EASA Flight Standards

ATO, AeMC & FSTD Section

Risk Assessment in Pilot Training

Simplified overview

Contents

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Introduction

This overview explains the methodology and application of RAPT - Risk Assessment in Pilot Training, giving examples, including simplified guidance. A detailed guidance will additionally be published in March 2016, including flow diagrams of detailed examples, risk category graphs, risk comparison graphs and risk envelope comparisons.

Safety risk management is an essential part of a coherent safety management system and risk matrices are elementary tools for organisations seeking fast, effective and practical risk assessment. They should not be used in isolation, but rather in conjunction with the rest of the organisations safety management processes.

The RAPT matrix is intended to be a practical and easy to use tool for Pilot Training Organisations, in order to:

- Promote targeted discussion; the discussion often being as useful as the resulting risk value.
- Help keep participants engaged in a risk workshop on track.
- Provide a degree of consistency to risk prioritisation.
- Decipher and present risk assessment in a concise visual fashion, by use of an alphanumeric risk index and risk value, which facilitates risk acceptance decisions.
- Bring attention to the management and decisions makers on the highest priority risks.
- Create a baseline for risk assessing changes

The RAPT is a methodology for risk assessment in pilot training.

As opposed to ORA - Operational Risk Assessment, where risk is primarily based on organisations operating aircraft and as a consequence directly exposed to hazards that may cause or contribute to aircraft accidents and incidents, TRA - Training Risk Assessment, focuses on pilot training, where risks are based on non-proficient pilots and training deficiencies. These risks are also relevant for training organisations that do not operate aircraft and where the causal and contributing factors to an aircraft incident or accident may be separated in terms of organisation, location and point in ti

Terminology

- **ARL Acceptable Risk Level** – The numerical value acceptable by the organisation / authority, against which the resulting Risk Value is measured for acceptability.
- **Barriers** – defenses, which act to protect against the safety risks. Breaches that penetrate all preventive and defensive barriers may potentially result in a lack of pilot competence and / or leading to a catastrophic situation. Barriers (or the lack thereof) are not necessarily identified as the outcome of an extensive study. In isolation or combination they can be identified within an organisation by:
    - Consulting SME expertise knowledge in the relevant area, relating to previous issues of similar nature, compliance feedback, safety analysis and other data comparison.
    - Seeking external expert opinion and bench marking against industry best practice may pinpoint the need for new barriers and serve to verify the existing ones.
- **Change Management** – management of change involve the assessment of risk as a result of a predicted/planned change to the operation/activity together with the consequential actions taken, to manage safety risks related to such change.
- **ORA** – Operational Risk Assessment.
- **RAFT** – Risk Assessment in Flight Training
- **Risk** – in simple terms it is the perceived measure of threat versus benefit. Relating to pilot training it is the predicted surety of training a pilot to proficiency in order to operate an aircraft safety.
- **Initial Risk Index** – an alphanumeric weighting given to each square of RAPT part I, risk matrix to enable differentiation of risk for the purpose initial urgent actions determination and quantitative analysis.
- **Risk Management** – is managing risk to an acceptable level through organised and structured methods. Further explanation to risk management is given in the SMICG documentation.
- **Risk Classification** – The resulting alphanumerical value of the RAPT part I/II/III.
- **Risk Value** – a numerical value calculated on the basic of the Risk Classification (alphanumerical designators) and used in the risk acceptance process.
- **Risk assessment group** – a group gather for the purpose of addressing SIE's and assessing their risk classification, value and category. It should incorporate SME's from the relevant domain including Safety Analysis. The group should have access to any information necessary for trend identification and be sufficiently autonomous to propose any mitigation actions / review as deemed necessary.
- **Risk Impact Assessment** – an identified risk is further assessed for impact according to the organisations training activity, with reference to RAPT Part II / III
- **Safety Analyst** - a person with the experience, training, responsibility and authority to perform risk assessments and to analyse the safety database / risk register.
- **SIE - Safety Identified Event**: Anything that has / may have or could have had a safety impact, irrespective of real or perceived significance. This includes undesirable conditions or situations resulting from a (potential) lack of pilot competence due to training deficiencies and includes those conditions, which could cause or contribute to unsafe; operation of aircraft or aviation safety-related equipment, products and services, processes and procedures. It may be a single threat or a specific manifestation of various issues.
- **SME** – Subject Matter Experts. Operational experience personnel, who are deemed to be experts in their field. Before participating in a risk assessment group they should have received adequate training as specified by the organisation.
- **Threat** – the trigger which releases the potential to create a Safety Identified Event
- **TRA** – Training Risk Assessment.
    Worst foreseeable situation – in training relates to training deficiencies in practised skill, acquired knowledge and gained awareness. These may be contributing factors in an accident/ incident.

