Advisory Circular

MULTI-CREW PILOT LICENCE (MPL) TRAINING COURSE

1. **GENERAL.** Pursuant to Paragraph 88B of the Air Navigation Order, the Director-General of Civil Aviation (DGCA) may, from time to time, issue advisory circulars (ACs) on any aspect of safety in civil aviation. This AC contains information about standards, practices and procedures acceptable to the Civil Aviation Authority of Singapore (CAAS). The revision number of the AC is indicated in parenthesis in the suffix of the AC number.

2. **PURPOSE.** This AC is issued to provide guidance to Aviation Training Organisations (ATOs) that intend to develop and implement a competency-based training programme leading to the issuance of a Multi-Crew Pilot Licence (Aeroplanes) [MPL(A)] by CAAS. Singapore Air Operator Certificate (AOC) holders who intend to carry out an MPL training course in partnership with an ATO should also refer to this AC. This AC also provides information to individuals wishing to pursue a career with a Singapore air operator through the MPL route.

3. **APPLICABILITY.** This AC is applicable to all ATOs, instructors and trainees involved in an MPL training course. This AC is also applicable to Singapore AOC holders who intend to carry out an MPL training course in partnership with an ATO.

4. **CANCELLATION.** This AC supersedes AC FCL-9(0) dated 15 December 2014.

5. **EFFECTIVE DATE.** This AC is effective from **6** March 2020.

6. **REFERENCES.** ICAO Annex 1, ICAO Annex 6, ICAO Procedures for Air Navigation Services – Training (PANS-TRG) (Doc 9868), ANO, SASP D, SASP 2, SASP 3, SASP 7, SASP 9 and SASP 10.

7. **INTRODUCTION.**

The MPL is a new category of professional pilot licences that was introduced by ICAO in March 2006, through amendment 167 to ICAO Annex 1. The MPL is not meant to replace the existing Commercial Pilot Licence (CPL), but rather, afford ATO and Singapore air operators greater flexibility in training pilots. The MPL provides the aviation industry with an opportunity to train pilots directly for co-pilot duties in an airline operational environment.

In traditional pilot training, such training first begins on small single-propeller aircraft followed by larger multi-propeller aircraft, and finally onto the multi-crew aircraft type flown by the air operator that the pilot is employed with. The MPL training methodology emphasises extensive training in flight simulators, with actual aircraft flying being done in the initial stage of the MPL training course so as to develop core pilot flying skills in the trainee. Training should be competency-based to help trainees achieve the terminal objective of acquiring the necessary skills of an airline co-pilot. Such training should also be broken down into functions, sub-tasks and task elements. An example is shown in **Appendix 1**. Competency-based training requires continuous evaluation of the pilots' performance.

At the end of the MPL training course, the trainee will be assessed for the required competencies to operate as the Pilot-in-command under the supervision of the Captain (PIC U/S), and as a co-pilot in an air transport aeroplane certified for operation with a minimum crew of two pilots. After successful assessment and demonstration that all associated requirements have been met, the trainee will be issued with an MPL(A) licence. An MPL(A) may be upgraded to ATPL subsequently upon the holder satisfying the ATPL requirements.

Restrictions on single-pilot commercial operations will apply if the MPL pilot has not qualified for commercial single-pilot privileges. To exercise commercial single-pilot privileges, MPL holders must undergo additional training and tests to meet the necessary requirements.

8. MPL TRAINING.

ATOs which are interested in conducting an MPL training course should write in to the DGCA, Attention: Head (Personnel Licensing), with their proposals. The ATO should develop the course in partnership with a Singapore AOC holder. A 'stand-alone' MPL training course, independent of air operator involvement, would run contrary to the principles of MPL training, given that the advanced training phase includes training the trainees in accordance with the participating air operator's Standard Operating Procedures (SOP).

ATOs that intend to conduct an MPL training course should be familiar with both ab-initio and type-rating training. Consequently, the ATO should satisfactorily demonstrate to CAAS that it has a proven track record in conducting ab-initio and type-rating training as prerequisites for approval to conduct the proposed MPL training course. ATOs with only experience in conducting ab-initio training should partner with another ATO which has experience conducting type-rating training, or vice versa, in order to offer a comprehensive MPL training course with the partnering Singapore air operator. In such a scenario, there must be a lead organisation identified to be responsible for the overall conduct of the entire MPL training course.

