CAANZ Policy on Threat and Error Management

Background

The International Civil Aviation Organization (ICAO) requires that Human Factors and Threat and Error Management (TEM) be introduced into all pilot training.

Traditionally human factors and TEM have been associated with airmanship or just plain common sense; and knowledge was gained through experience and a process of 'infusion'. The move to link airmanship to human factors and threat and error management is in effect, tantamount to bringing science to the often nebulous concept of airmanship**.**

Human factors training has already been successfully introduced to the various NZ licence syllabuses and threat and error management has been assessed at the ATPL level since May 2006. It is CAA's intention to comply with ICAO standards by introducing a requirement for threat and error management training to be included in all licences and ratings.

Threat and Error Management was developed by the University of Texas and derived from observations on flight decks during Line Operation Safety Audits (LOSA). Although some pilots may see TEM as just another fad with a new range of buzz words, TEM is in reality the formalisation of what many would call common sense.

The purpose of linking human factors, threat and error management and airmanship is not to diminish the importance of airmanship, but to make the measurement of it valid and reliable.

Purpose

The purpose of the proposed changes to the licence and rating syllabuses is to formalise TEM through training and assessment of situational awareness, decision making and those aspects of human factors that affect these.

Objective

TEM training needs to be structured and designed to meet competency standards. Therefore, it is essential that flight training organisations develop techniques and material for teaching threat and error management and that flight examiners conducting flight tests have methods and tools to assess competency.

Current Rules

The current Civil Aviation Rules require an applicant for the issue of a licence to demonstrate in a flight test "competence to operate the aircraft within its performance capabilities and limitations in accordance with the aircraft flight manual in all normal, abnormal, and emergency conditions and procedures while exercising appropriate levels of judgement and command" [PPL CAR 61.153 (7) (iv); CPL CAR 61.203 (7) (iv) and ATPL CAR 61.253 (6) (iv)].

Implementation

The intent is to formalise TEM in the above "demonstration of competence".

Initially by amendment to the relevant Flight Test Standards Guides (FTSG) and ultimately by specific reference to TEM in the current re-write of Part 61.

Timetable

This type of training is already being conducted albeit not necessarily referred to as such, nor formalised.

Therefore it is proposed that instructors should commence formal TEM training immediately and that the requirement for TEM to be formally assessed will come into force on 3 July 2010.

Training and assessment information is included in this document for use by students, instructors and examiners.

TEM was a subject introduced in the August 2009 Flight Instructor Seminars and will be a topic of the coming Flight Examiner Seminar (August 2010).

Costs

It is not intended to increase the total flight time experience requirements for a licence or rating as a result of TEM training. Therefore no additional training cost to the student is envisaged.

Training of the flight instructors who conduct this type of training will consist of formalising what is currently taught and raising awareness of how it is taught. Therefore, training is not seen as an ‘additional’ expense.

Training of the examiners is being provided free of charge by CAA through seminars and FTSG’s.

Threat and Error Management Training and Assessment Information
TEM is an operational concept applied to the conduct of a flight that is more than the traditional role of airmanship, as it provides for a structured and pro-active approach for pilots to use in identifying and managing threats and errors that may affect the safety of the flight.

The following sections provide a brief introduction to assist General Aviation (GA) pilots and trainers to apply the principles of TEM to their own operations.

Threats
Threats are defined as external events or errors that:
- occur outside the influence of the pilot;
- increase the operational complexity of the flight; and
- require pilot attention and management if safety margins are to be maintained.

Generally, threats are considered to be external (e.g. bad weather) or internal i.e. those the pilot or trainee bring to the operation (e.g. fatigue, complacency).

Pilots need good situational awareness to anticipate and recognise threats as they occur. Some typical external threats to operations are:
- adverse weather;
- weight and balance;
- density altitude;
- runway length;
- other traffic;
- high terrain or obstacles; or
- the condition of the aircraft.

Some typical internal threats to GA operations might be:
- fatigue;
- complacency;
- over or under confidence;
- lack of flight discipline;
- hazardous behaviour;
    - impulsiveness;
    - machoism;
    - invulnerability;
    - resignation; and
    - anti-authority or
- lack of currency and proficiency.

