats and prevent pilot errors by providing daily briefing on weather and operating procedures, and regular refresher training

Whilst threats occur independently of the pilot, they increase the pilots' workload and need to be thought about and planned for. Sometimes they can be managed in isolation and sometimes they interact with another issue, further complicating the necessary management.

Good TEM management starts before the pilot arrives on the airfield, by good preparation – being in a fit state to fly, checking the forecast and notams, maintaining equipment in good condition, and familiarity with programming GPS etc

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Threat Examples	
Environment	*Organisational*
Weather – strong winds/turbulence, crosswinds, rain storms, wave rotor	Aircraft - damage or equipment failures
Visibility - icing, misting, low sun	Launch crew – poor training, causing distractions
Surface – rough airfield, rabbit holes	Visitors – poor organisation or briefing
Traffic – ridge traffic, non-glider traffic such as paragliders	Communications – non-functioning radios, failure to communicate procedural changes
Terrain – unlandable areas, hilly or mountainous	Operational pressures – launch rates, ratio of ground crew to pilots
Navigational issues – complex airspace changes	

Errors

Errors may be the result of a momentary slip or lapse or induced by an expected or unexpected threat. For example: a distraction during pre-launch checks could result in the pilot not completing the checklist properly, causing the pilot to take off with a canopy unlocked.

Other errors are more deliberate: known as **intentional non-compliance errors** or sometimes known as violations. These occur when individuals or organisations deliberately disregard rules, regulations, or procedures. These errors are distinct from unintentional errors like slips or mistakes, as they involve a conscious choice to deviate from established norms. For example: shortcuts used by the pilot to save time even though they violate club SOP's for instance: towing a glider to the launch point without someone walking in front or driving straight across the airfield instead of around the perimeter.

Errors can be divided into:

- aircraft handling,
- procedural or
- communication

See table 2 opposite.

Aircraft handling errors may include flying errors such as poor speed and approach control, incorrect use of controls such as confusing the airbrake and flap levers, or technological errors, such putting the wrong settings in a GPS. They may be a consequence of poor training and/or lack of currency. (See BGA currency barometer for further guidance.) Aircraft handling errors may be addressed by better training and a self-awareness of skill level – many glider pilots do not fly that often and therefore loss of aircraft handling skills is a significant risk. The Competency Matrix or glider pilots gives a structured way of helping to identify these issues. (ref.)

Procedural errors are pilot deviations from regulations, flight manual requirements or club standard operating procedures. These may be the result of insufficient checklist discipline or airfield safety discipline.

Communication errors involve a miscommunication between the pilots, or ground crew. They may be due to lack of training or lack of proficiency with radio telephony.

An error that is recognised and effectively managed has no adverse impact on the flight. Conversely, a mismanaged error reduces safety margins and may induce additional errors and negative outcomes.

A common cause of all error types is distraction and/or mental overload. For example, VFR flight in complex airspace and around busy aerodromes often involves high workload. This can be mitigated by better planning and anticipation, task prioritisation and removal of unnecessary distraction.

We are all human and our response to making or identifying an error, has consequences.

For example, does the pilot:

- detect and recover the error quickly,
- do they acknowledge the error but do nothing, perhaps because they believe it is inconsequential
- or do they only 'see' the error when it escalates to a more serious undesired aircraft state?

Examples:	
Aircraft handling errors	Incorrect use of controls – flaps, airbrakes, etc
	On the ground – landing towards parked aircraft or obstacles. Landing in confined spaces
	Field landings – late field selection, poor judgement on approach
	Equipment – failure to check fully operational, mis-programming, incorrect settings
Procedural errors	Failure to read or comply with SOP's
	Inadequate pre-flights checks
	Failure to read or comprehend placard limits
Communication errors	Failure to attend or listen to briefings.
	Misunderstood communication, failure to communicate instructions.

The drill should be recover first, analyse the causes later.

For example, a pilot incorrectly enters a waypoint into his GPS such that the aircraft track now passes through class A airspace. Once the pilot executes the incorrect entry and the GPS unit directs him towards controlled airspace the 'error' has already occurred. When the error is spotted (hopefully not too late) the pilot can either analyse what is wrong with the GPS and fix the problem (causing a distraction from flying and lookout) or, better, concentrate on re-routing and avoiding the airspace. Analysing the cause of the error can wait until the flight is completed.