In qualifying for the MPL, trainees are required to complete a minimum of 6 take-offs and landings in the applicable aircraft type of the partnering Singapore air operator until they demonstrate that they have met the required competency.

ICAO has implemented the "proof-of-concept" methodology for the MPL. As part of this methodology, and in view of the developmental nature of the first MPL course in each ATO-Airline partnership, the initial approval from the DGCA for this first MPL training course would be provisional. The DGCA would evaluate the results from the first MPL course in each ATO-Airline partnership before granting an approval to allow for subsequent re-runs of the course. The evaluation process of each provisional MPL course will extend beyond the training stage and into the operational phase i.e. the Initial Operating Experience (IOE) with the partnering Singapore air operator. This includes observing these pilots during their line and proficiency checks (after the MPL(A) has been issued). On successful completion of the provisional MPL training course and IOE, approval will be given for the MPL course based on the same ATO-Airline partnership, which will qualify subsequent successful trainees for the issuance of the MPL(A). MPL graduates from provisional MPL courses will be restricted to operate with the partnering Singapore air operator until successful completion of the IOE. MPL graduates from subsequent re-runs of approved MPL courses will not be restricted as such.

9. REGULATORY REQUIREMENTS FOR MPL TRAINING.

MPL training is governed by the following regulatory requirements:

- ATOs which intend to carry out an MPL training programme in partnership with a Singapore AOC holder, as set out in SASP Part 10
- Authorised Flight Examiners (AFE) for the conduct of the MPL Final Assessment Flight Test, as set out in SASP Part 7
- Instructors giving instructions in an approved MPL course, as set out in SASP Part 3 and Part 10
- Applicants for a MPL(A), as set out in SASP Part 2

10. **MPL TRAINING SCHEME.**

The following figure describes the basic structure of an MPL training scheme.

<table>
<tr><th colspan="6">MPL Training Scheme
Minimum 240 hours of training including PF and PM*</th></tr>
<tr><th colspan="2">Phase of training</th><th>Training Items</th><th colspan="2">Flight and simulated flight training media – Minimum level requirement</th><th>Ground training media</th></tr>
<tr><td rowspan="6">Integrated TEM principles</td><td rowspan="2">Advanced

Type rating training within an airline-oriented environment</td><td rowspan="2">• CRM
• Landing training
• All weather scenarios
• LOFT
• Abnormal procedures
• Normal procedures</td><td>Aeroplane: Turbine
Multi-engine
Multi-crew certified</td><td>At least 6 take-offs and landings as PF</td><td rowspan="6">• CBT
• E-learning
• Part-task trainer
• Classroom</td></tr>
<tr><td>FSTD:
Type VII</td><td>PF/PM</td></tr>
<tr><td>Intermediate

Application of multi-crew operations in a high-performance, multi-engine turbine aeroplane</td><td>• CRM
• LOFT
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Type VI</td><td>PF/PM</td></tr>
<tr><td>Basic

Introduction of multi-crew operations and instrument flight</td><td>• CRM
• PF/PM complement
• IFR cross-country
• Instrument Flight</td><td>FSTD:
Type IV</td><td>PF/PM</td></tr>
<tr><td rowspan="2">Core Flying Skills

Specific basic single pilot training</td><td rowspan="2">• CRM
• VFR cross-country
• Solo flight
• Night Flight**
• Basic Instrument Flight
• Upset prevention and recovery
• Principles of Flight
• Cockpit procedures</td><td>Aeroplane:
Single engine</td><td rowspan="2">PF</td></tr>
<tr><td>FSTD:
Type I</td></tr>
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*PF – Pilot Flying; PM – Pilot Monitoring.
**Conducted as PPL Night Rating in Core Phase.

The course should consist of four training phases as follows:

(1) **Phase 1 — Core Flying Skills**
Specific basic single pilot training in a single-engine aeroplane. The trainees are required to pass a PPL(A) flight test conducted by an AFE as part of this phase.

(2) **Phase 2— Basic**
Introduction of multi-crew operations and instrument flight. Any generic SOPs used should be congruent with the philosophy of the airline's SOPs.

(3) **Phase 3 — Intermediate**
Application of multi-crew operations to a multi-engine turbine aeroplane. Introduction of the airline's operational procedures.