Errors
Threat and Error Management accepts that it is unavoidable that pilots, as human beings, will make errors. Errors are defined as pilot/flight crew actions or inactions that:
- lead to a deviation from pilot or organisational intentions or expectations;
- reduce safety margins; and
- increase the probability of adverse operational events.

Errors can be classified as handling errors, procedural errors or communications errors.

While errors may be inevitable, safety of flight requires that errors that occur are identified and managed before flight safety margins are compromised. Typical errors in GA flight might include:

- incorrect performance calculations;
- inaccurate flight planning;
- non-standard communications;
- aircraft mis-handling;
- incorrect systems operation or management; or
- checklist errors.

Undesired Aircraft State

Threats and errors that are not detected and managed correctly can lead to an undesired aircraft state, which could be a deviation from flight path, or an aircraft configuration that reduces normal safety margins.

The definition of undesired aircraft state is:

- Pilot induced aircraft position or speed deviations, misapplication of flight controls or incorrect systems configuration associated with a reduced margin of safety.

An undesired aircraft state can still be recovered to normal flight but, if not managed appropriately, may lead to an outcome such as an accident or incident. Safe flight requires recognition and recovery from an undesired aircraft state in a very short timeframe before an outcome, such as loss of control, failure to achieve optimum performance or flight into terrain occurs.

Examples of errors and associated undesired aircraft states in GA aircraft might be:

- loss of directional control during a stall (error) resulting in an unusual attitude (state);
- inappropriate or ineffective scan of aircraft instruments (error) resulting in flight below VYSE (best single-engine rate of climb speed [blue line speed]).

TEM requires the pilot to plan and use appropriate countermeasures to prevent threats and errors leading to an undesired aircraft state. Countermeasures used in TEM include many standard aviation practices and may be categorised as follows:

- **planning countermeasures:** including flight planning, briefing, and contingency planning;
- **execution countermeasures:** including monitoring, cross or rechecking, workload and systems management; and
- **review countermeasures:** including evaluating and modifying plans as the flight proceeds, and inquiry and assertiveness to identify and address issues in a timely way.

Once an undesired aircraft state is recognised, it is important to manage the undesired state through the application of the correct remedial solution and prioritise aircraft control for a return to normal flight, rather than to fixate on the error that may have initiated the event.

TEM application

Threats and errors occur during every flight as demonstrated by the considerable database that has been built up by observing flight operations worldwide through LOSA.

The following summary is intended to assist pilots to apply TEM in GA operations:

Pre flight:

A few minutes spent on the ground anticipating possible threats associated with the flight will provide the opportunity to plan and develop countermeasures (e.g. action in the event of unpredicted weather changes).

In flight:

Brief (self and passengers) planned procedures before take-off and prior to commencing each significant flight sequence (e.g. approach to an unfamiliar aerodrome);
Include anticipated threats and countermeasures in briefings (e.g. crosswind);
Monitor and cross or recheck visual and instrument indications to maintain situation awareness (e.g. SADIE checks);
Prioritise tasks and manage workload to avoid being overloaded (e.g. use checklists);
Identify and manage any undesired aircraft state; and;
Recover to planned flight and normal safety margins before dealing with other problems.

Post flight:

Reconsider what threats, errors and/or undesired aircraft states were encountered during the flight. Ask yourself how well they were managed and what you could do differently to improve the management of similar threats and errors on future flights;
Note your threats, errors, and/or undesired aircraft states and discuss them with more experienced pilots to assist with the development of improved TEM strategies.

Teaching threat management

Instructors must understand that threats (and errors) are a part of everyday aviation operations that must be managed. First, instructors should stress to trainees that threats fall into two main groupings: anticipated and unexpected.
However, there is a third group called latent threats. These threats may not be observable by pilots involved in flight operations and may need to be uncovered by safety analysis.
Some examples of latent threats are optical illusions (approaches to sloping runways), poor manuals, or equipment design faults (landing gear and flap levers located too close to each other) or unnecessary pressure to get a job done. Therefore, it is incumbent upon instructors to show trainees how to detect the three groups of threats, and the steps to take to mitigate these potential hazards.

Detection of anticipated threats relies mainly on knowledge and experience. As pilots learn (and gain experience) they will be able to predict where threats may occur. For example, being able to obtain and interpret a meteorological report will allow a pilot to prepare for adverse weather. Likewise, experience assists pilots to understand more about their own capabilities and limitations.