Process - simplified overview

1.a Part I: Initial Risk Index

1.1. A SIE is initially classified by using alphanumerical weighting and colour coding.
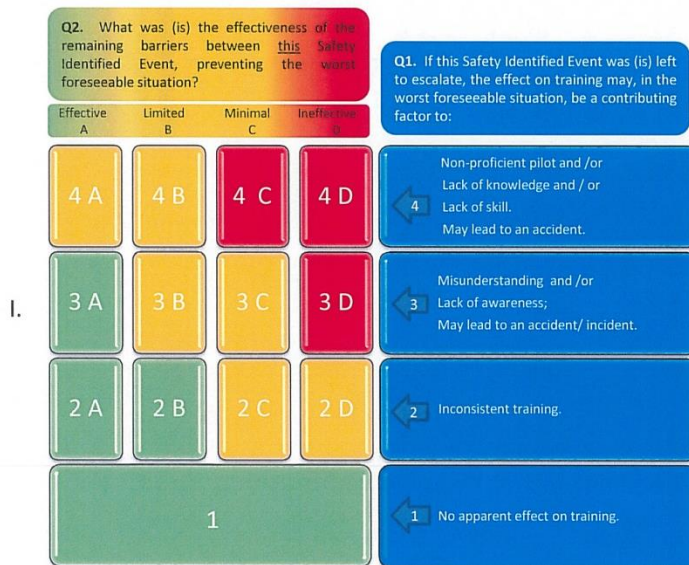
1.b Output of Part I - Initial Risk Index

1.1. Used for determination of the initial urgent actions against colour coding; in cases where an initial risk assessment is done outside of a safety review / risk assessment group, the urgent action is determined by colour coding:

1.1.1. Red and Amber: An intermediate safety review is needed.

1.1.2. Green: A standard safety review process can be followed.

1.2. Alphanumerical data used for statistics and trend analysis. Reassessed during safety review, independent of the alphanumerical data in RAPT part II and III

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2.a Part II and III: Risk Impact Assessment

The Initial Risk Index of part I is assessed for impact according to the training activity.
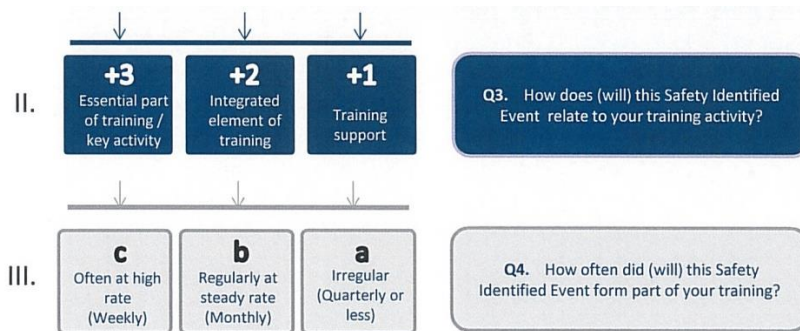
2.b Output of Part II and III - Risk Impact Assessment

1.1. Used for risk assessing the impact on training, in terms of applicability and exposure.
1.2. Alphanumerical data used for statistics and trend analysis. Reassessed during safety review, independent of the alphanumerical data in RAPT part I.