(4) **Phase 4 — Advanced**
Type-rating training within an airline-oriented environment which takes into consideration the OEM's type rating requirements for the applicable aircraft type.

Each phase of training in the flight instruction syllabus shall compose of both instructions in the underpinning knowledge and in practical training segments.

The trainees are expected to receive theoretical knowledge instruction at the ATPL level (which can include classroom work, interactive video, slide/tape presentation, learning carrels, computer based training, and other media as approved by the DGCA, in suitable proportions).

The Advanced phase of the training course shall include a sufficient number of take-offs and landings to ensure competency, which shall not be less than six. These take-offs and landings shall be observed by a CAAS inspector or an AFE in an aeroplane for which the type-rating shall be issued.

11. ASSESSMENT USING A COMPETENCY-BASED FRAMEWORK.

The competency-based framework consists of competency units, competency elements and performance criteria.

The **9 competency units (Job functions)** that a trainee has to demonstrate competence in are as follows:

(1) apply human performance principles, including principles of threat and error management;

(2) perform aeroplane ground operations;

(3) perform take-off;

(4) perform climb;

(5) perform cruise;

(6) perform descent;

(7) perform approach;

(8) perform landing; and

(9) perform after landing and aeroplane post-flight operations.

Refer to **Appendix 1** which lists these 9 competency units or job functions. These are further broken down into competency elements or sub-tasks, which are defined by specific performance criteria.

In the development of the MPL course, the ATO needs to ensure that the application of threat and error management (TEM) principles should be integrated with each of the other competency units for training and testing purposes. Refer to **Appendix 2** for guidance material on TEM.

12. MPL FINAL ASSESSMENT.

On completion of the MPL training course, the trainee must pass the MPL Final Assessment and the FC32 test requirements conducted by an AFE on the appropriate aeroplane type for which the MPL shall be issued. The MPL Final Assessment is conducted using the appropriate MPL Final Assessment / Instrument Rating Test report form.

If the six take-offs and landings are to be conducted on the same flight as the FC32 test, there must be at least one instructor for the purpose of completing the minimum six take-offs and landings and an AFE on board for the purpose of FC32 test. Alternatively, if there is only one AFE on board, the ATO can request for a CAAS inspector to observe the detail.

13. PRIVILEGES OF MPL(A).

The privileges of MPL(A) allows the holder to operate in an air transport aeroplane certified for operation with a minimum crew of at least two pilots as the Pilot-in-command under the supervision of the Captain (PIC U/S) or as the co-pilot.

MPL(A) includes PPL(A) privileges and with the PPL Night Rating.

Refer to **Appendix 3** for answers to Frequently Asked Questions (FAQ).

APPENDIX 1: MULTI-CREW PILOT LICENCE COMPETENCY UNITS – COMPETENCY ELEMENTS AND PERFORMANCE CRITERIA

[Examples extracted from ICAO Doc 9868 PANS - Training, Appendix 2 to Chapter 3. Please refer to the ICAO Doc for a more comprehensive list]

	Duty	Observation & assessment
3. Perform Take-off List of competency elements and performance criteria		
3.0 Demonstrate attitudes and behaviours appropriate to the safe conduct of flight, including recognising and managing potential threats and errors		
3.1 Perform pre-take-off and pre-departure preparation		satisfactory/unsatisfactory
3.1.1 checks and acknowledges line up clearance	PF/PM	
3.1.2 checks correct runway selection	PF/PM	
3.1.3 confirms validity of performance data	PF/PM	
3.1.4 checks approach sector and runway are clear	PF/PM	
3.1.5 confirms all checklists and takeoffpreparations completed	PF/PM	
3.1.6 lines up the aircraft on centreline without losing distance	PF	
3.1.7 checks weather on departure sector	PF/PM	
3.1.8 checks runway status and wind	PF/PM	
3.2 Perform take-off roll		satisfactory /unsatisfactory
3.2.1 applies take-off thrust	PF	
3.2.2 checks engine parameters	PM	
3.2.3 checks airspeed indicators	PF/PM	
3.2.4 stays on runway centreline	PF	
7. Perform Approach List of competency elements and performance criteria		
7.0 Demonstrate attitudes and behaviours appropriate to the safe conduct of flight, including recognizing and managing potential threats and errors		
7.1 Perform approach in general		satisfactory/unsatisfactory
7.1.1 executes approach according to procedures and situation	PF	
7.1.2 selects appropriate level / mode of automation	PF	
7.1.3 selects optimum approach path	PF	
7.1.4 operates controls smooth and coordinated	PF	
7.1.5 performs speed reduction and flap extension	PF/PM	
7.1.6 performs relevant checklists	PF/PM	
7.1.7 initiates final descent	PF	
7.1.8 achieves stabilised approach criteria	PF	
7.1.9 ensures adherence to minima	PF/PM	
7.1.10 initiates go-around if required	PF	
7.1.11 masters transition to visual segment	PF	