Unexpected threats are most likely in flight. These threats are generally managed by applying skills and knowledge acquired through training and flight experience. Typically, a practice engine failure or simulated system failure are methods of training a pilot to manage unexpected threats. Knowledge and repetition prepare a trainee to manage such events should they occur for real in flight.
During flight training the instructor must identify unexpected threats such as incorrect ATC instructions, traffic hazards or adverse weather and point them out to the trainee should they

fail to identify them. Then it is important to question the trainee to see what steps they could take to mitigate the threats, ensuring that the action is completed in the time available. Instructors may have to develop scenarios or 'what if' questions, to further train the trainee.

Teaching error management

The acknowledgement that errors will occur has changed the emphasis in aviation operations to error recognition and management rather than just error prevention.

Notwithstanding the fact that under ideal circumstances, errors will not occur, aviation is not an ideal situation and pilots must be trained to manage errors.

Rather than just pointing out errors as they occur, instructors should show trainees how to minimise the chances of errors happening, and then if they do happen, recognise the fact and implement strategies to manage them.

Instructors must afford the trainee the opportunity to recognise a committed error rather than intervening as soon as they see an error committed, they must wait (if time allows) to see if the error is identified by the trainee. If it is not, the instructor should then analyse why the error happened, why it was not recognised and how to prevent future occurrences.

Mitigators that are in place such as checklists, SOPs and aviation rules must be applied and complied with. Whether a checklist is used from memory or read, they are provided to enhance safety (by helping reduce errors) and instructors must continually stress their importance and accept no deviations to its application and terminology.

Teaching undesired aircraft state management

Unmanaged or mismanaged threats or errors may result in an undesired aircraft state. Ideally, pilots should be taught to manage threats and errors before an undesired aircraft state develops. During flight training, instructors will be dealing with many undesired aircraft states as trainees develop their flying skills.

In this context, instructors have the dual role of practicing TEM by ensuring that undesired aircraft states are managed and then teaching trainees how to do the same. Because trainees may not have the manipulative and cognitive skills of a qualified pilot, they will often not meet specified flight tolerances or procedures.

Some typical examples would be:

- taxiing too fast;
- too fast or slow on final approach; or
- inability to maintain altitude or heading during straight and level flight.

Although such examples would be classified as undesired aircraft states when committed by a qualified pilot, they are not unusual events during flight training. The difference is that the instructor should be aware of the threats and errors and should not let an undesired aircraft state develop into an undesired outcome (accident or incident).

A critical aspect that instructors must teach is the switch from error management to undesired aircraft state management. During the error management phase, a pilot can become fixated on determining the cause of an error and forget the old adage 'aviate, navigate, communicate'.

Assessing TEM

The basic concept for TEM is simply to:

- identify the threat, error or undesired aircraft state; and
- manage the threat, error or undesired aircraft state.

Although this sounds uncomplicated, flight examiners must obtain evidence to ensure that TEM is being practiced. Flight examiners cannot assume that just because a pilot completed a faultless trip, competent TEM was used.

On a flight test it is likely that scenarios will need to be created to allow proper assessment of TEM. A competent pilot is unlikely to get into an undesired aircraft state or would quickly correct an undesired aircraft state (e.g. low approach speed) and it could be necessary for the flight examiner to artificially create such a circumstance. For example:

- when approaching a destination aerodrome simulate a thunderstorm over the airfield
- simulate a radio failure approaching a reporting point or entering a control zone;
- simulate precautionary or forced landing;
- simulation of instrument or display failure.

The simulation of systems malfunctions and emergencies will afford the opportunity to evaluate threat, error and undesired state management competencies.

For example, it would be possible to assess a number of elements from the Human Factors and TEM standards if a flight examiner sets a scenario for a precautionary landing. Consider the list below:

- **Lookout:** selection of a suitable landing area, weather and terrain avoidance;
- **Situational Awareness:** perception of present situation and options, action plan, potential hazard awareness, aircraft configuration and performance;
- **Decision making**: decision to conduct a precautionary search, assessment of landing area and the decision to land;
- **Task prioritisation:** work management and prioritisation;
- **Communications:** communications with ATS, other aircraft;
- **Threat management:** weather, low-level operations, aircraft handling;
- **Error management:** recognition of any errors, countermeasures, checklist use;
- **Undesired aircraft state:** taking appropriate action to prioritise management of an undesired aircraft state.

