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ATSB

# Analysis checklists

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Australia's national transport safety investigator

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**Addendum**

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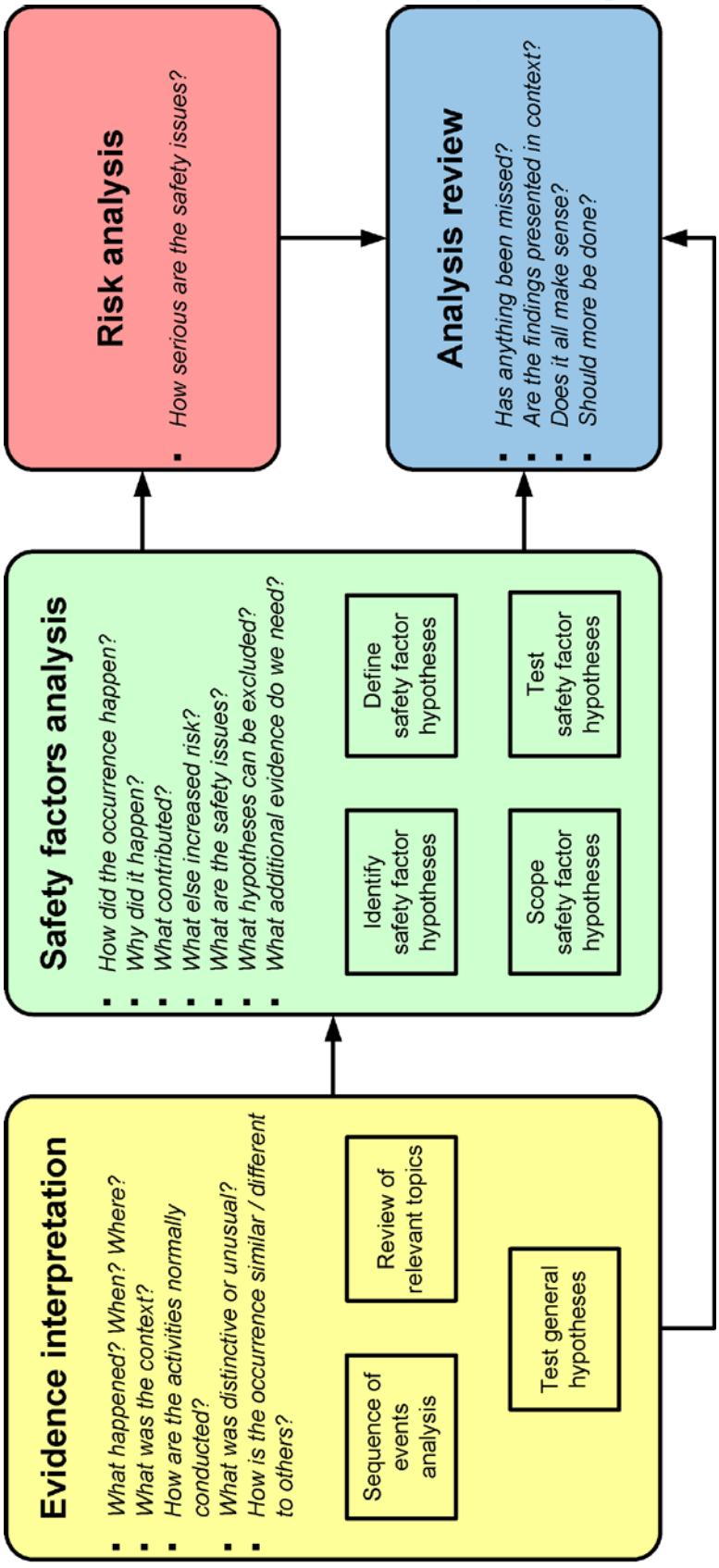
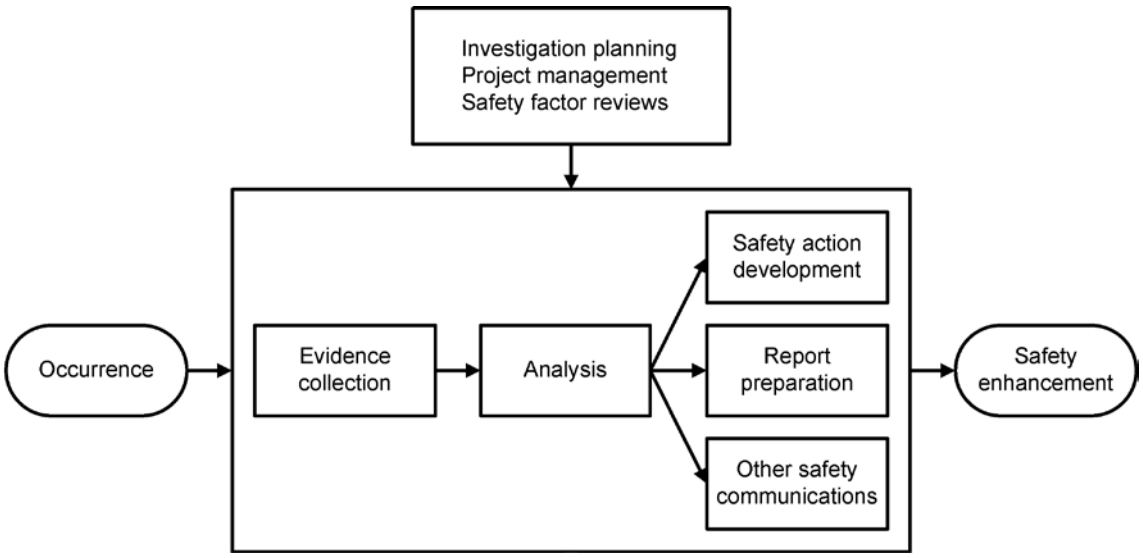
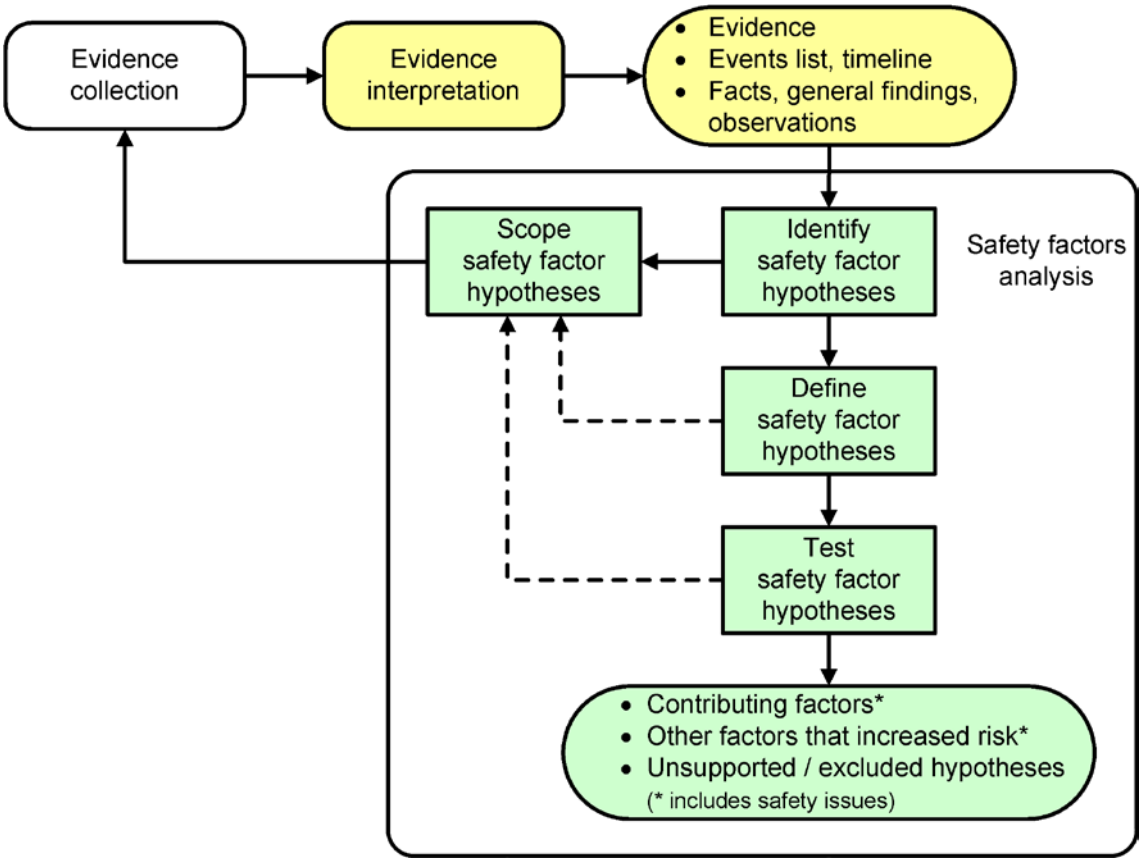
# Overview of analysis processes



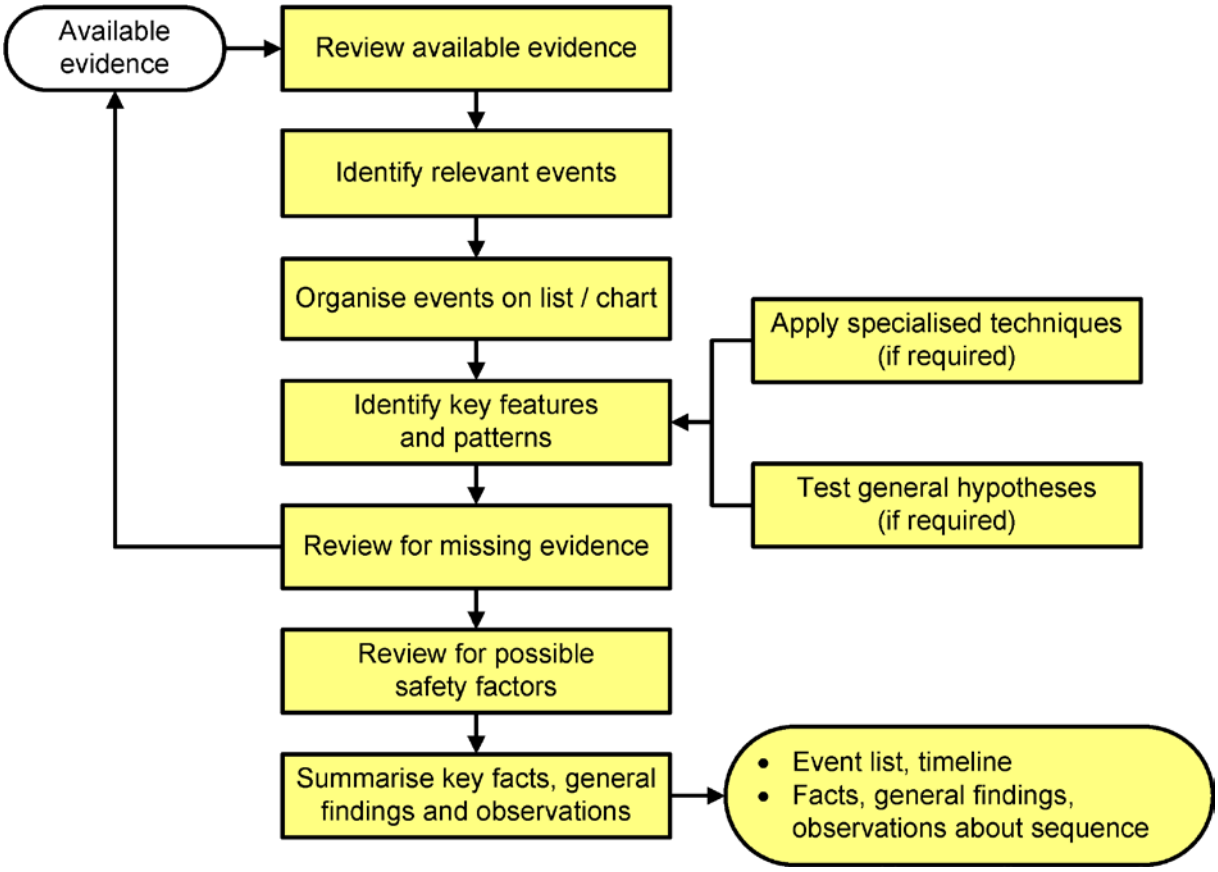
## Overall investigation processes




## Safety factors analysis processes



# Sequence of events analysis




## Sources of available evidence to consider

- vehicle recorders
- other recorded data on the vehicle
  - GPS, fault data from various systems…
- other recorded data
  - radar / traffic control data, CCTVs and other cameras, meteorological monitoring equipment, mobile phones, infrastructure monitoring equipment, key card entry / exit times, sleep monitoring devices…
- participant and witness interviews
- operational records
  - trip/activity logs, sign-on sheets, weather forecasts / observations…
- accident site, wreckage and component examinations
  - impact sequence, configuration changes…
- evidence about the normal sequence of events for the same operation (from previous trips or interviews)