	Duty	Observation & assessment
8. Perform Landing Competency elements and performance criteria		
8.0 Demonstrate attitudes and behaviours appropriate to the safe conduct of flight, including recognising and managing potential threats and errors		
8.1 Land the aircraft		satisfactory/unsatisfactory
8.1.1 maintains a stabilized approach path during visual segment	PF	
8.1.2 recognizes and acts on changing conditions for wind shift / wind shear segment	PF	
8.1.3 initiates flare	PF	
8.1.4 controls thrust	PF	
8.1.5 achieves touchdown in touchdown zone on centreline	PF	
8.1.6 lowers nose wheel	PF	
8.1.7 maintains centreline	PF	
8.1.8 performs after-touchdown procedures	PF	
8.1.9 makes use of appropriate braking and reverse thrust	PF	
8.1.10 vacates runway with taxi speed	PF	
8.2 Perform systems operations and procedures		satisfactory /unsatisfactory
8.2.1 monitors operation of all systems	PF	
8.2.2 operates systems as required	PF	
8.3 Manage abnormal and emergency situations		satisfactory /unsatisfactory
8.3.1 identifies the abnormal condition	PF/PM	
8.3.2 interprets the abnormal condition	PF/PM	
8.3.3 performs the procedure for the abnormal condition	PF/PM	
9. Perform After Landing and Post Flight Operations Competency elements and performance criteria		
9.0 Demonstrate attitudes and behaviours appropriate to the safe conduct of flight, including recognising and managing potential threats and errors		
9.1 Perform taxiing and parking		satisfactory/unsatisfactory
9.1.1 receives, checks and adheres to taxi clearance	PM	
9.1.2 taxies the aircraft including use of exterior lighting	PF	
9.1.3 controls taxi speed	PF/PM	
9.1.4 maintains centreline	PF	
9.1.5 maintains lookout for conflicting traffic and obstacles	PF	
9.1.6 identifies parking position	PF/PM	
9.1.7 complies with marshalling / stand guidance	PF/PM	
9.1.8 applies parking and engine shut down procedures	PF	
9.1.9 completes with relevant checklists	PF/PM	
9.2 Perform aircraft post-flight operations		satisfactory /unsatisfactory
9.2.1 communicates to ground personnel and crew	PF	
9.2.2 completes all required flight documentation	PF/PM	
9.2.3 ensures securing of the aircraft	PF	
9.2.4 conducts the debriefings	PF	

APPENDIX 2: PRINCIPLES OF THREAT AND ERROR MANAGEMENT

One model that explains the principles of threat and error management is the TEM model (Threat and Error Management). [Reference ICAO Doc 9868 PANS - Training, Appendix C to Chapter 3]

1. The components of the TEM Model

1.1 There are three basic components in the TEM Model, from the perspective of flight crews: threats, errors and undesired aircraft states. The model proposes that threats and errors are part of everyday aviation operations that must be managed by flight crews, since both threats and errors carry the potential to generate undesired aircraft states. Flight crews must also manage undesired aircraft states, since they carry the potential for unsafe outcomes. Undesired state management is an essential component of the TEM Model, as important as threat and error management. Undesired aircraft state management largely represents the last opportunity to avoid an unsafe outcome and thus maintain safety margins in flight operations.

2. Threats

2.1 Threats are defined as events or errors that occur beyond the influence of the flight crew, increase operational complexity, and which must be managed to maintain the margins of safety. During typical flight operations, flight crews have to manage various contextual complexities. Such complexities would include, for example, dealing with adverse meteorological conditions, airports surrounded by high mountains, congested airspace, aircraft malfunctions, errors committed by other people outside of the cockpit, such as air traffic controllers, flight attendants or maintenance workers, and so forth. The TEM Model considers these complexities as threats because they all have the potential to negatively affect flight operations by reducing margins of safety.