Therefore it is intended to assess TEM through the following elements of Situational Awareness, Decision Making and other Human Factors considerations.

Situational awareness (SA).

Simply defined SA is; ‘Knowing what is going on around you, and being able to predict what could happen’. A more colloquial term is ‘street smarts’.

In the context of aviation, three levels of SA are often assigned. They are:

- **Level 1:** perception of the current environment;
- **Level 2:** interpretation of the immediate situation; and
- **Level 3:** anticipation of the future environment.

Monitoring and gathering information from both within the cockpit and outside the aircraft achieves perception of the current environment.

This information is collected by the senses (Level 1). Next the process of interpretation (Level 2) leads to making conclusions of what is likely to occur (Level 3).

Relevant Human Factors considerations

Information processing

Pilots are required to continuously process information during flight operations. It is therefore necessary for instructors to understand how information is processed so that they can apply the principles involved to assist trainees with situational awareness, decision-making, task management, communications and an effective lookout.

Stimuli are collected by the sensors: eyes, ears, nose, taste buds, skin and muscles (feel), and the vestibular senses (balance mechanism), and then this information is passed to the brain. The information is analysed and interpreted (perception or mental model) and is initially stored in the sensory memory for a short time (one to five seconds) until it is passed to the short term (working) memory, or replaced by new information. Failure to receive information or analyse it appropriately, may result in poor situational awareness.

Teaching situation awareness

From the moment training begins, a trainee should be made aware of SA, its importance, and how it will be taught and assessed. In the normal course of flight training, trainees are shown how to monitor flight instruments, aircraft systems and flight attitudes and to manage them appropriately to achieve the desired performance. Instructors need to point out how all this information is applied to develop SA. Additionally, trainees must learn to monitor, gather and interpret appropriate information from both inside and outside the aircraft. This continual monitoring assists perception (mental model) of what is happening and what is likely to happen in the near future, which is the basis of SA. Visual information is the greatest source for building and maintaining SA.

Instructors should also explain to trainees the importance of maintaining a good radio listening watch and, during initial training, explain how interpretation of radio-telephone (R/T) transmissions will enable them to anticipate other traffic and likely air traffic instructions.
As training progresses, the instructor must observe the trainee's performance and if necessary develop scenarios to improve, challenge and assess SA.

Observation and questioning are the primary means of making a formative assessment of SA. For example, one of the first senses that can degrade during higher workload is hearing. If a trainee (or instructor) is aware they require ATC to repeat clearances more often than normal, and/or they are starting to miss radio calls altogether, this could be the first sign of overload and degraded SA. Questions like "What would you do if…?" can be used to assess a person's SA. This type of assessment should be conducted throughout a pilot's training and the results used to modify the training plan when appropriate.

Trainees must be encouraged to verbalise their observations so that the instructor is also informed and able to make assessments. Therefore, instructors may need to plan how they will conduct SA instruction and possibly create scenarios to enable the learning to occur. It is likely however that, during the normal course of a flight, situations will spontaneously evolve that present trainees with the opportunity to apply and demonstrate their SA.

Assessing situation awareness

The most important aspect of assessing SA is to confirm that the trainee's mental model (or perception) of the environment is accurate. Next, find out what options of what could happen have been generated and whether they are realistic. In other words, the flight examiner should

see if the 'what ifs' complement the mental model and provide a basis for an accurate and timely decision if one is required. There may be no need to proceed to the next step of making a decision, as SA is an ongoing process and further action only needs to be taken if some of the perceived situations compromise flight safety. For example, if there are thunderstorms in the area but they do not conflict with the intended track, and the adverse effects of the storm will not affect the flight, no mitigating action would need to be taken.

However, it would indicate a lack of SA if the pilot did not consider the storms and the associated threats in their planning.

Flight examiners must determine if SA is being maintained regardless of workload. During periods of high workload it is possible that information may be overlooked. For example, if the trainee is busy during an approach into a very active terminal area, radio transmissions may be missed or instructions forgotten. A possible cause for this reduction in SA is failure to recall the information received (short-term memory breakdown causing faulty perception) which can lead to failure to take appropriate action.