Errors can lead to a safety-compromising event called an undesired aircraft state (UAS). A UAS is when the aircraft is in an unsafe attitude, configuration or location. It usually reduces the safety margins. It may result from pilot error, actions, or inaction; such as incorrect speed and coordination in thermalling leading to a spin, incorrect speed on approach leading to a heavy landing, mis-rigging, incorrect flap settings etc

TEM: Tools & Techniques

Some of the safety management tools, the 'hard' safeguards, are associated with aircraft design, and include automated control connection systems, instrument displays, and aircraft warnings. The Flarm collision avoidance system, which provides pilots with visual and audio warnings of nearby sailplanes to prevent midair collisions, is a good example of a 'hard' TEM safeguard. Even with the best designed equipment however, these 'hard' safeguards are not enough to ensure effective TEM performance

The 'soft' safeguards are very common in gliding (and other high-risk sports). They include regulations, standard operating procedures, and checklists to direct pilots and maintain equipment; and licensing standards, checks, and training to maintain proficiency.

With the hard and soft safeguards in place, the last line of defence against threat, error, and undesired aircraft states, is still, ultimately, the pilot.

TEM in Action:

Pre-flight Planning: We all know the 5 P's: Prior preparation prevents poor performance. Preparation starts well before the flight. Identify potential threats (e.g., weather, terrain) and develop countermeasures.

Effective use of checklists: Checklists/ drills and procedures only work if pilots use them. They are even more effective said out loud. The 'point and say' technique is surprisingly effective. When you say, for example, the recovery airspeed, put your finger on it on the ASI.

Monitoring and Cross-checking: actively monitor the situation, systems, instruments, and actions. Alert ground crew may prevent launch accidents by noticing mistakes or omissions by a pilot, for example.

Effective Communication: Clear and concise communication using standard phraseology.

Error Detection and Recovery: Recognizing errors early and implementing corrective actions.

Maintaining Situational Awareness: Being aware of the surrounding environment, potential threats, and the aircraft's status.

The inclusion of TEM as a standard part of every pre-flight briefing serves several purposes. Obviously we must consider the TEM for the flight that's about to happen, but the instructor is also giving training in identifying what the likely 'gotchas' are in various flight scenarios and, thirdly, helping to instil the TEM habit in the trainee, in the hope they will carry this into all of their own flying as an ingrained part of their preparation.

Airmanship and Human Factors

Many glider pilots will have an accident or incident at some point in their flying careers. If you read an accident report and think 'what kind of idiot would....?' the answer is anyone could.

If a pilot thinks they are unlikely to have an accident because they are experienced / skilled / smarter / or an above average pilot (delete where applicable) then simply replace those descriptions with 'arrogant / overconfident / unrealistic / unaware' (delete where applicable) and we see a different picture.

It is easy to define the qualities that are common to poor airmanship, but harder to define good airmanship. The CAA Skyway code references a way of defining it as:

Knowledge: Aircraft, environment, risk

Skill: Physical, cognitive, communication, management and team

Attitudes: Professionalism, discipline, self-improvement, knowledge of hazardous attitudes

It is helpful to stop thinking about 'check flights' and work towards providing an opportunity for refresher training and giving the pilot the opportunity to reflect on areas for development and improvement. Skills should not simply be flying skills, but wider competencies, such as situational awareness or decision making.

Much of your role as an instructor is about improving knowledge and skills, but we need to give equal emphasis to developing positive attitudes. The descriptors of the 5 hazardous attitudes (see chart below) in the Skyway code should be required reading.

Changing attitudes and behaviours is challenging and must be part of changing the wider culture in which the individual operates.

Useful techniques for working with an individual can be found in the chapter on developing pilot competencies.

The Five Hazardous Attitudes	Antidote
Anti-authority: "Don't tell me." This attitude is found in people who do not like anyone telling them what to do. In a sense, they are saying, "no one can tell me what to do." They may be resentful of having someone tell them what to do or may regard rules, regulations, and procedures as silly or unnecessary. However, it is always your prerogative to question authority if you feel it is in error.	**Follow the rules. They are usually right.**
Impulsivity: "Do it quickly." This is the attitude of people who frequently feel the need to do something, anything, immediately. They do not stop to think about what they are about to do, they do not select the best alternative, and they do the first thing that comes to mind.	**Not so fast. Think first.**
Invulnerability: "It won't happen to me." Many people falsely believe that accidents happen to others, but never to them. They know accidents can happen, and they know that anyone can be affected. However, they never really feel or believe that they will be personally involved. Pilots who think this way are more likely to take chances and increase risk.	**It could happen to me.**
Macho: "I can do it." Pilots who are always trying to prove that they are better than anyone else think, "I can do it–I'll show them." Pilots with this type of attitude will try to prove themselves by taking risks in order to impress others. While this pattern is thought to be a male characteristic, women are equally susceptible.	**Taking chances is foolish.**
Resignation: "What's the use?" Pilots who think, "What's the use?" do not see themselves as being able to make a great deal of difference in what happens to them. When things go well, the pilot is apt to think that it is good luck. When things go badly, the pilot may feel that someone is out to get them or attribute it to bad luck. The pilot will leave the action to others, for better or worse. Sometimes, such pilots will even go along with unreasonable requests just to be a "nice guy."	**I'm not helpless. I can make a difference.** *©CAA*