2.2 Some threats can be anticipated, since they are expected or known to the flight crew. For example, flight crews can anticipate the consequences of a thunderstorm by briefing their response in advance, or prepare for a congested airport by making sure they keep a watchful eye for other aircraft as they execute the approach.

2.3 Some threats can occur unexpectedly, such as an in-flight aircraft malfunction that happens suddenly and without warning. In this case, flight crews must apply skills and knowledge acquired through training and operational experience.

2.4 Lastly, some threats may not be directly obvious to, or observable by, flight crews immersed in the operational context, and may need to be uncovered by safety analysis. These are considered latent threats. Examples of latent threats include equipment design issues, optical illusions, or shortened turn-around schedules.

2.5 Regardless of whether threats are expected, unexpected, or latent, one measure of the effectiveness of a flight crew's ability to manage threats is whether threats are detected with the necessary anticipation to enable the flight crew to respond to them through deployment of appropriate countermeasures.

2.6 Threat management is a building block to error management and undesired aircraft state management. Although the threat-error linkage is not necessarily straightforward, although it may not be always possible to establish a linear relationship, or one to one mapping between threats, errors and undesired states, archival data demonstrates that mismanaged threats are normally linked to flight crew errors, which in turn are often linked to undesired aircraft states. Threat management provides the most proactive option to maintain margins of safety in flight operations, by voiding safety compromising situations at their roots. As threat managers, flight crews are the last line of defence to keep threats from impacting flight operations.

2.7 Table 1 presents examples of threats, grouped under two basic categories derived from the TEM Model. Environmental threats occur due to the environment in which flight operations take place. Some environmental threats can be planned for and some will arise spontaneously, but they all have to be managed by flight crews in real time. Organizational threats, on the other hand, can be controlled (i.e. removed or, at least, minimised) at source by aviation organizations. Organizational threats are usually latent in nature. Flight crews still remain the last line of defence, but there are earlier opportunities for these threats to be mitigated by aviation organizations themselves.

Table 1. Examples of threats (List not exhaustive)

Environmental Threats	Organizational Threats
- **Weather:** thunderstorms, turbulence, icing, wind shear, cross/tailwind, very low/high temperatures. - **ATC:** traffic congestion, TCAS RA/TA, ATC command, ATC error, ATC language difficulty, ATC non-standard phraseology, ATC runway change, ATIS communication, units of measurement (QFE/meters). - **Airport:** contaminated/short runway; contaminated taxiway, lack of/confusing/faded signage/markings, birds, aids U/S, complex surface navigation procedures, airport constructions.	- **Operational pressure:** delays, late arrivals, equipment changes - **Aircraft:** aircraft malfunction, automation event/anomaly,MEL/CDL. - **Cabin:** flight attendant error, cabin event distraction, interruption, cabin door security. - **Maintenance:** maintenance event/error. - **Ground:** ground-handling event, de-icing, ground crew error. - **Dispatch:** dispatch paperwork event/error. - **Documentation:** manual error, chart error. - **Other:** crew scheduling event

- **Terrain:** High ground, slope, lack of references, "black hole". - **Other:** similar call-signs.	

3. Errors

3.1 Errors are defined actions or inactions by the flight crew that lead to deviations from organizational or flight crew intentions or expectations. Unmanaged and/or mismanaged errors frequently lead to undesired aircraft states. Errors in the operational context thus tend to reduce the margins of safety and increase the probability of adverse events.

3.2 Errors can be spontaneous (i.e. without direct linkage to specific, obvious threats), linked to threats, or part of an error chain. Examples of errors would include the inability to maintain stabilized approach parameters, executing a wrong automation mode, failing to give a required callout, or misinterpreting an ATC clearance.

3.3 Regardless of the type of error, an error's effect on safety depends on whether the flight crew detects and responds to the error before it leads to an undesired aircraft state and to a potential unsafe outcome. This is why one of the objectives of TEM is to understand error management (i.e. detection and response), rather than solely focusing on error causality (i.e. causation and commission). From the safety perspective, operational errors that are timely detected and promptly responded to (i.e. properly managed), errors that do not lead to undesired aircraft states, do not reduce margins of safety in flight operations, and thus become operationally inconsequential. In addition to its safety value, proper error management represents an example of successful human performance, presenting both learning and training value.