3 Output of Part I, II and III

1.1. Risk Classification is the combined alphanumerical value of part I/II/III – and the sum of the risk assessment.
1.2. Risk Value is a numerical value calculated from the alphanumerical Risk Classification and used in the risk acceptance process.
1.3. Risk Value is referenced against the Acceptable Risk Level in the process of risk acceptability.

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Methodology

The description in this section gives an overview of the methods to be used in the RAPT.

The user is taken through the RAPT assessment by four guiding questions, including a 4X4 matrix with two subsequent but separate sliding evaluations.

Question 1.

The considerations of severity must primarily be related to the (possible) effect of the activity, the environment and the consequences of actions, in which the organisation is engaged.

As a secondary reflection, for organisation not directly engaged in aircraft operations, the severity may be related to the causal and contributing factors to an aircraft incident, where this is applicable.
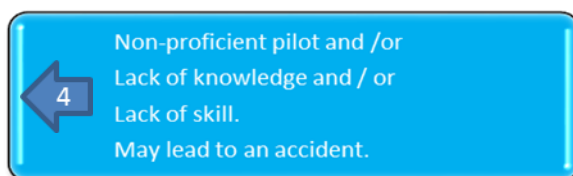
In cases of reactive SIE assessments typically the RAPT - Part I, should be done as a first measure close to the time of the SIE.

Q1 should be done in isolation and attention given to avoiding the contemplation of Q2 (barriers in place) simultaneously. This is best done by keeping the question and reasoning in mind: "SIE left to escalate ⇨ the effect on training ⇨ worst foreseeable situation" This is a hypothetical questions relating to the organisations activity, as a primary factor and where applicable, a contributing factor to an aircraft accident / incident.

Wide spread scoring when assessing the seriousness of various SIE's is not uncommon and demonstrates that the range of the risk matrix spans the organisations activity and is as such a suitable tool for the risk assessor.

It must also be born in mind that a reactive risk assessment may show a higher initial risk value, dictating a mitigating action / review. It is the combined ability to pinpoint a SIE; allocate the appropriate seriousness; objectively assessing the effective barriers; subsequent determining the risk level and allocating the necessary mitigating / review actions, which reflects the effectiveness of the risk assessment.

The following may be of assistance when selecting the horizontal column:

4 — Non-proficient pilot and /or
Lack of knowledge and / or
Lack of skill.
May lead to an accident.

Non-Proficient pilot and / or lack of knowledge and / or lack of skill (May lead to an accident)

Could arise from any of the following actual or perceived conditions:
- Essential training items not taught

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- Transfer of knowledge not taking place or might be in jeopardy.
- The practise of skill omitted or not leading to proficiency.

Further consideration only if applicable:

- In terms of aircraft operations or as a secondary reflection the SIE may be viewed as a contribution factor leading to an aircraft accident.
  Note: Reverse engineering the severity question by primarily considering an aircraft accident/incident as the worst foreseeable case, where this is not the direct activity of the organisation, will render the risk assessment inconsistent and ineffective.

> **3** Misunderstanding and / or
> Lack of awareness
> May lead to an incident / accident.
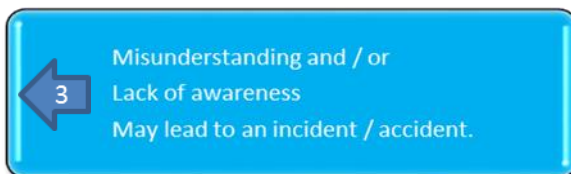
### Misunderstanding and / or lack of awareness. (May lead to an accident / Incident)

Could arise from any of the following actual or perceived conditions:

- Incorrect use of documentation or essential information missing.
- Previous known errors / lessons learned not considered nor incorporated into the training.
- Insufficient information / guidelines for the delivery of training
- Training not under direct control of the organisation.
- Primary assessment of training delivery not conducted within organisation

Further consideration only if applicable:

- In terms of aircraft operations or as a secondary reflection the SIE may be viewed as a contribution factor leading to an aircraft accident / incident.
  Note: Reverse engineering the severity question by primarily considering an aircraft accident/incident as the worst foreseeable case, where this is not the direct activity of the organisation, will render the risk assessment inconsistent and ineffective.