## Types of events to consider including in event list or timeline

- key occurrence event
- other occurrence events
  - fuel starvation, speed exceedance, SPAD, technical failure…
- change in the phase of the vehicle trip or activity
  - engine start, take-off, climb, cruise…
- commonly-accepted milestone for the vehicle trip or activity
  - top of climb, passed outer marker, passed signal 113.5….
- change in vehicle / equipment status
  - configuration, speed, heading, altitude, equipment serviceability, warning / caution messages, automation mode…
- change in crew roles or personnel
- change in external / infrastructure conditions
  - status of a signal, runway lights…
- change in environmental conditions
  - rain, wind gust, decreased visibility…
- event or action that was distinctive or different to normal operations
- event or action that appeared to be unexpected by those involved
- decision point (point in time where a key decision or action was made and other options were available)
- event after impact that could have exacerbated or reduced the severity of the consequences of an accident
  - evacuation command, rescue services notified…
- any other event that appeared to increase risk or be undesirable from a safety viewpoint
- any other event that appeared to significantly reduce risk

**Hints:**

- Use a timeline to show durations and overlapping events
- Use an event list if you want to record a lot of information about each event.
- Distinguish between different types of events using different labels, colours, …
- Keep the event list / timeline up to date.

# Useful evaluation questions

***Facts and findings about the sequence:***

- What aspects of the sequence are consistent with a normal operation?
- What aspects of the sequence are not consistent with a normal operation?
- What events are interesting, salient or distinctive?
- What events are unusual or surprising?
- What patterns of events in the sequence are interesting, salient or distinctive?
- What events would be expected but seem to be missing?
- What events seem to have occurred in a different order to that expected?
- What intervals between events are longer than expected?
- What intervals between events are shorter than expected?
- What aspects of the sequence are difficult to understand or explain?
- What does the sequence suggest about the context in which the events happened?
- What are other implications of the sequence?
- What else is worth remembering or communicating to others?

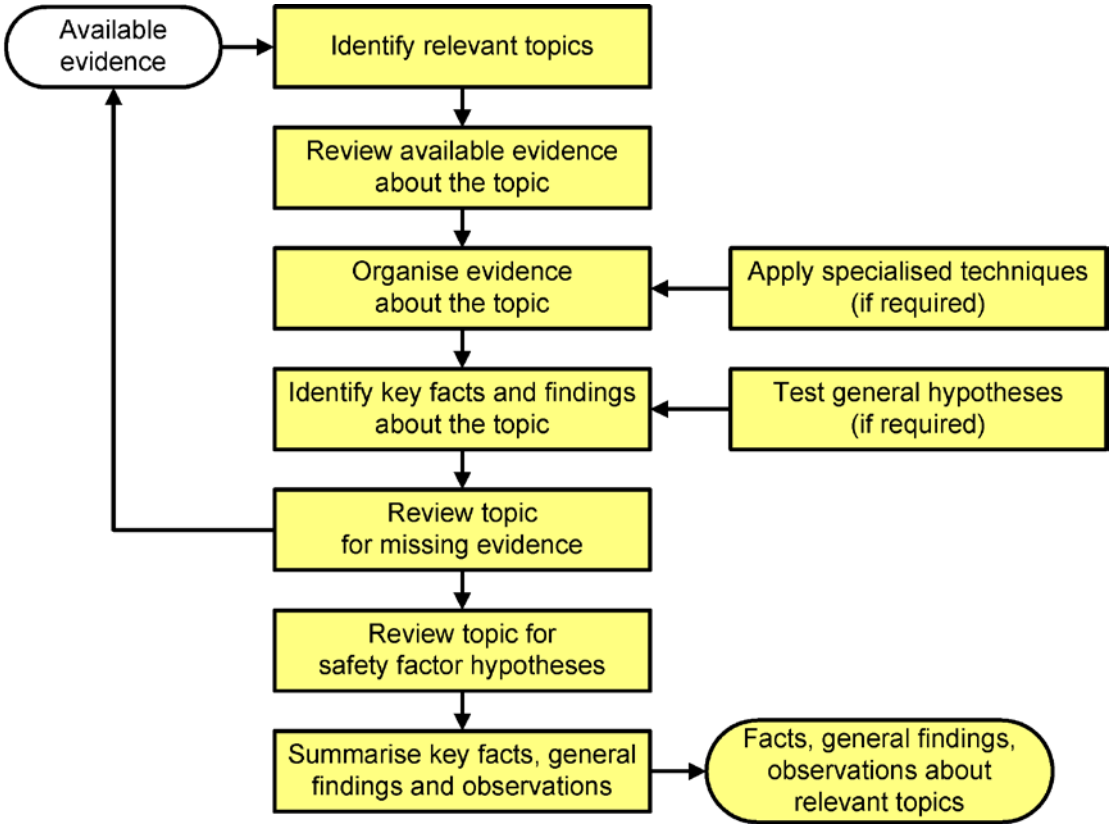
***Missing evidence about the sequence:***

- What key information about the sequence is missing?
- Does the sequence contain sufficient information to explain what happened? In what areas would more information be useful?
- Does the timeframe of the sequence need to be expanded to provide a better understanding of what happened or the context?
- What other sources of evidence about the sequence are available? Are they more useful or reliable than what you already have?

***Safety factors:***

- What events appeared to increase risk?
- What events could or should have decreased risk but did not?

# Review of relevant topics




**Hints:**

- You can also use the same basic process for reviewing a specific type or source of evidence. For example, the wreckage examination, passenger video, a specific document…
- You should always conduct a review of related occurrences.
- Evidence matrices are a great way to summarise the available evidence about a topic when there are multiple sources of evidence covering the same aspects of the topic.
- Sometimes a review of a topic of interest has to be broad initially, but can then become more focussed as the investigation progresses.

## Potential topics of interest (for detailed review)

- related occurrences
- transport vehicle
  - maintenance history, serviceability, recent history, design…
- equipment or systems on board the vehicle
  - availability, history, serviceability, functionality, how it works, how information was displayed at time, anomalies at the time…
- personnel operating the vehicle
  - qualifications and experience, recency, fitness for duty, alertness, recent history…
- other safety-critical personnel (e.g. controllers, maintenance personnel, cabin crew)
  - qualifications and experience, recency, fitness for duty, alertness, recent history…
- environmental conditions at relevant points of time
- operational conditions at relevant points of time
  - traffic levels, availability of relevant information…
- relevant infrastructure or facilities (e.g. runway lighting, navigational aids, signals, track):
  - availability, serviceability, functionality, how it works, anomalies at the time…
- procedures, training, guidance for key tasks
  - availability, history…

## Ways of organising evidence

- chronologically (event list, timeline)
- thematically (evidence matrix)
- spatially / geographically
- statistically
- functionally (e.g. flow chart, ‘who knew what’ diagram, control structure diagram)

## Useful evaluation questions

***Facts and findings about the topic:***

- What aspects of the topic are consistent with a normal operation?
- What aspects of the topic are not consistent with a normal operation?
- What aspects of the topic are interesting, salient or distinctive?
- What aspects of the topic are surprising or unusual?
- What patterns or trends about the topic are interesting, salient or distinctive?
- What aspects of the set of evidence are difficult to understand or explain?
- What does the set of evidence suggest about the context in which relevant events and conditions occurred?
- Is there conflicting evidence about any important aspects?
- What are other implications of the set of evidence?
- What else is worth remembering or communicating to others?

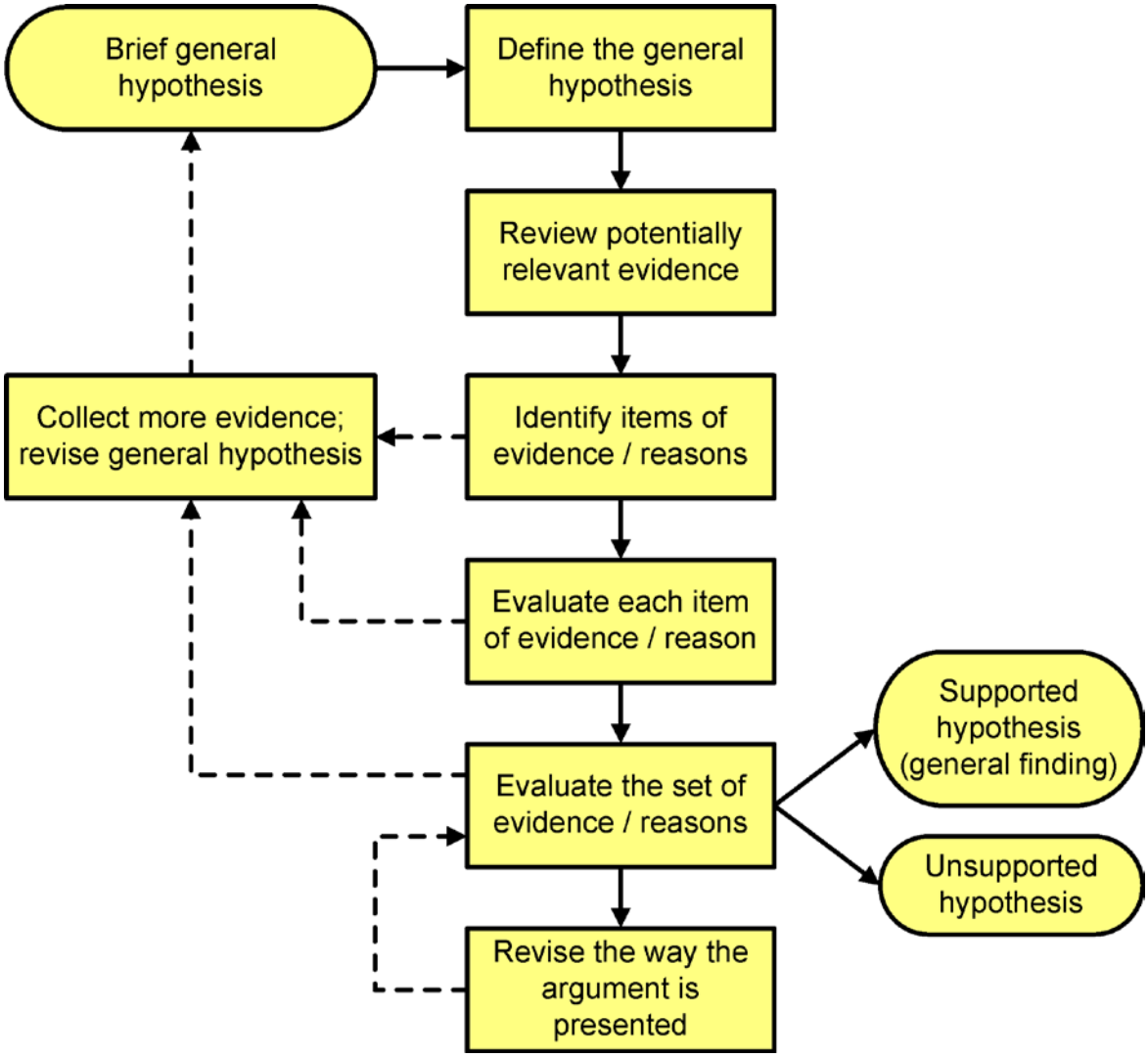
***Missing evidence about the topic:***

- What key information about the topic is missing?
- Does the set of evidence contain sufficient information about the topic? In what areas would more evidence be useful?
- What other sources of evidence about the topic are available? Are they more useful or reliable than what you already have?

***Safety factors:***

- What events or conditions associated with the topic appeared to increase risk?
- What events or conditions associated with the topic could or should have decreased risk but did not?