3.4 Capturing how errors are managed is then as important, if not more, than capturing the prevalence of different types of error. It is of interest to capture if and when errors are detected and by whom, the response(s) upon detecting errors, and the outcome of errors. Some errors are quickly detected and resolved, thus becoming operationally inconsequential, while others go undetected or are mismanaged. A mismanaged error is defined as an error that is linked to or induces an additional error or undesired aircraft state.

3.5 Table 2 presents examples of errors, grouped under three basic categories derived from the TEM Model. In the TEM concept, errors have to be "observable" and therefore, the TEM Model uses the "primary interaction" as the point of reference for defining the error categories.

3.6 The TEM Model classifies errors based upon the primary interaction of the pilot or flight crew at the moment the error is committed. Thus, in order to be classified as aircraft handling error, the pilot or flight crew must be interacting with the aircraft (e.g. through its controls, automation or systems). In order to be classified as procedural error, the pilot or flight crew must be interacting with a procedure (i.e. checklists; SOPs; etc). In order to be classified as communication error, the pilot or flight crew must be interacting with people (ATC, ground crew, other crewmembers, etc).

3.7 Aircraft handling errors, procedural errors and communication errors may be unintentional or involve intentional non-compliance. Similarly, proficiency considerations (i.e. skill or knowledge deficiencies, training system deficiencies) may underline all three categories of error. In order to keep the approach simple and avoid confusion, the TEM Model does not consider intentional non-compliance and proficiency as separate categories of error, but rather as subsets of the three major categories of error.

Table 2. Examples of errors (List not exhaustive)

Aircraft handling errors	- Manual handling/flight controls: vertical/lateral and/or speed deviations, incorrect flaps/speed brakes, thrust reverser or power settings. - Automation: incorrect altitude, speed, heading, auto throttle settings, incorrect mode executed, or incorrect entries. - Systems/radio/instruments: incorrect packs, incorrect anti-icing, incorrect altimeter, incorrect fuel switches settings, incorrect speed bug, incorrect radio frequency dialled. - Ground navigation: attempting to turn down wrong taxiway/runway, taxi too fast, failure to hold short, missed taxiway/runway.
Procedural errors	- SOPs: failure to cross-verify automation inputs. - Checklists: wrong challenge and response; items missed, checklist performed late or at the wrong time.

	- Callouts: omitted/incorrect callouts. - Briefings: omitted briefings; items missed. - Documentation: wrong weight and balance, fuel information, ATIS, or clearance information recorded, misinterpreted items on paperwork; incorrect logbook entries, incorrect application of MEL procedures.
Communication errors	- Crew to external: missed calls, misinterpretations of instructions, incorrect read-back, wrong clearance, taxiway, gate or runway communicated. - Pilot to pilot: within crew miscommunication or misinterpretation

4. Undesired Aircraft States

4.1 Undesired aircraft states are flight crew-induced aircraft position or speed deviations, misapplication of flight controls, or incorrect systems configuration, associated with a reduction in margins of safety. Undesired aircraft states that result from ineffective threat and/or error management may lead to compromising situations and reduce margins of safety in flight operations. Often considered at the cusp of becoming an incident or accident, undesired aircraft states must be managed by flight crews.

4.2 Examples of undesired aircraft states would include lining up for the incorrect runway during approach to landing, exceeding ATC speed restrictions during an approach, or landing long on a short runway requiring maximum braking. Events such as equipment malfunctions or ATC controller errors can also reduce margins of safety in flight operations, but these would be considered threats.

4.3 Undesired states can be managed effectively, restoring margins of safety, or flight crew response(s) can induce an additional error, incident, or accident.

4.4 Table 3 presents examples of undesired aircraft states, grouped under three basic categories derived from the TEM Model.