> **2** Inconsistent training.
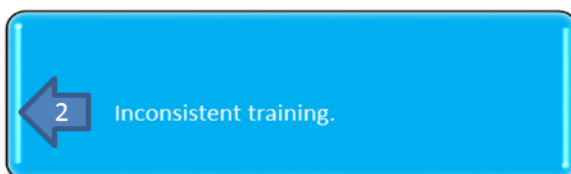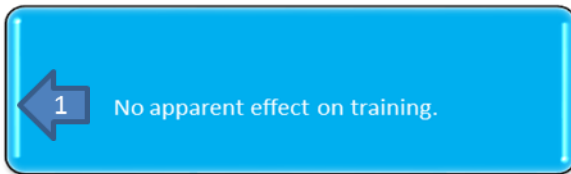
Inconsistent training.

Could arise from any of the following actual or perceived conditions:

- Use of out-dated manuals / supporting documents, including incorrect referenced material / manuals

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- Procedures or training not deliver as planned.

1 No apparent effect on training.

No apparent effect on training.

Could arise from any of the following actual or perceived conditions:

- The SIE considerations may be valid but have no apparent effect on training or its delivery.

Question 2.

To assess the effectiveness i.e. the safety margin, consider the number, magnitude and robustness of the remaining barriers between this SIE Safety Identified Event and the worst foreseeable situation mentioned in Q. 1. For reactive assessment only the barrier that worked and barriers already in place are taken into account. Subsequently those barriers, which have failed should be analysed separately from the effectiveness assessment.

Assessment of proposed mitigation actions after a re-occurring SIE, must evaluate the safety barriers as being Effective or at least Limited, dictated by the nature of activity and training given.

It should be recognised that there is subjectivity in the answer to the Q.2 and that expert judgement is fundamental in making an accurate assessment of the safety barriers. It is therefore recommended that organisations should develop methods to reduce subjectivity by means of standardising this risk assessment process and providing company specific definitions, guidance and examples to the risk assessment group.

The following may be of assistance when selecting the vertical column:

Effective	Limited	Minimal	ineffective
A	B	C	D

Ineffective column

Could be any of the following:

- Deficiency in training / skill / knowledge acquisition, which is left unattended.
- Safety barriers are either not in place or ineffective.
- Preventing this from being a possible contributing factor in an accident was / is pure luck or exceptional skill / intuition, which was / is not trained nor taught.

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Minimal column

Could be any of the following:

- Safety barrier(s) were / are still in place but may be inconsistent.
- Their total effectiveness was / is weak.
- Similar SIE reoccurring after mitigation actions.

Limited column

Could be any of the following:

- The effectiveness of the safety barrier(s) have limitations, but remain solid.
- Barriers may be limited in numbers but considerable safety margin exists.
- Due to nature of operation / activity the limited barriers cannot be improved further.
- Mitigation actions have been implemented for a SIE and pending reassessment.

Effective column

Could be any of the following:

- Safety margin was / is large and robust.
- Typically consisting of several good barriers.
- Mitigation actions have been implemented for a SIE and may be pending reassessment.

Initial Risk Index.

1. Enter and extract an Initial Risk Index for a SIE in RAPT Part I.
    1.1. The entry may be (but not limited to) any SIE - including a single perceived threat, a planned change (proactive use) or a past safety issue (reactive use).
        Ref. to SIE Terminology
2. The result will be a red, amber or green colour coding and an alphanumerical index.

    2.1. The colour code will help determine the risk level and initial actions required.
    2.2. Red will require immediate investigation / action / cease activity.
    2.3. Amber will require mitigation and /or short-term review.
    2.4. Green may be acceptable dependent on the impact on training activity, assessed in table II/III.
    2.5. The alphanumerical value should be incorporated into the risk register for statistics and tracking purposes.

Considerations when assessing: Probability, Frequency and Exposure -

Introduction to Part II and Part III of the RAPT

Evaluating "probability and frequency of consequences of hazards" can amount to assumptions and subjective deductions, by the inherent multitude of variables, which should be considered.