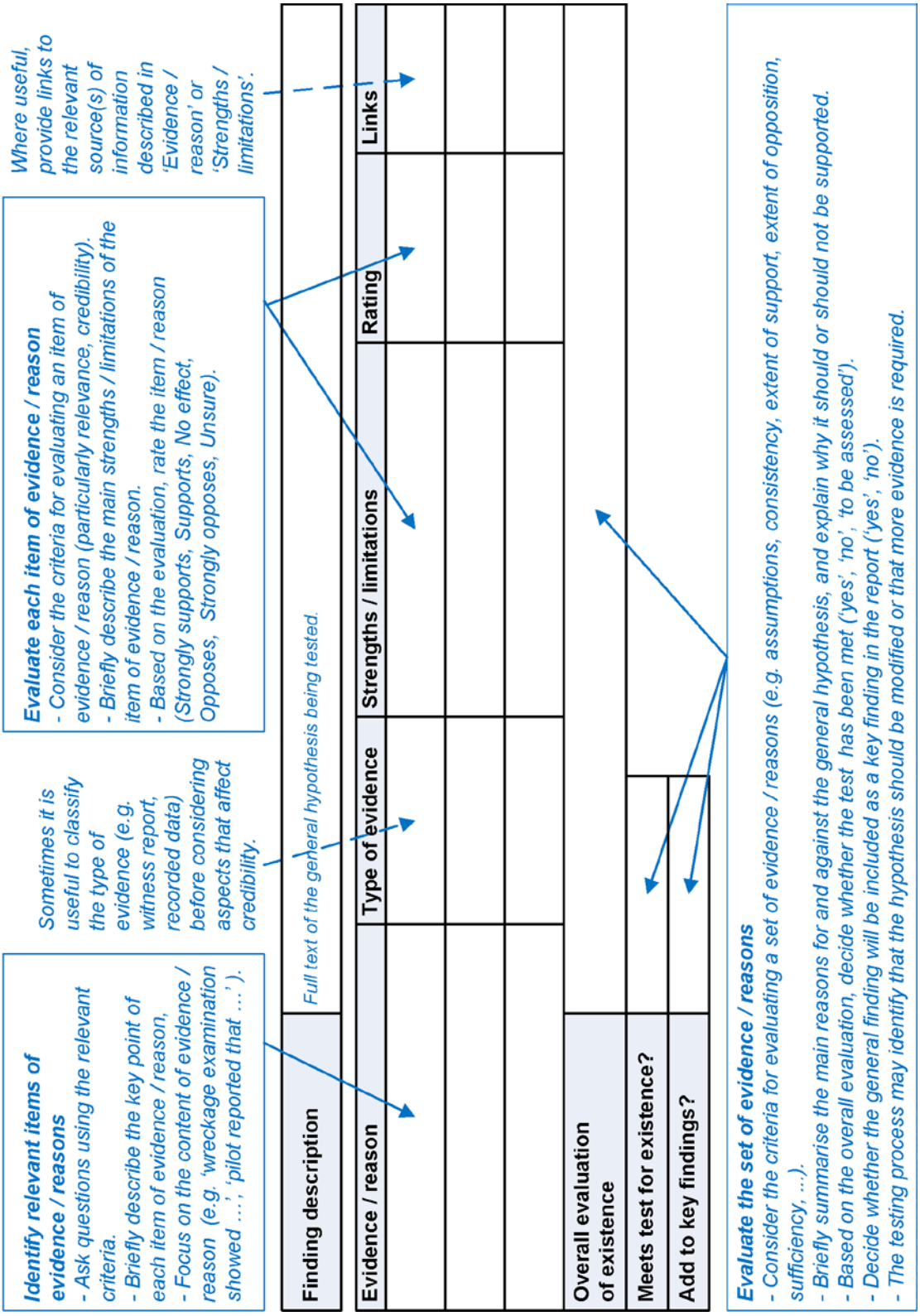
# Test general hypotheses




**Hints:**

- General findings that will be included in the key findings need to be formally tested. It is also useful to formally test intermediate hypotheses that will greatly assist the analysis of safety factors (particularly about topics that have had a high profile during the investigation).
- For intermediate findings, sometimes it may be useful to start with a question ('what was the wind speed at landing?) than a specific hypothesis ('the wind speed was about 20 kt at landing').

# General finding evidence table



## Identify relevant items of evidence / reasons

| | |
|---|---|
| **Primary considerations** | |
| Direct observation | Was the event / condition directly observed or recorded? If not, should it have been? |
| Symptoms | Were there symptoms, effects or consequences of the event / condition? |
| Sources | Were there factors present that could lead to, produce or exacerbate the event / condition? |
| Predictions | Could existence of the event / condition be deduced, calculated or inferred from the available evidence? |
| Expectations (of existence) | If the event / condition existed, what would we expect to see or find? How well does the evidence match these expectations?<br>(Consider confirmed expectations, unfulfilled expectations, unexpected evidence.) |
| **General considerations** | |
| Clearly supports | What evidence and reasons support the existence of the event / condition? |
| Clearly opposes | What evidence and reasons oppose the existence of the event / condition? |
| Generally relevant | What types of evidence or reasons are normally relevant for demonstrating the existence of this type of event / condition? |
| **Other considerations** | |
| Frequency | To what extent has the event / condition occurred on other occasions? |
| Other perspectives | What do experts and other parties believe are reasons for supporting or opposing the existence of the event / condition? |

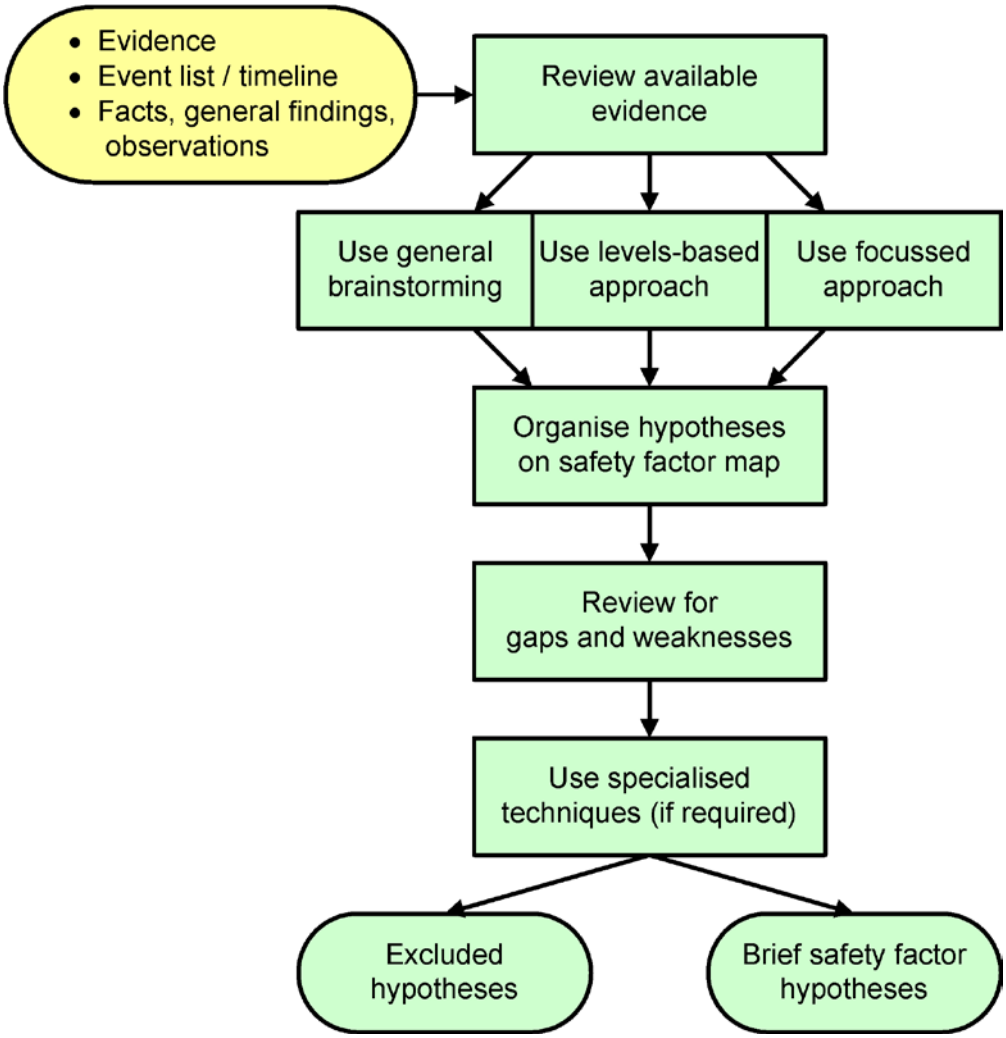
## Criteria for evaluating an item of evidence / reasons

(See the same section in *Test safety factor hypotheses*)

## Criteria for evaluating a set of evidence / reasons

(See the same section in *Test safety factor hypotheses*)

# Identify safety factor hypotheses




**Relevant tools to use:**

- Safety factor (SF) map – for every occurrence investigation
- Safety factor (SF) exclusions list - for SF hypotheses not going to test
- Safety factor (SF) list - for hypotheses going to test
- Alternative explanations mind map - when attempting to explain a specific event or condition

# General brainstorming questions

***General questions:***

- What was the occurrence? (collision with terrain, derailment, grounding…)
- What possible factors have we already identified during our evidence collection / evidence interpretation activities?
- What events / conditions do we need to explain?
- What other events / conditions help describe this occurrence?
- What else is interesting about the occurrence?
- What does a 'good day' (normal operation) look like? How was this different?
- How did the occurrence happen?
- Why did the occurrence happen?
- Has this type of occurrence happened before? If so, what types of factors have been associated with previous occurrences? Which ones are potentially applicable in this case?
- What do experts and other parties believe were factors involved?

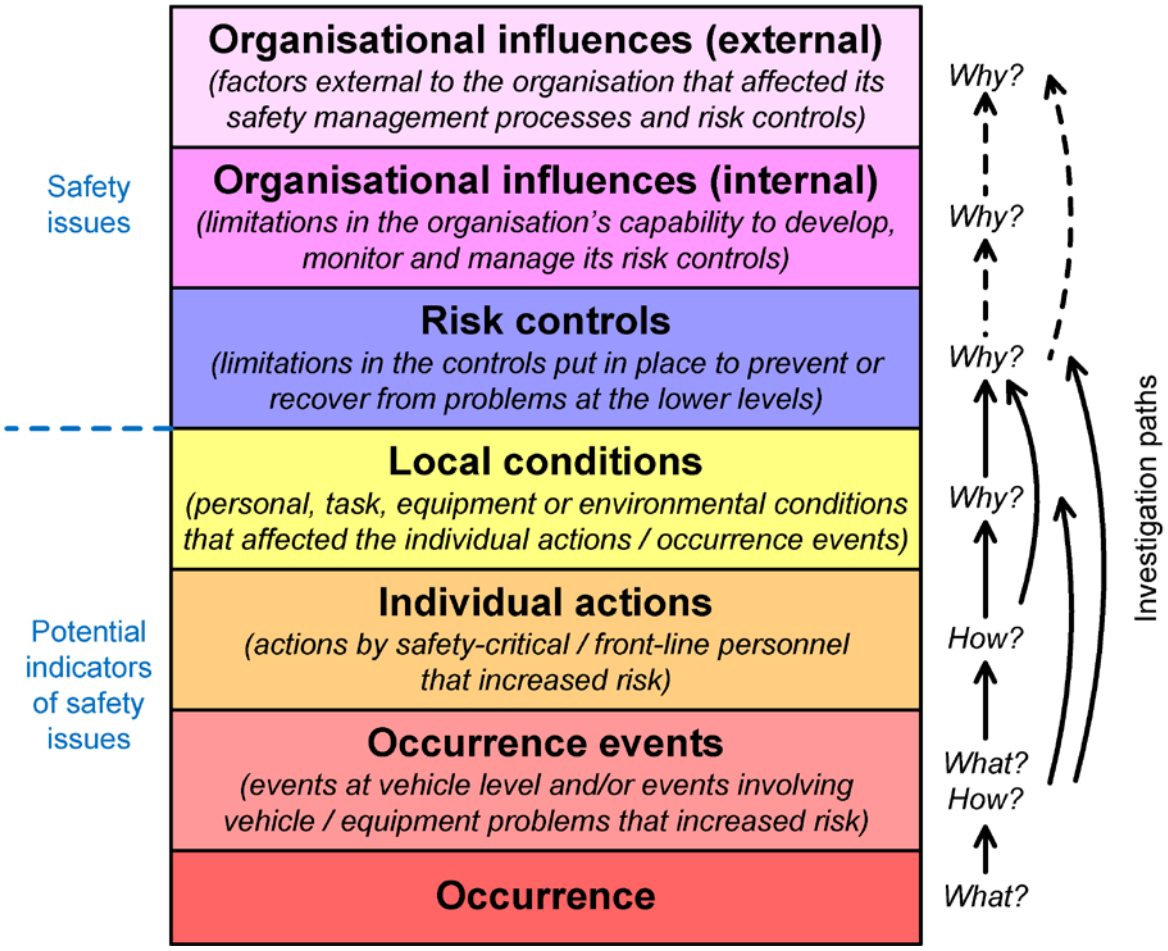
***Risk-based questions:***

- What events / conditions increased risk?
- What events / conditions decreased risk? What else could have decreased risk but was not effective?
- What aspects of the safety system worked well? What did not work so well?
- What could be done to reduce the risk of this type of occurrence?
- What has already been done to reduce the risk? What can these changes tell us about potential problems that existed at the time?
- What are the main safety lessons that could / should be learnt from this occurrence?