Equally, flight examiners must continue to monitor the trainee during periods of low arousal or workload (inactivity) to ensure that an appropriate level of SA is maintained. During a long navigation leg that is proceeding according to plan, a trainee may relax and stop thinking about "what is happening and what could happen", i.e. the anticipation of potential threats and errors. It would be appropriate to confirm that SA is being maintained by the use of questions such as "Where would you divert to now if a passenger became seriously ill?", "If you suffered an engine failure where would you land?" or "What is our endurance now?"

Flight examiners must also observe the appropriate application or otherwise of knowledge, because SA can be adversely affected by a lack of knowledge. For example, deficiencies in aircraft systems knowledge could lead to an undesirable aircraft state. Fuel system mismanagement would be a typical example.

Proposed assessment criteria for situational awareness

Not yet competent	Competent	Ideal
(1) The candidate's situational awareness is compromised and/or not applied to the operational situation (as simulated if applicable)	(1) The candidate exhibits a competent level of situational awareness and highlights situations relevant to the operation (as simulated if applicable)	(1) The candidate exhibits a high level of situational awareness with emphasis on operational factors

Decision making

In daily life people are always making decisions - often sub-consciously. However, in the aviation environment the decisions that sometimes must be made can have tragic consequences if they are incorrect or inappropriate. Therefore, it is important for pilots to understand and be able to apply the decision making process and to be aware of the need to make timely and correct decisions.

Relevant Human Factors considerations

A decision is arrived at after the brain determines what to do about the options. This process involves memory to recall stored information that is applicable to the situation. The working or short-term memory holds the information being used at the time and may call on the long-term memory to evaluate new information. The brain is a 'single channel processor' and can

only deal with one decision at a time. Therefore, if decisions are not prioritised correctly (the most critical decision first), the outcome could be unfavourable.

Instructors must be aware of the many limitations that affect information processing and decision-making. Some of the limitations are:

- time;
- mental overload, task mismanagement;
- conflicting information;
- expectations and anticipation;
- fatigue;
- insufficient knowledge;
- forgetting;
- emotions; confirmation bias (ignoring information that does not support the decision);
- personality traits;
- failure to seek or apply feedback;
- stress; and
- fixation and destination obsession.

This is not a comprehensive list but it represents some of the factors that an instructor should take into account when dealing with information processing and decision-making.

Teaching decision making

By applying situational awareness, a pilot may arrive at a number of options of 'what could happen', and the next step is to make a decision that achieves the optimum outcome. Instructors must mentor trainee pilots through the decision-making process. For example, by applying information such as meteorological reports, radio transmissions, visual observations and previous knowledge to the situation, to make decisions.

Trainees must be given the opportunity to decide and, if a decision is flawed, the reasons should be clearly explained. For example, if the weather is marginal before a flight, rather than cancelling the sortie, the instructor could ask the trainee (who probably is very eager to fly) whether or not it would be prudent to undertake the flight, or consider what alternative flight training profiles might be applicable.

It is quite normal for an instructor to make decisions during flight, but it may be of more benefit to ask the trainee for their opinions. By doing this it is possible to assess their progress and then to provide guidance if it is required.

During flight training there will be many occasions to observe, assess and improve a trainee pilot's decision making. Instructors must be conscious of when there is a requirement for a trainee to make a decision. They must then determine if it is an acceptable decision that has been made in the time available. If the decisions are defective, it may be necessary to go through the reasoning that was used and point out any faults and explain how considerations and logic should be applied to reach an acceptable decision. Although this may seem to be a laborious procedure, it is better than simply revealing to a trainee that they had made a wrong judgment, and telling them what they should have done, without analysing why the mistake was made and offering guidance to help them improve their decision-making skills.

The timeliness of decisions is another facet of decision-making that instructors should emphasise. A mishandled final approach may require a quick decision to go-round to avoid

damage to the aircraft. However, a decision to divert because of adverse weather or fuel shortage on a navigation flight may have a 'deadline', by which time a decision must be made.

In the second case the situation is dynamic, variable, emotive and subject to bias. These aspects of decision-making make the process more difficult and susceptible to errors.

Although the aforementioned decisions must be made in different timeframes, the information process will be the same. That is:

- receive information;
- convert information into reality;
- options are generated;
- options are analysed;
- a decision is made; and
- the effect of the decision evaluated.