The RAPT module uses two pragmatic questions (Q3 and Q4 in Part II and III) to assist in evaluating the probability and exposure in the risk assessment process. Removing these evaluations from the initial risk assessment (Part I) has several reasons:

1. The assessments of part I/II/III can be done independently and by different personnel with different competences and responsibility.
2. Reactive assessments can be done by using Part I, shortly after (or included in) a SIE report, and by competent personnel in this domain (SME / Safety Analysis), perhaps also in the location where the SIE occurred. The evaluation of probability and exposure (Part II/III) may require a different insight to the organisation's activity, perhaps not possible nor feasible at the time of the Part I assessment. The Initial Risk Index of severity versus effectiveness of safety barriers (Part I) may determine an initial urgent action and facilitate an immediate safety review by simple colour coding.
3. RAPT Part I/II/III may be amended/updated independent of each other making it possible to reassess and reclassify the same SIE after; reoccurrence of the same or similar SIE, verification of effective mitigation action, change in activity or change to exposure. This flexibility and these option are not granted when using a matrix where probability / frequency is integrated.
4. Integrating probability / likelihood into a risk assessment will call into question the resulting risk value, if a similar SIE occurs (reactive assessment). Should previous risk assessments be voided as the probability / likelihood assessment needs change?
5. Integrating frequency in a risk matrix will corrupt the safety database if SIE are accumulated for trend analysis, since the equation would be severity X frequency X frequency.

Question 3.

When evaluating the impact against the training activity, definitions to the following categories should be considered by the organisations:

(+3) "Essential part of training / key activity" refer to the organisations core training processes:

- Core processes include the (integrated) management system and associated processes including the change management process. Examples of such may be, but are not limited to: clear lines of communication, document management, accountability, effective review mechanisms in place, continuous improvement processes and resource management.
- Essential part of the training includes those aspects of the training, which make up the

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training delivery, both theoretical and practical. This may include the training courses, instructional standardisation and student progress / competence assessment.

- Key activity relate to the mainstay of the organisations activity. These may change over time depending on the training engagement and financial focus of the organisation.

(+2) "Integrated element of training" is that part, aspect, documentation and material of the training that support the essential part of training / core processes and without which the successful training cannot be delivered.

(+1) "Training support" is any activity and aspect of the training not relating to the training delivery without which the quality of the training delivery is not impaired. This includes documentation not under the control of the organisation.

Question 4.

Risk assessing the absolute numbers, in terms of frequency can be misleading. In order to normalise the value, rate (work over time) is used in Q4.

Value in the brackets of the three categories (Weekly, Monthly, Quarterly or less) are generic and must be adjusted by the organisation, to reflect the time spectrum of their activity.

Calculation of Risk Classification, Risk Value and Acceptable Risk Level.

1. The first output from table I. is an Initial Risk Index, supporting early and timely risk awareness and helps to prioritise actions, which needs to be taken.
2. The second output of the RAPT is a combined alphanumerical number called the Risk Classification. This is the sum of the alphanumerical values from table I/II/III and shall be used for trend analysis and data grouping the risk register.
3. The third output is the Risk Value; a mathematical conversion of the Risk Classification into a numerical value, used in the further process of risk mitigation and risk acceptance. The numerical value is essential in maintaining risk awareness and overview.
4. When converting the alphanumerical values the following mathematical rules should be used:
    a. Alphabetic numbering equals numerical values i.e. a=1, B=2.
5. When calculating the Risk Value the following mathematical rules should be used:
    a. The two values of part I are multiplied
    b. The two values of part II and III are multiplied
    c. The resultant values of a. and b. above are added.

Risk Classification = _____ ➡ Risk value = _____

The ARL - Acceptable Risk Level is a numerical value, determined by the organisation at the

implementation of the RAPT, against which the resulting Risk Value is measured for acceptability. Subsequent mitigation or further actions are then determined. It is supporting the organisations ALARP (as low as reasonably practical) safety decisions. For a coherent and reproducible risk process the Acceptable Risk Level must remain constant.

The RAPT module uses a defaulted Acceptable Risk Level of 13. This value should be confirmed or modified initially by the organisation when adjusting the module for suitability.