**Hints when asking brainstorming questions**

- Apply questions to each functional areas or theme as well as the whole occurrence (e.g. operations, engineering, traffic control, cabin safety…).

## Levels-based questions




## Occurrence events

- What was the key occurrence event? (collision with terrain, derailment, grounding…)
- What are the other significant events we need to explain?
- What other events in the occurrence sequence could be considered as reportable incidents?
- What events increased safety risk before the key occurrence event?
- What events increased safety risk after the key occurrence event?
- If we had the same situation again, what would we want the vehicle or equipment to do differently?
- What events involved problems with the functioning of the vehicle or related equipment?

## Individual actions

- What actions by safety-critical or front-line personnel increased safety risk?
- If we had the same situation again, what would we want the personnel to do differently?
- What are the individual actions we need to explain?
- What actions by operational personnel were needed to effectively prevent the adverse situation? Which of these actions were not effective?
- What actions by operational personnel were needed to effectively recover from the adverse situation? Which of these actions were not effective?
- What other actions by operational personnel:
  - were unusual compared to normal operations?
  - were absent compared to normal operations?
  - were inconsistent with published or normal procedures?
  - were inconsistent with best practice or ideal performance?
  - have been factors in similar occurrences?

## Local conditions to individual actions

- What local conditions increased safety risk?
- Why did the action make sense to the individual(s) at the time?
- What aspects of the local context made it difficult to perform tasks effectively?
- Would other individuals in the same type of situation perform the same way?
  - Yes: what task / environment / system conditions make you think this?
  - No: what differences between this individual and many others make you think this?
- What local conditions:
  - were unusual compared to normal operations?
  - were at levels inappropriate for normal operations?
  - changed in the period prior to when the event(s) occurred?
  - were inconsistent with best practice or the ideal situation?
  - have been factors in similar occurrences?
- Were there limitations with understanding how to do tasks or how the system functioned?
- Were there limitations with the information provided about task progress or system performance?
- Were there problems, limitations or concerns with any of the following:
  - knowledge, skills, experience (including recency, consolidation…)
  - fatigue, alertness (sleep quantity / quality, hours awake, time of day, sustained workload…)
  - medical and physiological factors
  - personal circumstances (recent changes, preoccupations…)

- recent behaviour (nutrition, hydration, exercise…)
- task demands (workload amount / complexity, distractions, time pressure…)
- physical environment (illumination, glare, noise, vibration, temperature, humidity, air quality…)
- operating environment (weather conditions, visibility, quality of information provided by external parties…)
- social factors / teamwork (authority gradient, interpersonal differences…)
- equipment / systems
- procedures, training, guidance
- organisational environment (relationship with supervisor, morale, job design, company pressure to do tasks…)

- What was the 'error type'? What factors are commonly associated with this error type and are potentially relevant? Consider the following table.

| Error type | Local conditions / aspects to consider |
|---|---|
| Detection / perception error | Obstructions, target salience, contrast with background<br>Perceptual abilities (vision, hearing)<br>Expectancies (recent / total experience)<br>Focus of attention, workload, distractions,<br>Scanning technique<br>Fatigue (if completely missed) |
| Situation assessment / diagnostic error | Expectancies (recent / total experience)<br>System knowledge<br>Way information is presented / salience of cues<br>Similarity of perceived situation to actual situation |
| Decision / action selection error | Training, experience with situation<br>System knowledge<br>Time / task pressure |
| Action execution slip | Focus of attention, workload, distractions<br>Similarity of task sequence with other tasks<br>Task progress feedback |
| Action execution lapse | Focus of attention, workload, distractions<br>Reliance on prospective memory<br>Fatigue |
| Routine violation | Design of procedure (ease of compliance)<br>Awareness / understanding of procedure<br>Consequences if follow versus not follow rules (effort, comfort, perceived risk, peer feedback, supervisory feedback…) |
| Exceptional violation | As per routine violation<br>Time pressure / task pressure<br>Available resources |

## Local conditions to occurrence events

- What local conditions increased safety risk?
- What aspects of the local context made it difficult for the vehicle / equipment to operate or perform effectively?
- What local conditions:
  - were unusual compared to normal operations?
  - were at levels inappropriate for normal operations?
  - changed in the period prior to when the event(s) occurred?
  - were inconsistent with best practice or the ideal situation?
  - have been factors in similar occurrences?
- Would other vehicles / equipment of the same type perform the same way?
  - Yes: what task / equipment / system characteristics make you think this?
  - No: what differences between this item of equipment and many others make you think this?
- Were there problems, limitations or concerns with:
  - physical environment
  - operating environment
  - interaction between system components.
- Was there a technical failure or problem? If so:
  - Was there a pre-existing defect?
  - What was the technical failure mechanism (e.g. fracture, wear, corrosion, deformation, mechanical discontinuity, electrical discontinuity, software anomaly)? What factors are often associated with such defects / mechanisms and are potentially relevant?
  - Did the equipment perform to its designed reliability level?
  - Yes: is the designed level appropriate?
  - No: what factors limited the ability to achieve the expected reliability level?
  - What limitations were involved in the following processes: equipment design; manufacture; maintenance; operation?

**Hints when asking levels-based questions**

- Always seek to explain individual actions.
- Always look for potential risk control problems.
- Apply questions to different functional areas or themes as well as the whole occurrence (e.g. operations, engineering, traffic control, cabin safety…).
- Apply the questions to different phases of the transport activity (e.g. prior to departure, taxi, take-off and climb, cruise…).

## Risk controls

- What risk controls were in place to eliminate, prevent or minimise the likelihood of problems with the occurrence events, individual actions and local conditions? (i.e. preventive controls)
  - Were these controls effective? If not, how were they ineffective?
  - Did these controls operate as designed or intended? If not, how were they different?
- What risk controls were in place to detect, correct, or minimise the consequences of problems with the occurrence events, individual actions and local conditions? (i.e. recovery controls)
  - Were these controls effective? If not, how were they ineffective?
  - Did these controls operate as designed or intended? If not, how were they different?
- What other risk controls could have been in place to better prevent or reduce the likelihood of problems with the occurrence events, individual actions and local conditions?
- What other risk controls could have been in place to better detect or manage problems with the occurrence events, individual actions and local conditions?
- If we had the same situation again, what would we want the organisation to do differently with its risk controls?
- What aspects of the risk controls:
  - were unusual compared to similar organisations?
  - were absent compared to similar organisations?
  - were inconsistent with formal requirements or guidance?
  - were inconsistent with best practice or the ideal situation?
  - had recently changed?
  - have been factors in similar occurrences?
- Did the risk controls allow the safety critical personnel to effectively do their tasks? If not, how could the situation have been better?
- Were the risk controls easy to use by the safety-critical personnel? If not, what aspects made them difficult or inconvenient to use?
- Were there problems, limitations or concerns with any of the following:
  - equipment design / availability (displays, controls, workspace layout, detection / warning systems, safety equipment…)
  - procedures design / availability (normal procedures, emergency procedures, checklists…)
  - training and assessment processes (initial, recurrent, non-technical, safety awareness)
  - people management processes (supervision, rosters, job design…)
  - infrastructure outside the vehicle (runways, navigation aids, lighting, signals…).

## Organisational influences – internal

- What processes did the organisation have in place to develop, monitor, manage and minimise problems with its risk controls?
  - Were these processes effective? If not, how were they ineffective?
  - Did these processes operate as designed or intended? If not, how were they different?
- What other processes could have been in place to better minimise limitations with the risk controls?
- If we had the same situation again, what would we want the organisation to do differently with its safety management processes?
- Why did the design of the risk controls make sense to the organisation (or management personnel) at the time?
- Was there awareness of the problems with the risk controls prior to the occurrence?
  - Yes: what risk assessment and communication processes occurred? Were there any limitations?
  - No: what hazard identification processes occurred? Were there any limitations?
- What internal organisational conditions made it difficult for the organisation to effectively develop, monitor, manage or minimise problems with its risk controls?
- What aspects of the way the organisation was managing its risk controls (or safety in general):
  - were unusual compared to similar organisations?
  - were absent compared to similar organisations?
  - were inconsistent with formal requirements or guidance?
  - had recently changed?
  - have been factors in similar occurrences?
- Were there indications of problems with the organisation's safety culture? What are specific examples? What common themes are involved in these examples?
- Were there problems, limitations or concerns with any of the following:
  - hazard identification, risk assessment
  - training needs analysis, procedures development, equipment selection / testing
  - change management
  - occurrence reporting, occurrence investigation
  - internal auditing
  - collection and analysis of safety information
  - organisational learning / benchmarking
  - organisational structure

- corporate memory
- skills of key management / safety personnel
- communication processes, leadership / management style,
- safety philosophy / priorities.

## Organisational influences – external

- What external factors limited or constrained the effectiveness of the organisation's risk controls?
- What external factors made it difficult for the organisation to effectively develop, monitor, manage or minimise problems with its risk controls?
- What processes did external organisations have in place to monitor, manage and minimise problems with the organisation's risk controls and safety management processes?
  - Were these processes effective? If not, how were they ineffective?
  - Did these processes operate as designed or intended? If not, how were they different?
- Were external organisations aware of problems with the organisation's risk controls or safety management processes prior to the occurrence?
  - Yes: what risk assessment and communication processes occurred? Were there any limitations?
  - No: what hazard identification processes occurred? Were there any limitations?

**Hints about safety factor maps (SF maps):**

- Start early, and keep it up to date.
- Do not worry about formatting too much initially. As the map matures, convert it into the ATSB template.
- Start with occurrence events / individual actions in chronological order, then add hypotheses at higher levels.
- Show potential links between hypotheses if you think one may have influenced the other (do not show links just to show chronological order).
- Distinguish between events / conditions that are safety factors and other events / conditions (refer to the ATSB template).
- Keep related items close together (horizontally and vertically) if possible.

# Focussed approach

***Understanding the selected event / condition (or 'target factor')***

**Basic aspects:**

- What is the event / condition that we are trying to explain?
- Who / what was involved? (individual, vehicle, component, procedure, organisation …)
- When did it occur / exist? (time, duration, continuous / intermittent, place in sequence …)
- Where did it occur / exist? (location, localised / widespread …)
- What was its extent, magnitude or severity?

**Additional aspects:**

- What else is distinctive about it?
- What else is interesting about it?
- Why was it problematic?
- What was the context in which it existed / occurred? (what else was present / absent, what happened in the period before, other unusual / salient aspects…)
- How common is it?
- What else do we know about it?

***Identifying hypotheses to explain the selected target factor***

**Enhancing factors:**

- What hypotheses that we have already identified could help explain the target factor?
- How did the target factor occur / exist?
- Why did it occur / exist?
- What made it more likely to occur / exist?
- What increased its extent, magnitude or severity?
- What enabled, exacerbated or facilitated the target factor?