During flight training opportunities will arise to gauge and advise a trainee about timely decisions, but there may be a need to create scenarios to give a trainee practice at this type of (more complex) decision-making process, for example, partial power loss.

This scenario potentially offers more time and provides the trainee with a larger number of options from which to make a final decision. In itself this type of scenario is a richer training environment for decision-making as it leaves the trainee with a number of options that can be discussed in the debrief: why the trainee chose a specific course of action, what were their considerations for reaching their conclusion etc.

When teaching decision-making, instructors should remember that individuals have different emotional attitudes, learning rates, thought processes, analytical skills, aspirations and cultural backgrounds which may influence how this skill is taught. Therefore, instructors should be flexible, imaginative and innovative in developing ways of passing on decision-making skills to pilots of all experience levels.

Assessing decision-making

Flight training provides ample opportunities for instructors to conduct formative assessments of decision-making skills, though it may be necessary to create scenarios to analyse a trainee's ability to manage complex decision-making. This process may be more difficult for a flight examiner to assess on a flight test because of a limited time frame and reduced opportunity.

For an obvious decision such as a 'go around' after a mishandled final approach, the action and results will be very evident. However, more complicated decisions may require greater analysis by both the pilot and the flight examiner and some questioning may be required to obtain an accurate assessment.

Proposed assessment criteria for decision making

Not yet competent	Competent	Ideal
(1) The candidate's decision making process cannot be evaluated or clearly ignores available information, especially any information related to the operation	(1) The candidate verbalises the decision making process and highlights any decision influenced by the operational environment	(1) The candidate verbalises the decision making process with emphasis on any decision influenced by the operational environment

Other relevant Human Factors considerations

Lookout

Vision is the primary source of information for a pilot. Whether it is aircraft attitude, position, physical hazards or other traffic, what a pilot sees is processed by the brain and used to build up situational awareness. Therefore, it is important for an instructor to effectively train a pilot how to best utilise vision to maintain safety.

Teaching an effective lookout

Effective lookout means seeing what is 'out there' and assessing the information that is received before making an appropriate decision.

Instructors should guide trainees through the multitude of factors that can adversely affect vision and lookout such as the amount of ambient light, window posts, the cleanliness and crazing of windscreens and other physiological and psychological factors.

During flight training, stress the importance of ensuring the windscreen and eyewear is always clean and free of crazing. Trainees must be taught to move their head and to momentarily change the aircraft's attitude to see below the nose, beyond a wing or beyond window posts and any other obstructions such as passengers in the adjacent seat.

Seeing and interpreting

Not only is seeing important, but accurately interpreting what is seen is equally vital.

Instructors may assume that a trainee interprets what they see in the same way as the instructor – but this may not always be the case and instructors should spend time explaining the logic of observations.

Examples for consideration are observing and interpreting:

- aircraft attitude;
- indications of adverse weather;
- wind strength and direction from clouds, blowing dust, smoke, trees and water;
- terrain effects on wind;
- other air traffic;
- reduced visibility;

Throughout training instructors should firstly teach and then assess a trainee's ability to observe what is happening around them and to apply that knowledge to ensure safety.

Looking for traffic

A great deal of a pilot's time must be spent looking for and sighting air traffic in order to avoid possible conflict. The concept of see-and-avoid is far from reliable**.** By employing an effective scanning technique and understanding how to enhance visual detection of other traffic, a pilot is more likely to reduce the likelihood of collision.

Size and contrast are the two primary factors that determine the likelihood of detecting other aircraft. Size is the more important parameter in detecting aircraft and as GA aircraft are usually small, the problem of detecting aircraft is exacerbated.

Passengers may also be used to help improve lookout. Trainees should be taught to ask their passengers to advise them if they sight anything that may be a threat or could compromise

safety. An instructor should provide and demonstrate acceptable lookout techniques, and ensure that trainees practice and apply these techniques.

Alerted search

An alerted search is visual scanning when air traffic information has been provided and a pilot is, in effect, told where to look. Air traffic services or other pilots could provide this information. Listening to and interpreting radio transmissions in the circuit area are an ideal opportunity to teach this aspect to a trainee.

A summary of maintaining an effective lookout:

- threats are external to the aircraft; so
- the pilot must look outside the aircraft;
- search the available visual field to detect threats that will often appear in the peripheral vision;
- shift vision directly to the threat and if identified as a collision risk, decide on what effective evasive action to take; and
- manoeuvre the aircraft to mitigate the risk.