Examples

The following examples are given for illustration purposes only.

The Acceptable Risk Level is 13.

The examples are not to be used as reference since:

- The risk assessment in terms of seriousness is dependent on the SIE
- The effectiveness evaluation is depending on remaining safety margins
- The training activity is depending on the training scope
- The rate is depending on the amount of training conducted

- **SIE_XX01: The established lesson plan for a practical flight training session was not followed.**
    - Table I. Initial Risk Index: 2A, GREEN, initially acceptable
    - Table II/III assessment: +2c.
        - Risk Classification: 2A+2c
        - Risk Value: 8

Activity continues, is monitored and periodically reviewed. Acceptable.
During such a review the SIE is re-identified:

    - Table I. Initial Risk Index: 2B GREEN (the barriers have not been Effective)
    - Table II/III assessment: +2c. (Unchanged)
        - Risk Classification: 2B+2c
        - Risk Value: 10

Activity continues but needs a review with shorter intervals. Acceptable, on condition.

- **SIE_XX02: Aviation language proficiency**.
    It is forecasted that a large increase of foreign speaking students will be signing up for training from different parts of the world with varying language proficiency.
    - Table I. categorisation: 3B, AMBER
    - Table II/III assessment: +3c.
        - Risk Classification: 3B+3c
        - Risk Value: 15 Above ARL and mitigation required.

Activity is not started before further safety barriers have been established.

Subsequent review identify safety barriers more effective
- o Table I. categorisation: 3A, GREEN

- o Table II/III assessment: +3c.
  - Risk Classification: 3A+3c
  - Risk Value: 12

Activity continues but needs a review with shorter intervals. Acceptable, on condition.

- **SIE_XX03: Theory of stall and upset recovery is not taught correctly**.
  - o Table I. Initial Risk Index: 4C, RED, halt operations
  - o Table II/III assessment: +2c.
    - Risk Classification: 4C+3c
    - Risk Value: 21

Activity is stopped. The training deficiencies are corrected and the new training validated to meet the training requirements. Subsequent review identify safety barriers more effective

- o Table I. Initial Risk Index: 3A, GREEN
- o Table II/III assessment: +3c.
  - Risk Categorisation: 3A+3c
  - Risk Value: 12

Activity continues but needs a review with shorter intervals. Acceptable, on condition.

- **SIE_XX04: Organisation preparing a major document change as part of their change management process.**
  The change is to the footprint of a type-rating course, where the total numbers of simulator hours are reduced.
  - o Table I. categorisation: 3B, AMBER
  - o Table II/III assessment: +3c.
    - Risk Categorisation: 3B+3c
    - Risk Value: 15 Above ARL and mitigation required.

The change management process must not be implemented before more barriers are identified and implemented. The effectiveness of the safety barriers must be evident during subsequent review.

Annex I: RAPT Matrix

RAPT - Risk Assessment in Pilot Training.

Q2. What was (is) the effectiveness of the remaining barriers between this Safety Identified Event, preventing the worst foreseeable situation?

| Effective A | Limited B | Minimal C | Ineffective D |

Q1. If this Safety Identified Event was (is) left to escalate, the effect on training may, in the worst foreseeable situation, be a contributing factor to:

I.

| 4 A | 4 B | 4 C | 4 D |

4 — Non-proficient pilot and /or Lack of knowledge and / or Lack of skill. May lead to an accident.

| 3 A | 3 B | 3 C | 3 D |

3 — Misunderstanding and /or Lack of awareness; May lead to an accident/ incident.

| 2 A | 2 B | 2 C | 2 D |

2 — Inconsistent training.

| 1 |

1 — No apparent effect on training.

II.

| +3 Essential part of training / key activity | +2 Integrated element of training | +1 Training support |

Q3. How does (will) this Safety Identified Event relate to the training activity?

III.

| c Often at high rate (Weekly) | b Regularly at steady rate (Monthly) | a Irregular (Quarterly or less) |

Q4. How often did (will) this Safety Identified Event form part of the training?

Risk Classification = _____ ➡ **Risk value = ___**

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