**Problems with mitigators:**

- What could have prevented or eliminated it?
- What could have made it less likely to occur /exist?
- What could have reduced its extent or magnitude?
- What could have detected and/or corrected it?
- What could have minimised its adverse consequences?

**Additional aspects:**

- Why now? Why here? Why this time?
- What were necessary conditions for it to occur / exist?
- What are common explanations for this type of target factor?
- What have experts and other parties suggested?
- What else should we consider (just in case)?

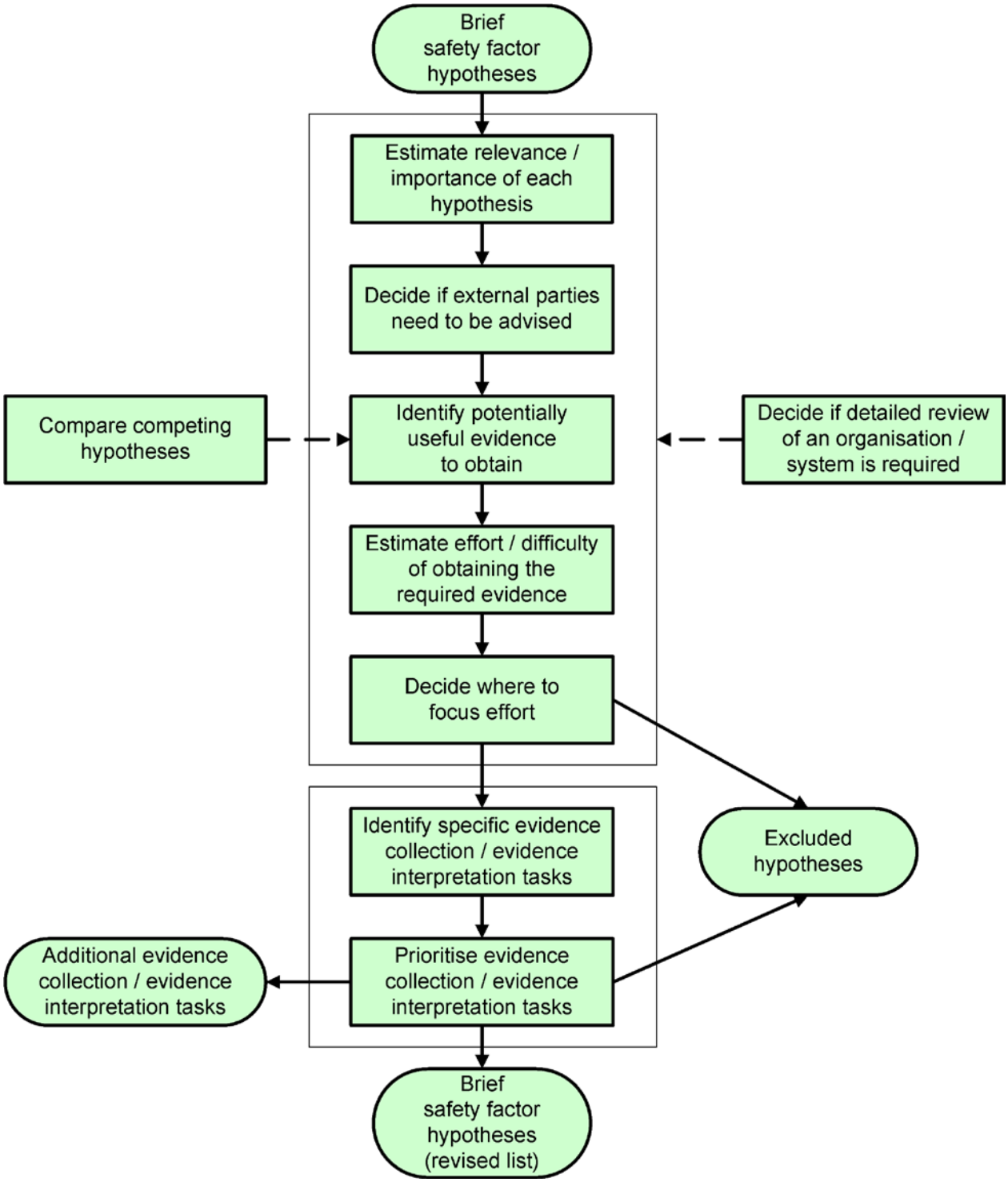
**Hints when asking focussed approach questions:**

- When considering the target factor, also consider what it is not (as well as what it is).
- If there are many potential hypotheses to explain the target factor, it is useful to use a mind map to organise them.
- Some levels-based questions can also be useful when identifying hypotheses to explain a specific target factor (e.g. local condition questions for identifying reasons for a specific individual action).

## Review for gaps and weaknesses

- Are any of the identified SF hypotheses not potential safety factors (i.e. they are not events or conditions that increase risk)? [These should either be removed or made a different shape on the SF map.]
- Are there any SF hypotheses currently on the SF map / list that we can be very confident did not actually exist?
- Do any of the SF hypotheses appear to be weak or unnecessary?
- Are there any SF hypotheses that should be explained but do not have any potential explanations?
- Are there any SF hypotheses that should be explained but at present only have weak explanations?
- Are there any hypotheses that are very closely related and could be merged to make a better finding?

# Scope safety factor hypotheses



# Estimate potential relevance / value of each hypothesis

***Potential relevance / value as safety factors***

- What is the potential that the hypothesis will exist?
- If it does exist, what is the potential that the hypothesis had an influence (on the key occurrence event, the adverse consequences or a contributing factor)?
- Regardless of whether it had an influence, what is the potential that the hypothesis is still important from a safety perspective?
- Is the hypothesis a potential safety issue? What is the (approximate) level of safety risk?
- Could further investigation of the hypothesis lead to identifying safety issues?
- To what extent could the hypothesis affect the safety of future operations?
- Could further investigation lead to useful safety lessons (or reinforce previous lessons)?
- So what? Will examining this hypothesis any further realistically provide any benefit for future safety or for the investigation?

***Potential relevance / value for other reasons***

- Is the hypothesis related (or likely to be related) to the key themes of the investigation?
- What is the potential for the hypothesis (if supported / not supported) to influence the scope of further investigation activities?
- Is the hypothesis of interest to the industry / public?
- Is the hypothesis related to ATSB safety watch priorities?
- Could further investigation of the hypothesis be useful for other ATSB investigations?
- To what extent are other investigations (by ATSB or by other agencies) examining this hypothesis / topic?
- Could there be criticism of the investigation if this hypothesis is not examined?
- Could there be criticism of the investigation if this hypothesis is examined?

**Relevant tools to use:**

- Safety factor (SF) scoping form – to determine additional evidence collection / interpretation tasks for selected hypotheses
- Safety factor (SF) exclusions list - for SF hypotheses not going to test
- Safety factor (SF) hypotheses matrix – for comparing competing hypotheses (prior to doing any SF evidence tables)

## Identify potentially useful evidence to obtain

- Identify the evidence you would like for each hypothesis. Consider:
  - If the hypothesis is true, what would we expect to see or find? How can we measure this?
  - If the hypothesis is false, what would we expect to see or find? How can we measure this?
  - How can we prove it is true?
  - How can we prove it is false?
  - What data is normally collected for this type of hypothesis? (to prove existence and/or influence)
  - How can we determine the breadth / range / magnitude of the potential problem? (particularly relevant for safety issues)
- Review the evidence you already have.
- Compare what you would like with what you already have to identify significant gaps. Consider:
  - Do we already have sufficient information to determine whether the factor existed?
  - Do we already have sufficient information to determine whether the factor had an influence?
  - Do we already have sufficient information to determine the breadth / range / magnitude of the problem? (more important for safety issues)
  - How much more confidence do we need to make a useful finding?
  - Overall, what additional evidence is necessary or most useful to further analyse this hypothesis?

## Estimate effort / difficulty of obtaining the required evidence

- What effort will be required to obtain this evidence and examine this hypothesis?
- What other resources or costs will be required to obtain this evidence and examine this hypothesis?
- How long will it take to examine this hypothesis (including time waiting for internal / external personnel)?
- How likely is it that the obtained evidence will be able to help make reliable decisions about existence and/or influence?
- Will there be concerns raised by external parties if this evidence is obtained (or this hypothesis is examined)?
- What other difficulties are associated with examining this hypothesis?

## Decide where to focus effort

- Stop rules to consider for a specific hypothesis / topic of interest:
  - Further investigation will not lead to a safety factor finding (or substantially change an existing finding).
  - The benefit (or potential for safety enhancement) is not worth the cost / difficulty.
  - The hypothesis is too difficult to investigate effectively.
  - Hypothesis is a potential safety issue no organisation could reasonably be expected to address (and does not involve a critical risk level).
  - Further investigation requires significant effort and the hypothesis has low relevance for this investigation.
- Stop rules to consider for a group of related hypotheses (or whole investigation):
  - Further investigation will not lead to / substantially change any findings.
  - Further investigation will not identify any (more) safety issues.
  - The identified safety factors (including safety issues) can be explained / discussed in context.
  - The remaining hypotheses / topics are too difficult to investigate effectively.
  - Significantly more safety benefit can be obtained by allocating resources to investigating other topics / investigations.

**Hints when scoping**

- Investigations are usually scoped and reviewed in phases (e.g. occurrence events, individual actions, local conditions in the first phase, then risk controls, then organisational influences).
- Management approvals are required to significantly vary scope or extend scope to the different levels.
- Early in the investigation some of the hypotheses may be quite broad in nature (more akin to ‘topics of interest’ or ‘lines of inquiry’), whereas over time they will become more focussed.

## Prioritise evidence collection / interpretation tasks

- Evaluate the benefits of each proposed task. Consider:
  - Is the information perishable or likely to be contaminated with time?
  - Does the task have to be completed before other tasks can be planned/conducted?
  - Is there potential to obtain information that will prove / disprove existence and/or influence?
  - Could the evidence help demonstrate the breadth / range / magnitude of a problem?
  - What is the likely relevance / importance of the associated hypothesis?
  - Can evidence be obtained that may be useful for multiple hypotheses?
  - What other benefits are there for doing the task? (e.g. industry liaison, investigator training, public confidence)
- Evaluate the costs of each proposed task. Consider:
  - What effort is required to conduct the task?
  - What other costs are involved in conducting the task?
  - What time is required to conduct the task (including time waiting for internal / external personnel)?
  - Will there be concerns raised by external parties if the task is conducted?
  - What other difficulties are associated with conducting the task?
  - Are there alternative options to get all or most of the required information with less cost / effort / difficulty? (If so consider changing the nature of the task and reassess.)