Pilots must realise that this process takes time and that factors affecting lookout are not errors or poor airmanship, but are limitations of the human visual and information processing systems, which are present to various degrees in all humans.

Nonetheless, effective training can improve lookout technique.

Assessing lookout

Flight examiners have the task of assessing the ability of trainees to maintain an effective lookout.

There are two main elements to effective lookout.
Firstly, to see an 'object' and secondly, to react appropriately to what has been seen.

Flight examiners should watch the trainee to ensure that tasks are prioritised and managed to ensure a good lookout is maintained. This can be achieved by monitoring head and eye movement, when possible. Additionally the flight examiner should monitor the candidate to determine whether traffic information received by radio transmissions is reacted to appropriately.

Flight examiners should observe whether the trainee always uses an acceptable procedure before manoeuvring the aircraft. This 'clearing procedure' should not only be used to locate other aircraft but also any terrain, weather or other threats.

An assessment criterion for this task is already in place.

Not yet competent	Competent	Ideal
(1) Lookout deficient – examiner needs to intervene	(1) Maintains an adequate lookout (**critical element**)	(1) Maintains a continuous and systematic lookout both on the ground and in the air

Workload management

Workload mis-management can lead to excessive 'head in the cockpit' during busy periods. Instructors should warn trainees about these situations and highlight such incidents when they occur during flight training.

Teaching how to set priorities and manage tasks
'Aviate, navigate and communicate' is the basis of prioritisation and task management.

Task management means completing a job or operation competently in the time available. If the workload is high and many tasks have to be completed, they must be prioritised in a logical and efficient sequence.

The brain is a single-channel processor (linear) and humans can normally only manage one activity at a time. Many things that experienced pilots take for granted must be pointed out and explained to the novice. For example, when a pilot is first introduced to the cockpit they must be shown how to adjust their harness and seat, and reach and touch controls and switches. Proficiency in these operations will make workload management easier.

During flight training, trainees should be encouraged to prioritise tasks to ensure that the important and safety critical actions are dealt with first. Referring to the adage at the beginning of this section 'aviate' or maintaining control of the aircraft must be a pilot's first concern. One of the cornerstones of managing an undesired aircraft state in threat and error management is the timely correction of the undesired state rather than concentrating on why an error may have occurred. This is prioritising correctly. Instructors should alert trainees when they have incorrectly prioritised and offer a more appropriate solution. A question like "What is more important?" may prompt a pilot to prioritise correctly.

Another practice that instructors should stress is good organisation in the cockpit. This is particularly applicable when navigating. Thoughtful selection and storage of charts, flight plans, computers, publications and writing implements should result in more precise and simpler navigation.

One of the keys to workload management is the ability to recognise factors that adversely affect a pilot's ability to operate efficiently such as;

- **lack of preparation**: (confusion, disorganisation);
- **fatigue:** (poor decision making, errors);
- **discomfort**: (distraction, fatigue);
- **stress**: (inefficiency, distraction);
- **arousal**: (increased or decreased work cycles);
- **domestic stress**: (distraction, lack of concentration);
- **distraction**: (diverted attention);
- **non-use of automation**: (increased work);
- **destination or task obsession**: (poor decision making, press-on-itis);
- **bad health**: (decreased physical and psychological performance); or
- **overload**: (fixation, tunnel vision, broken work cycles).

Although this is not a comprehensive list, instructors should advise trainees of methods of developing and applying countermeasures or strategies to manage these inhibiters to efficient workload management.

Whether it is a minor or major problem that is being encountered, it must always be remembered that the first priority is control of the aircraft.

Assessing prioritisation and task management

A flight examiner should ssemble evidence of competence in setting priorities and managing tasks on a flight test by observing a pilot's work pattern and task completion. For example, if a pilot is told by ATC to "Expedite takeoff", and does so before completing pre-take-off checks then the pilot could be reasonably deemed as not competent at prioritising tasks.

When assessing task management the flight examiner is looking for competent completion of a task in the time available. It may be necessary to create scenarios and ask questions so as to determine how a candidate's mind is functioning while managing tasks, in order to judge the pilot's ability to competently set priorities and manage tasks.