Table 3. Examples of undesired aircraft states (List not exhaustive)

Aircraft handling	- Aircraft control (attitude). - Vertical, lateral or speed deviations. - Unnecessary weather penetration. - Unauthorized airspace penetration. - Operation outside aircraft limitations. - Unstable approach. - Continued landing after unstable approach .- Long, floated, firm or off-centreline landing.
Ground navigation	- Proceeding towards wrong taxiway/runway - Wrong taxiway, ramp, gate or hold spot
Incorrect aircraft configurations	- Incorrect systems configuration - Incorrect flight controls configuration. - Incorrect automation configuration. - Incorrect engine configuration. - Incorrect weight and balance configuration.

4.5 An important learning and training point for flight crews is the timely switching from error management to undesired aircraft state management. An example would be as follows: a flight crew selects a wrong approach in the Flight Management Computer (FMC). The flight crew subsequently identifies the error during a crosscheck prior to the Final Approach Fix (FAF). However, instead of using a basic mode (e.g. heading) or manually flying the desired track, both flight crew members become involved in attempting to reprogram the correct approach prior to reaching the FAF. As a result, the aircraft “stitches” through the localiser, descends late, and goes into an unstable approach. This would be an example of the flight crew getting "locked in" to error management, rather than switching to undesired aircraft state management. The use of the TEM Model assists in educating flight crews that, when the aircraft is in an undesired state, the basic task of the flight crew is undesired aircraft state management instead of error management. It also illustrates how easy it is to get locked in to the error management phase.

4.6 Also from the learning and training perspective, it is important to establish a clear differentiation between undesired aircraft states and outcomes. Undesired aircraft states are transitional states between a normal operational state (i.e., a stabilised approach) and an outcome. Outcomes, on the other hand, are end states, most notably, reportable occurrences (i.e. incidents and accidents). An example would be as follows: a stabilised approach (normal operational state) turns into an un-stabilised approach (undesired aircraft state) that results in a runway excursion (outcome).

4.7 The training and remedial implications of this differentiation are of significance. While at the undesired aircraft state stage, the flight crew has the possibility, through appropriate TEM, of recovering the situation, returning to a normal operational state, thus restoring margins of safety. Once the undesired aircraft state becomes an outcome, recovery of the situation, return to a normal operational state, and restoration of margins of safety is not possible.

5. Countermeasures

5.1 Flight crews must, as part of the normal discharge of their operational duties, employ countermeasures to keep threats, errors and undesired aircraft states from reducing margins of safety in flight operations. Examples of countermeasures would include checklists, briefings, call-outs and SOPs, as well as personal strategies and tactics. Flight crews dedicate significant amounts of time and energies to the application of countermeasures to ensure margins of safety during flight operations. Empirical observations during training and checking suggest that as much as 70 per cent of flight crew activities may be countermeasures-related activities.

5.2 All countermeasures are necessarily flight crew actions. However, some countermeasures to threats, errors and undesired aircraft states that flight crews employ build upon "hard" resources provided by the aviation system. These resources are already in place in the system before flight crews report for duty, and are therefore considered as systemic-based countermeasures. The following would be examples of "hard" resources that flight crews employ as systemic-based countermeasures:

- Airborne Collision Avoidance System (ACAS);
- Ground Proximity Warning System (GPWS),
- Standard Operation Procedures (SOPs);

- Checklists;
- Briefings;
- Training;

5.3 Other countermeasures are more directly related to the human contribution to the safety of flight operations. These are personal strategies and tactics, individual and team countermeasures, that typically include canvassed skills, knowledge and attitudes developed by human performance training, most notably, by Crew Resource Management (CRM) training. There are basically three categories of individual and team countermeasures:

- Planning countermeasures: essential for managing anticipated and unexpected threats;
- Execution countermeasures: essential for error detection and error response;
- Review countermeasures: essential for managing the changing conditions of a flight.

5.4 Enhanced TEM is the product of the combined use of systemic-based and individual and team countermeasures. Table 4 presents detailed examples of individual and team countermeasures. Further guidance on countermeasures can be found in the sample assessment guides for terminal training objectives (ICAO Doc 9868 PANSTRG, Chapter 3, Attachment B) as well as in the ICAO manual, Line Operations Safety Audit (LOSA) (Doc 9803).