## Compare competing hypotheses

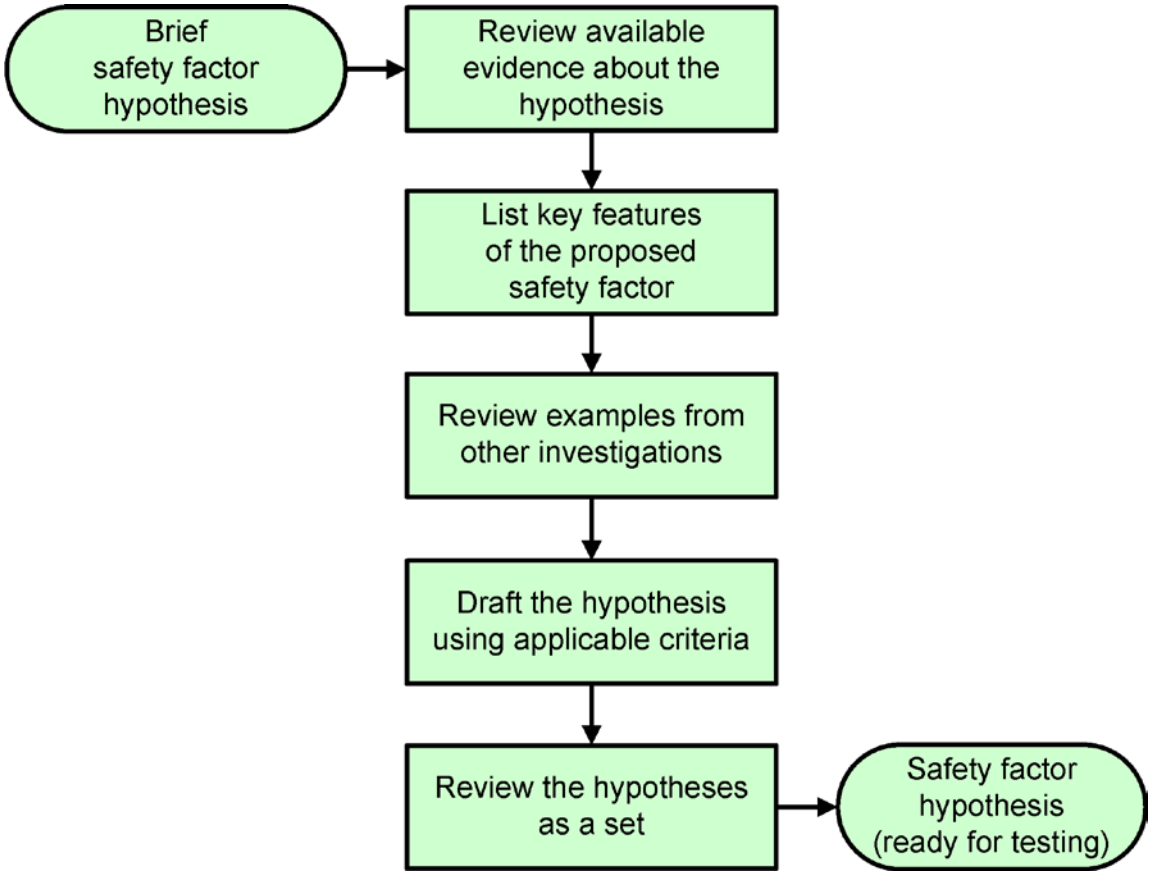
- Key facts: What are the key facts that a good explanation should be able to explain? How well does the SF explain these key facts?
- Existence: What evidence do we have that the SF existed?
- Frequency: How common is the SF?
- Plausibility: How plausible is this explanation?
- Covariation: How often has this SF explained this type of target factor before?
- Expectations: If this SF explains the target factor, what would we expect to see? (existence, influence)
- Required assumptions? If this SF explains the target factor, what assumptions do we need to make? Are these assumptions realistic?
- Other: What are the other strengths of this SF as an explanation? What are the other limitations?

## Decide if a detailed review of an organisation / system is required

- Identify if there is a ‘mandate’ or justification for investigating internal organisational influences.
  - What is the nature of the operation(s) involved? For example:
  - passenger transport, commercial, private
  - frequency of operation and number of people per operation
  - potential for significant environmental damage / economic cost to society
  - Are there concerns with the rate / trend of related occurrences?
  - What is the nature of the potential risk control problems already identified (in this investigation, previous ATSB investigations, external investigations, internal / external audits)? Consider the number, risk level, range of operations affected, trend / pattern.
  - Is a risk control problem(s) likely to be a ‘one off’ or isolated problem?
  - Are there indications that the organisation has problems with monitoring and managing these types of risk controls?
  - Does the organisation have a known history of safety management or safety culture problems?
  - Has the organisation (or industry) gone through recent changes that could negatively influence its safety management processes or safety culture?
  - Has the organisation (or industry) gone through recent changes that could positively influence its safety management processes or safety culture?
  - To what extent was it practicable for the organisation to have done more to reduce the severity of its risk control problems?
  - What gives us confidence about the way the organisation monitors and manages its risk controls?
  - What gives us concerns about the way the organisation monitors and manages its risk controls?
  - How does this organisation compare to similar organisations in terms of its risk control problems and the way it manages its risk controls?
  - What is this occurrence (and other related occurrences) telling us about the organisation / safety system? What else could it tell us?
- Identify the types of tasks required to investigate organisational influences relevant to the risk control problems / safety issues already identified.
  - Consider the types of questions listed above for identifying potentially useful evidence to obtain (for each hypothesis), and either apply them to specific organisational influence hypotheses or in a more general sense.

- Evaluate the benefits / costs of doing a detailed investigation into this organisation.
  - What is the prospect that further investigation will lead to identifying safety issues at the organisational influence level?
  - To what extent will further investigation work be able to connect any safety management problems or organisational issues with the identified risk control problems?
  - What are the likely resources required for a detailed investigation?
  - How will conducting a detailed examination of the organisation / system affect the schedule of this investigation and other investigations?
  - Are there new or useful lessons about safety management to learn from this occurrence for other organisations?
  - Are there expectations from the industry / public that a detailed investigation will be conducted?

# Define safety factor hypotheses




## Review available evidence about the hypothesis

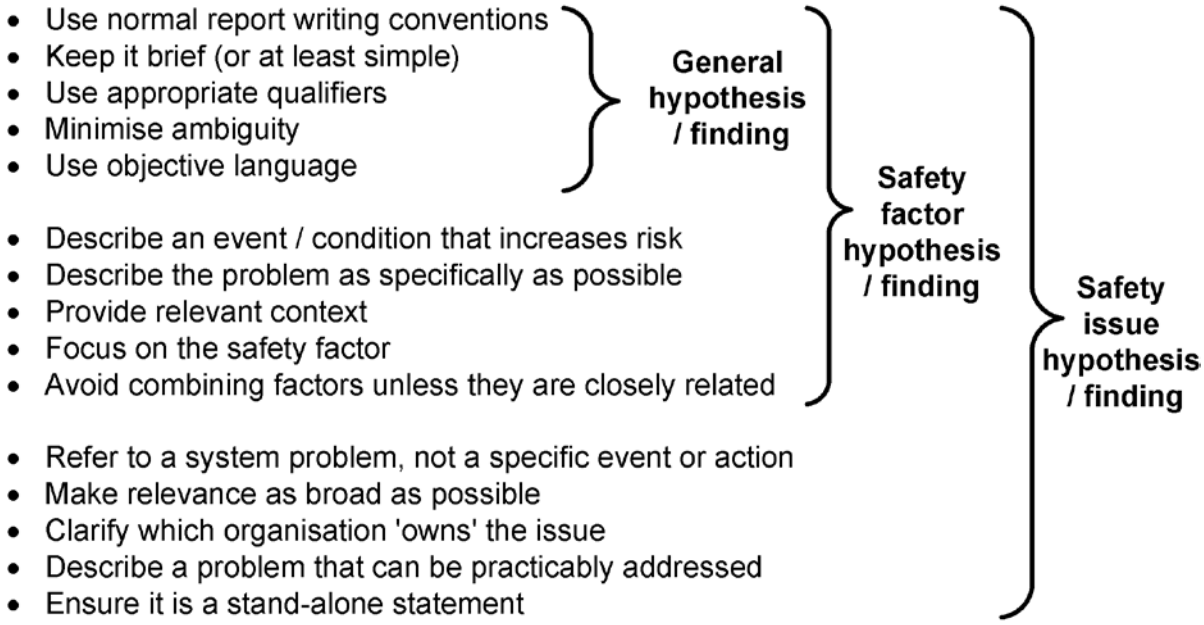
- Basic aspects:
  - What is the event / condition that we are trying to explain?
  - Who / what was involved? (e.g. individual, vehicle, component, procedure, organisation …)
  - When did it occur / exist? (e.g. time, duration, continuous / intermittent, place in sequence …)
  - Where did it occur / exist? (e.g. location, localised / widespread …)
  - What was its extent, magnitude or severity?
- Additional aspects:
  - What aspects of the set of evidence are consistent with a normal operation? What aspects are not consistent?
  - What else is distinctive about it?
  - What else is interesting about it?
  - Why was it problematic?

- What was the context in which it existed / occurred? (what else was present / absent, what happened in the period before, other unusual or salient aspects …)
- How common is it?
- What else do we know about it?

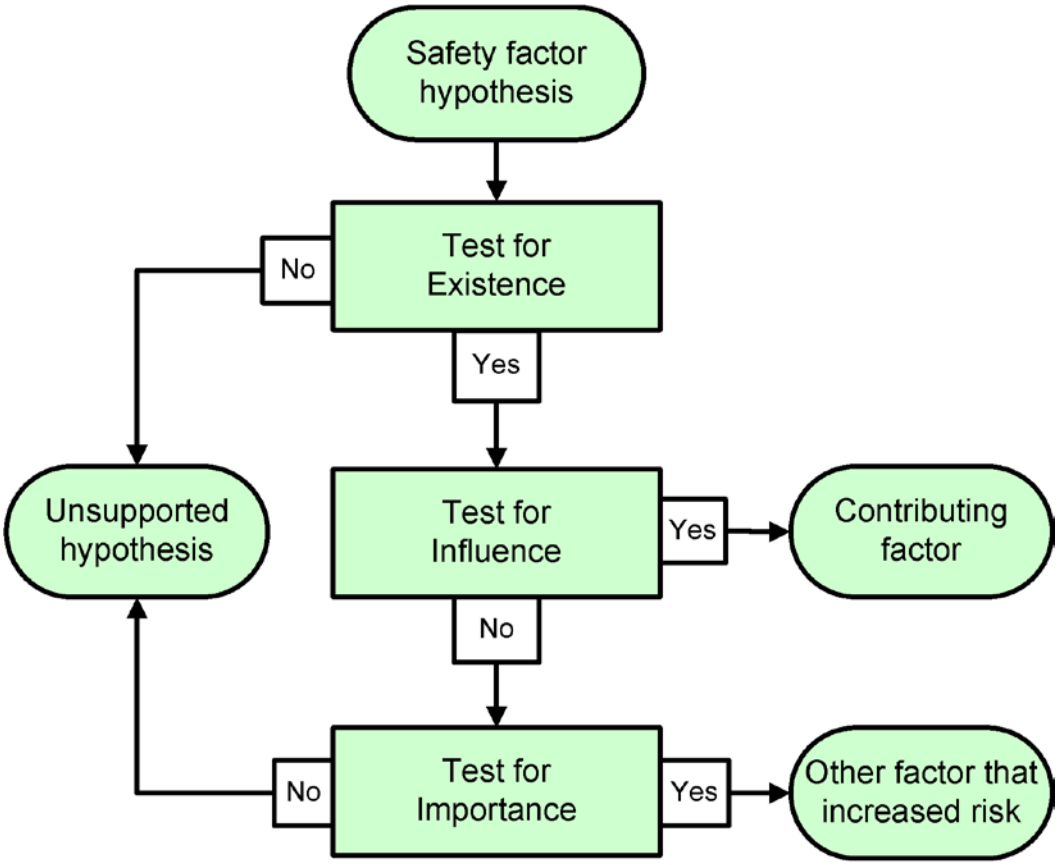
## List key features of the proposed safety factor

- What is the real 'problem'?
- What exactly are we concerned about?
- What is the main point we want to make?
- What other information do we need to include?
- What are we really trying to say?
- So what?