Assessment criteria for task management is already in place and in part reads:-

Not yet competent	Competent	Ideal
(1) Seriously neglects aircraft control	(1) Gives priority to aircraft handling (**critical element**)	(1) Flys the aircraft accurately at all times

Effective communications and interpersonal relationships
Communication is a two-way process; it involves the accurate transmission, receipt, and interpretation of information. Communication is not limited to the radiotelephone; it also involves direct verbal and non-verbal exchanges. 'Effective interpersonal relationships' is a topic that may seem to be 'touchy-feely', but involves being able to get a positive or helpful, rather than negative or obstructive, response from individuals or groups that a pilot deals with.

Teaching effective communications and interpersonal relationships
The first requirement for communication is a common language, which is the English language and 'Aviation English'. Aviation English is the use of standardised, abbreviated, precise and agreed terminology and phraseology. Pilots are expected to use Aviation English and will gain knowledge and experience in its use as their flight training progresses.

Instructors must monitor and develop a pilot's communication skills throughout flight training, pointing out when communications are confusing, ambiguous or out of context. The next step would be to suggest a way to modify and improve their communication.

Extra care is required when teaching trainees who do not have English as a first language. The instructor must be precise with their use of language and be careful not to use slang or colloquial speech.

The intent of 'maintaining effective interpersonal relationships' is to make pilots aware of the need to always foster positive and cooperative relationships with persons involved in the flying operation to be performed. This does not mean that instructors must teach manners or how to be nice, but they should provide guidance on achieving positive outcomes.
Some personal characteristics that should be evaluated are:

- tone and phrasing of communications;
- openness;
- reaction to criticism;
- aggressiveness or lack of assertion;
- willingness to listen;
- respect for others;
- arrogance; and
- use of authority.

This is not an all-encompassing list, but it highlights some of the positive and negative characteristics that, if applied inappropriately, could cause an adverse response from others.

A question that instructors may well ask themselves is "Is it a communications error if I fail to get the message across to a trainee during training?"

Assessing effective communications and interpersonal relationships
The behaviours that the flight examiner may look for could include tone of voice, non-assertive or aggressive approach, willingness to listen, body language (when applicable) and assertiveness.

An assessment criteria for this task is already in place and in part reads:-.

Not yet competent	Competent	Ideal
(1) Adopts a non-assertive, excessively assertive or verbose communication style	(1) Communicates in an adequately assertive manner	(1) Communicates in an appropriately authoritative and assertive manner

Definitions

Airmanship: The consistent use of good judgement and well developed knowledge, skills and attitudes to accomplish flight objectives (International Civil Aviation Organization (ICAO)**.**

Error: Flight crew actions or inactions that:
- lead to a deviation from crew or organisational intentions or expectations;
- reduce safety margins; and
- increase the probability of adverse operational events on the ground and during flight.

Flight environment: The environment, internal and external to the aircraft that may affect the outcome of the flight.

The aircraft's internal environment may include, but is not limited to, aircraft attitude and performance, instruments, observations, flight controls, equipment, warning and alerting devices, trainee members, procedures, publications, checklists and automation.

The external environment may include, but is not limited to, airspace, meteorological conditions, terrain, obstacles, the regulatory framework, other stakeholders and operating culture**.**

Formative assessment: Formative evaluation monitors learning progress during instruction and provides continuous feedback to both trainee and instructor concerning learning success and failures.

Human factors: Optimising the relationship within systems between people, activities and equipment.

Non-technical skills: Specific human factors competencies, sometimes referred to as 'soft skills', such as lookout, situation awareness, decision making, task management and communications.

Situation awareness: Knowing what is going on around you and being able to predict what could happen.

Summative assessment: A summative evaluation is conducted at the end of a course of training and determines if the instructional objectives (competency standards) have been achieved.

Threat *(University of Texas/GAPAN definition for multicrew/LOSA operations)**:***
Events or errors that:

- occur outside the influence of the flight crew;
- increase the operational complexity of the flight; and
- require crew attention and management if safety margins are to be maintained.

Threat and Error Management (TEM): The process of detecting and responding to threats and errors to ensure that the ensuing outcome is inconsequential, i.e. the outcome is not an error, further error or undesired state.

Undesired aircraft state: Pilot induced aircraft position or speed deviations, misapplication of flight controls, or incorrect systems configuration, associated with a reduced margin of safety.