Table 4. Examples of individual and team countermeasure

Planning Countermeasures		
SOP BRIEFING	The required briefing was interactive and operationally thorough	- Concise, not rushed, and met SOP Requirements - Bottom lines were established
PLANS STATED	Operational plans and decisions were communicated and acknowledged	- Shared understanding about plans - "Everybody on the same page"
WORKLOAD ASSIGNMENT	Roles and responsibilities were defined for normal and non-normal situations	- Workload assignments were communicated and acknowledged

CONTINGENCY MANAGEMENT	Crew members developed effective strategies to manage threats to safety	- Threats and their consequences were anticipated - Used all available resources to manage threats
Execution Countermeasures		
MONITOR / CROSS-CHECK	Crew members actively monitored and crosschecked systems and other crew members	- Aircraft position, settings, and crew actions were verified
WORKLOAD-MANAGEMENT	Operational tasks were prioritized and properly managed to handle primary flight duties	- Avoided task fixation - Did not allow work overload
AUTOMATION MANAGEMENT	Automation was properly managed to balance situational and/or workload requirements	- Automation setup was briefed to other members - Effective recovery techniques from automation anomalies
Review Countermeasures		
EVALUATION/ MODIFICATION OF PLANS	Existing plans were reviewed and modified when necessary	- Crew decisions and actions were openly analyzed to make sure the existing plan was the best plan
INQUIRY	Crew members asked questions to investigate and/or clarify current plans of action	- Crew members not afraid to express a lack of knowledge – “Nothing taken for granted” attitude
ASSERTIVENESS	Crew members stated critical information and/or solutions with appropriate persistence	- Crew members spoke up without hesitation

APPENDIX 3: FREQUENTLY ASKED QUESTIONS

Note: Reference in [ ] refers to relevant paragraph in the Advisory Circular.

Q1. How does the MPL training framework differ from traditional training methods for professional pilots?

In the traditional pilot licensing scheme, the training first begins on small single-propeller aircraft followed by larger multiple propeller aircraft, and finally onto the multi-crew aircraft type flown by the airline that the pilot is employed with. The MPL training methodology emphasises training extensively in flight simulators, with actual aircraft flying being done in the initial stage of the MPL training course so as to develop core pilot flying skills. Training is competency-based to achieve the terminal objective of an airline co-pilot [7].

Please refer to SASP Part 10, Appendix I for the detailed MPL training framework acceptable to the DGCA.

Q2. Does the MPL(A) contain PPL(A) or CPL(A) privileges?

The MPL(A) privileges allow the holder to operate as a co-pilot for multi-crew operations for hire and reward. It also includes PPL(A) with Night Rating privileges, which allows the holder to carry out private flying in a single-pilot aircraft type. However, as the nature of the MPL training framework is quite different from a traditional CPL course, the holder may not carry out single-pilot operations for the purpose of hire and reward. Should the MPL holder wish to carry out such operations, he will need to qualify for a CPL(A) by undergoing additional training to meet the flying experience requirements pertaining to the CPL(A) [7].

If the MPL(A) holder satisfies the requirements of a CPL(A)/IR as set out in the Air Navigation Order and applicable parts of the SASP Part 2, he may apply to the DGCA for such a licence.

Q3. What happens when a student in a MPL course is unable to meet the requirements for the issue of MPL(A)?

An applicant failing or unable to complete the entire MPL course may apply to the DGCA for credit of the theoretical knowledge examinations and flying experience towards an alternative licence, if the applicable requirements are met and subjected to acceptance by the DGCA.

Q4. Can an MPL(A) holder join another Singapore air operator?

Yes, an MPL(A) holder may join another Singapore air operator and will be subject to any additional operational training requirements. However, an MPL(A) holder from a provisional (trial) MPL course may only do so after successful completion of the IOE with the partnering Singapore air operator [8].

Q5. How does an MPL(A) holder qualify for an ATPL(A)?

To qualify for an ATPL(A), the applicant must meet the requirements as set out in the Air Navigation Order and SASP Part 2. If the MPL(A) holder has not met the full CPL(A) and single pilot instrument rating requirements, the ATPL(A) will be restricted to multi-pilot commercial operations only [7].

Q6. What are the licence conversion requirements for foreign MPL(A) holders?

The applicant may refer to the licence conversion requirements as set out in the SASP Part 2.

Q7. Is the MPL(A) internationally recognised?

ICAO has left Contracting States to decide if they wish to issue an MPL(A) within their own States. The Singapore MPL(A) will be recognised by other ICAO Contracting States, even those that decide not to establish an MPL(A) as a professional pilot licence within their own state.