## Criteria to consider when drafting a hypothesis



# Test safety factor hypotheses



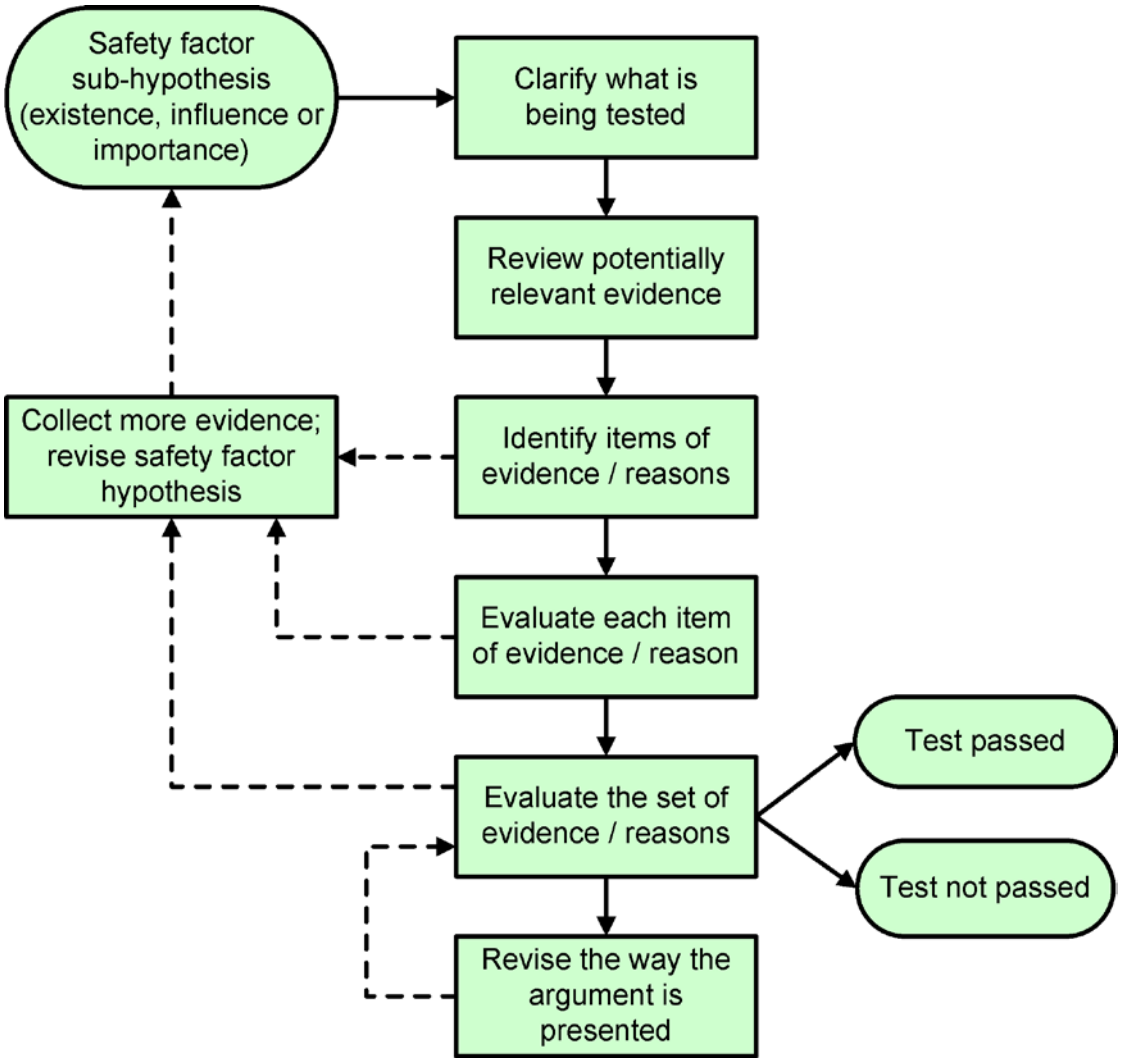

For each test:

- Clarify what is being tested
- Review potentially relevant evidence
- Identify items of evidence / reasons
- Evaluate each item of evidence / reason
- Evaluate the set of evidence / reasons
- Revise the way the argument is presented

## Sub-hypotheses

- Existence - the hypothesised safety factor (probably) occurred (for an event) or existed (for a condition).
- Influence - the safety factor (probably) contributed to a target factor (that is, the key occurrence event, the severity of the occurrence's consequences, or a known contributing factor).
- Importance - the safety factor is important enough to include in the investigation report's findings (even though it was not a contributing factor).

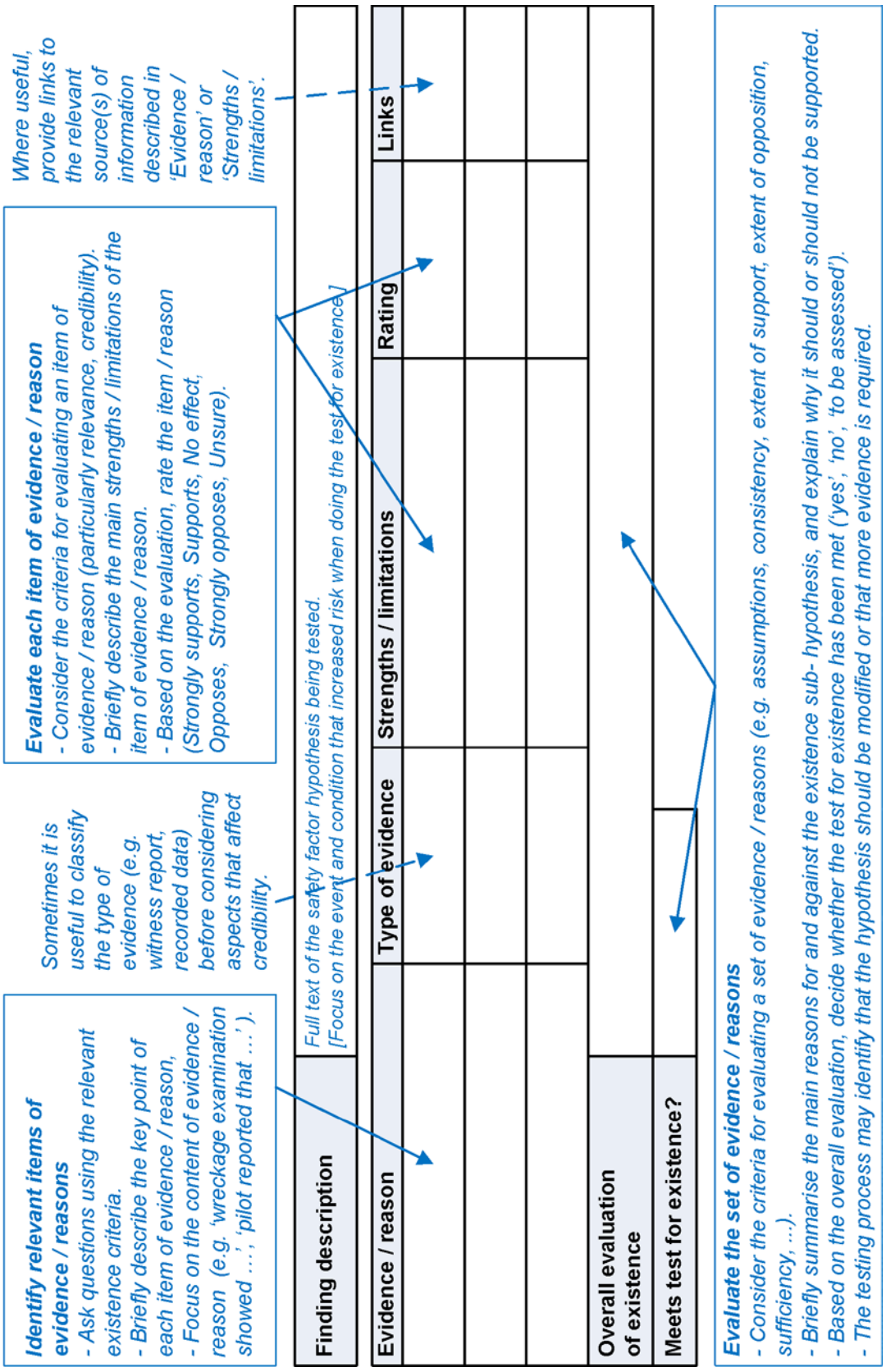
## For each test




**Hints for testing hypotheses**

- Existence: Focus on the event or condition that increased risk.
- Influence: Focus on assessing whether the SF influenced the target factor (what the safety factor influenced), and confirm that the target factor is on the SF map.
- Look for evidence and reasons.
- Look for supporting and opposing evidence and reasons.
- If the testing becomes complex, consider using an argument map / mind map to structure the argument before completing an evidence table.

# Existence evidence table



## Existence: Identify relevant items of evidence / reasons

| | |
|---|---|
| **Primary considerations** | |
| Direct observation | Was the SF directly observed or recorded? If not, should it have been? |
| Symptoms | Were there symptoms, effects or consequences of the SF? |
| Sources | Were there factors present that could lead to, produce or exacerbate the SF? |
| Predictions | Could existence of the SF be deduced, calculated or inferred from the available evidence? |
| Expectations (about existence) | If the SF existed, what would we expect to see or find? How well does the evidence match these expectations?<br>Confirmed expectations: What evidence is present that we would have expected to find?<br>Unfulfilled expectations: What evidence is absent that we would have expected to find?<br>Unexpected evidence: What evidence is present that we would have not expected to find? |
| **General considerations** | |
| Clearly supports | What evidence and reasons support the existence of the SF?<br>What were the main reasons why we identified this as a SF hypothesis?<br>What reasons are there for believing the SF did exist?<br>What evidence provides the strongest argument for the existence of the SF? |
| Clearly opposes | What evidence and reasons oppose the existence of the SF?<br>What reasons are there for believing the SF did not exist?<br>What evidence provides the strongest argument against the existence of the SF? |
| Generally relevant | What types of evidence or reasons are normally relevant for demonstrating the existence of this type of SF? |
| **Specific situations** | |
| Frequency | To what extent has the SF occurred on other occasions? |
| Practicability | (For potential safety issues?): Is it reasonable to expect that the SF could be addressed by the relevant organisations? |
| Relative strength | Is this SF one of a number of competing hypotheses to explain another SF (and only one is likely to have existed)? If so, what are the merits of this hypothesis compared to the others? |
| **For completeness** | |
| Other perspectives | What do experts and other parties believe are reasons to support or oppose the existence of the safety factor? |

## Influence evidence table

***Identify relevant items of evidence / reasons***
*- Ask questions using the relevant influence criteria.*
*- Briefly describe the key point of each item of evidence / reason.*
*- Focus on the content of evidence / reason (e.g. 'wreckage examination showed …', 'pilot reported that …').*

*Sometimes it is useful to classify the type of evidence (e.g. expert opinion, , research study) before considering aspects that affect credibility.*

***Evaluate each item of evidence / reason***
*- Consider the criteria for evaluating an item of evidence / reason (particularly relevance, credibility).*
*- Briefly describe the main strengths / limitations of the item of evidence / reason.*
*- Based on the evaluation, rate the item / reason (Strongly supports, Supports, No effect, Opposes, Strongly opposes, Unsure).*

*Where useful, provide links to the relevant source(s) of information described in 'Evidence / reason' or 'Strengths / limitations'.*

| | |
|---|---|
| **Finding description** | *Full text of the safety factor hypothesis being tested.* |
| **What did it influence?** | *Brief description of the target factor thought to have been influenced (i.e. key occurrence event, injuries / damage, a known contributing factor).* |

| **Evidence / reason** | **Type of evidence** | **Strengths / limitations** | **Rating** | **Links** |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| **Overall evaluation of influence** | | | | |
| **Meets test for influence?** | | | | |

***Evaluate the set of evidence / reasons***
*- Consider the criteria for evaluating a set of evidence / reasons (e.g. assumptions, consistency, extent of support, extent of opposition, sufficiency, ...).*
*- Briefly summarise the main reasons for and against the influence sub-hypothesis, and explain why it should or should not be supported.*
*- Based on the overall evaluation, decide whether the test for influence has been met ('yes', 'no', 'to be assessed').*
*- The testing process may identify that the hypothesis should be modified or that more evidence is required.*

## Influence: Identify relevant items of evidence / reasons

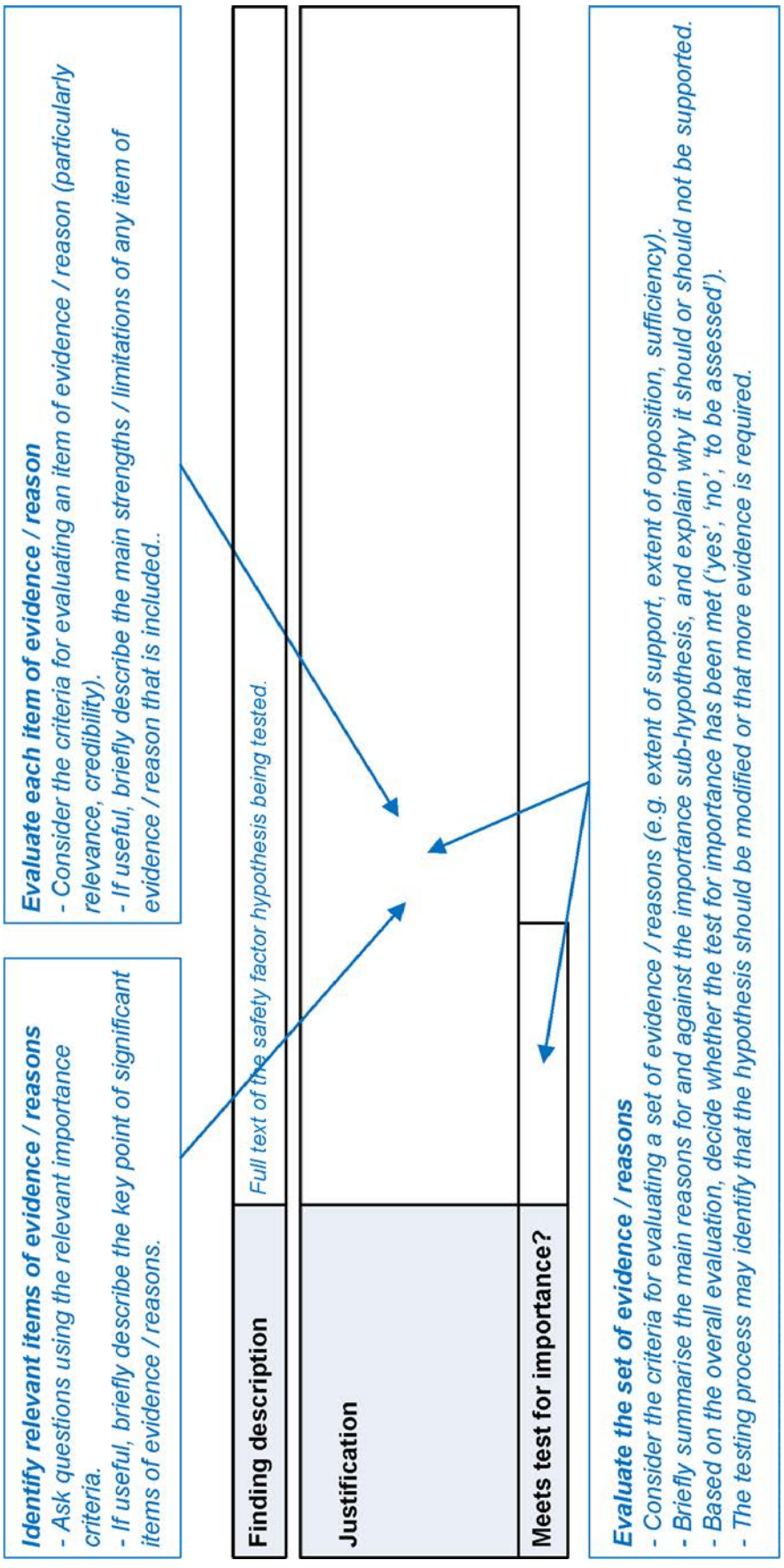
| | |
|---|---|
| **Primary considerations** | |
| Reversibility | If the SF had not existed, would the target factor have happened anyway? Why? |
| Plausibility | Is there a plausible or logical mechanism to explain how the SF contributed to the target factor? Does the influence make sense? |
| Covariation | To what extent has the SF been associated with this type of target factor on other occasions? |
| Alternative explanations | Are there alternative explanations for the target factor? If so, how well do they compare to the SF of interest? |
| **General considerations** | |
| Clearly supports | What evidence and reasons support the SF having an influence?<br>What reasons are there for believing the SF had an influence?<br>What evidence provides the strongest argument for the SF having an influence? |
| Clearly opposes | What evidence and reasons oppose the SF having an influence?<br>What reasons are there for believing the SF did not have an influence?<br>What evidence provides the strongest argument against the SF having an influence? |
| Generally relevant | What types of evidence or reasons are normally relevant for demonstrating this type of SF contributed to this type of target factor? |
| **Additional considerations** | |
| Expectations (about the target factor) | If the SF contributed to the target factor, what would we expect to see or find about the target factor? How well does the available evidence match these expectations?<br>Confirmed expectations: What evidence is present that we would have expected?<br>Unfulfilled expectations: What evidence is absent that we would have expected?<br>Unexpected evidence: What evidence is present that we would have not expected? |
| Key aspects (about the target factor) | What key aspects of the available evidence about the target factor should a good explanation be able to address? How well does the SF address these key aspects? |

| Specific situations | |
|---|---|
| Timing | Did the SF exist at the right time to have an influence? |
| Location | Did the SF exist at the right location to have an influence? |
| Magnitude | Was the magnitude or extent of the SF sufficient to have an influence? |
| Enhancers | Were there any events or conditions present that could increase or enhance the SF's influence? |
| Inhibitors | Were there any events or conditions present that could decrease or inhibit the SF's influence? |
| **For completeness** | |
| Other perspectives | What do experts and other parties believe are reasons for supporting or opposing the SF being a contributing factor? |

## Importance: Identify relevant items of evidence / reasons

| Risk | |
|---|---|
| Risk level | [For potential safety issues]<br>Is the risk level critical or significant?<br>If the potential safety issue was addressed, would the risk level change? |
| Risk-related aspects | [For factors that are not potential safety issues]<br>Does the SF indicate a potential problem with risk?<br>[This involves considering frequency, magnitude, applicability and other aspects.] |
| **General considerations** | |
| Relationship to change | Is the SF associated with the operation of a new system or process, or recent changes to the system? |
| Potential for learning | Will including this SF in the report's findings assist in highlighting something of safety benefit? |
| Completeness | Will including this SF in the report's findings provide useful context for other findings? |
| Consistency with other investigations | Has this type of SF been included in other investigation reports? If so, are there reasons to include it this time for consistency? |
| Scope | Is this SF within the broad scope or themes addressed by the investigation? |
| Other perspectives | What do experts and other parties believe are reasons for supporting or opposing the importance of the SF? |

# Importance justification field



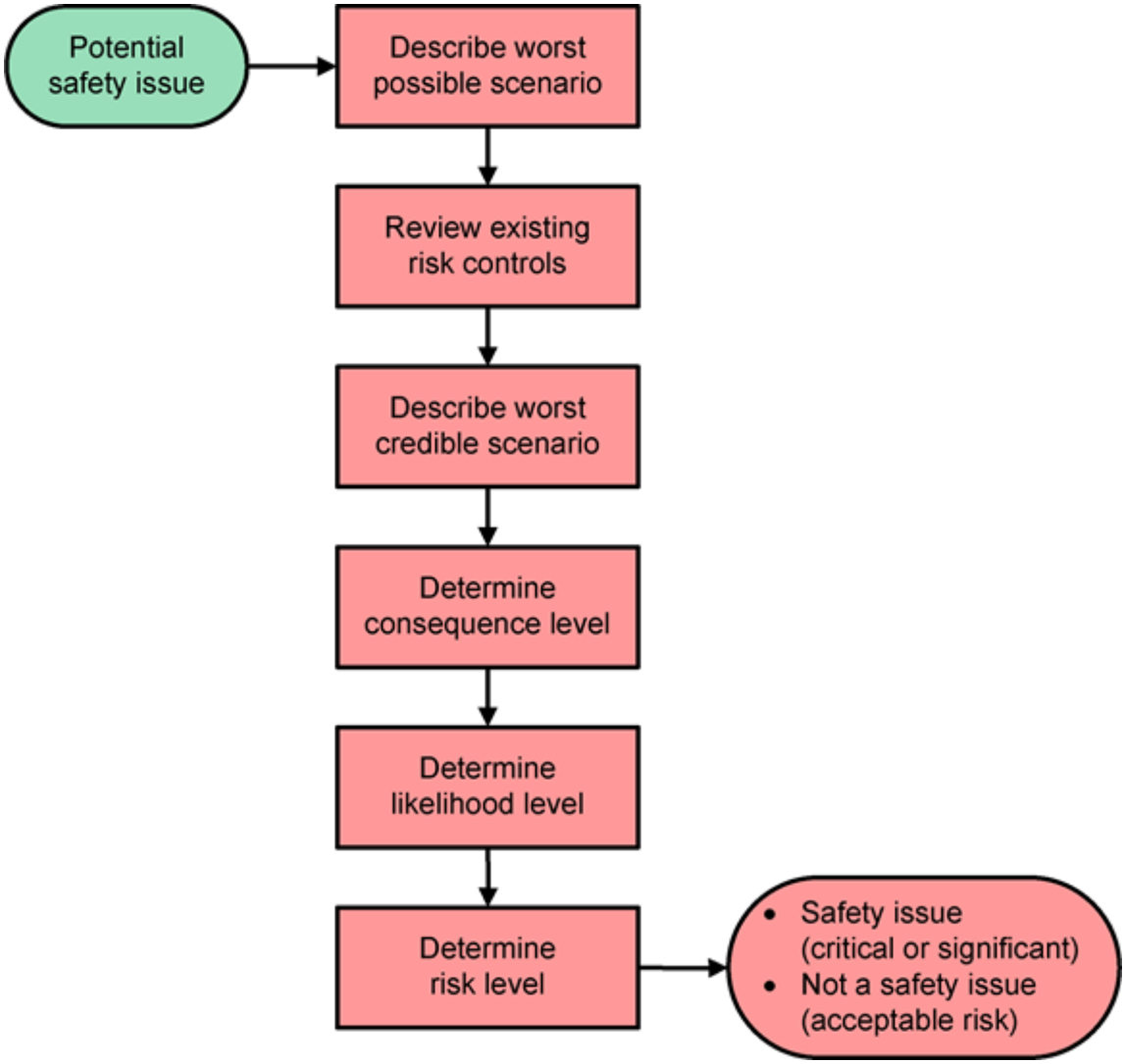
## Criteria for evaluating an item of evidence / reasons

| Essential considerations | |
|---|---|
| Relevance | Is the item of evidence / reason relevant? (So what?)<br>Does it make any difference whether the evidence is true or false?<br>Will our overall assessment of this hypothesis change if we delete this item of evidence / reason? |
| Credibility | Is the item of evidence / reason credible? (Can we believe it?)<br>Validity: Does the evidence represent what it is claimed to represent?<br>Reliability: To what extent is the evidence repeatable or consistent?<br>Bias: To what extent is there a potential for bias or a lack of objectivity?<br>Sensitivity: Is this type of evidence able to show important differences or changes?<br>Thoroughness: If we are discussing the absence of evidence, how extensive was the search for the evidence? |
| **Additional considerations** | |
| Other strengths | What are other strengths or benefits of the item of evidence / reason? |
| Other limitations | What are other limitations or weaknesses of the item of evidence / reason? |
| Other perspectives | What do experts and other parties believe are strengths and limitations of the item of evidence / reason? |
| Appropriateness | Are there good ethical reasons for not including the item of evidence / reason in the final report? |

## Criteria for evaluating a set of evidence / reasons

| | |
|---|---|
| **General considerations** | |
| All parts | Does the hypothesis have multiple parts? If so, have they all been addressed? |
| Assumptions | General: If we accept that the hypothesis was supported, what else do we need to assume? Are these assumptions realistic?<br>Existence: If we accept that the SF existed, what else do we need to assume? Are these assumptions realistic?<br>Influence: If we accept that the safety factor had an influence, what else do we need to assume? Are these assumptions realistic? |
| Consistency | To what extent are the items of evidence / reasons conflicting or in agreement? |
| Extent of support | What is the extent of the support for the sub-hypothesis?<br>Quantity: How many items of evidence / reasons support the hypothesis?<br>Strength: What is the relative strength of each of the supporting items of evidence / reasons?<br>Independence: To what extent are supporting items of evidence from different sources?<br>Convergence: To what extent is there converging evidence (i.e. different types of evidence)? |
| Extent of opposition | What is the extent of the opposition to the sub-hypothesis?<br>Quantity: How many items of evidence / reasons oppose the hypothesis?<br>Strength: What is the relative strength of each of the opposing items of evidence / reasons?<br>Independence: To what extent are opposing items of evidence from different sources?<br>Convergence: To what extent is there converging evidence (i.e. different types of evidence)?<br>Ability to account for opposition: Are there opposing items of evidence / reasons that cannot be easily explained? |
| **Additional considerations** | |
| Sufficiency | Is there sufficient justification to conclude that the sub-hypothesis is supported?<br>Does the hypothesis / finding need to be modified to better fit the available evidence / reasons? |
| Gross error check | Overall, does the finding make sense? |

# Risk analysis




**Hints for conducting risk analysis**

- Remember you are estimating the risk of the safety issue leading to the worst credible scenario (not the risk of the scenario itself).
- It is generally best to avoid using the worst possible scenario, as it is difficult to estimate likelihood for very rare events. One approach is to allow at least one risk control to fail.
- Likelihood consists of two components: exposure to the safety issue, and the probability that any specific exposure will result in the worst credible scenario.

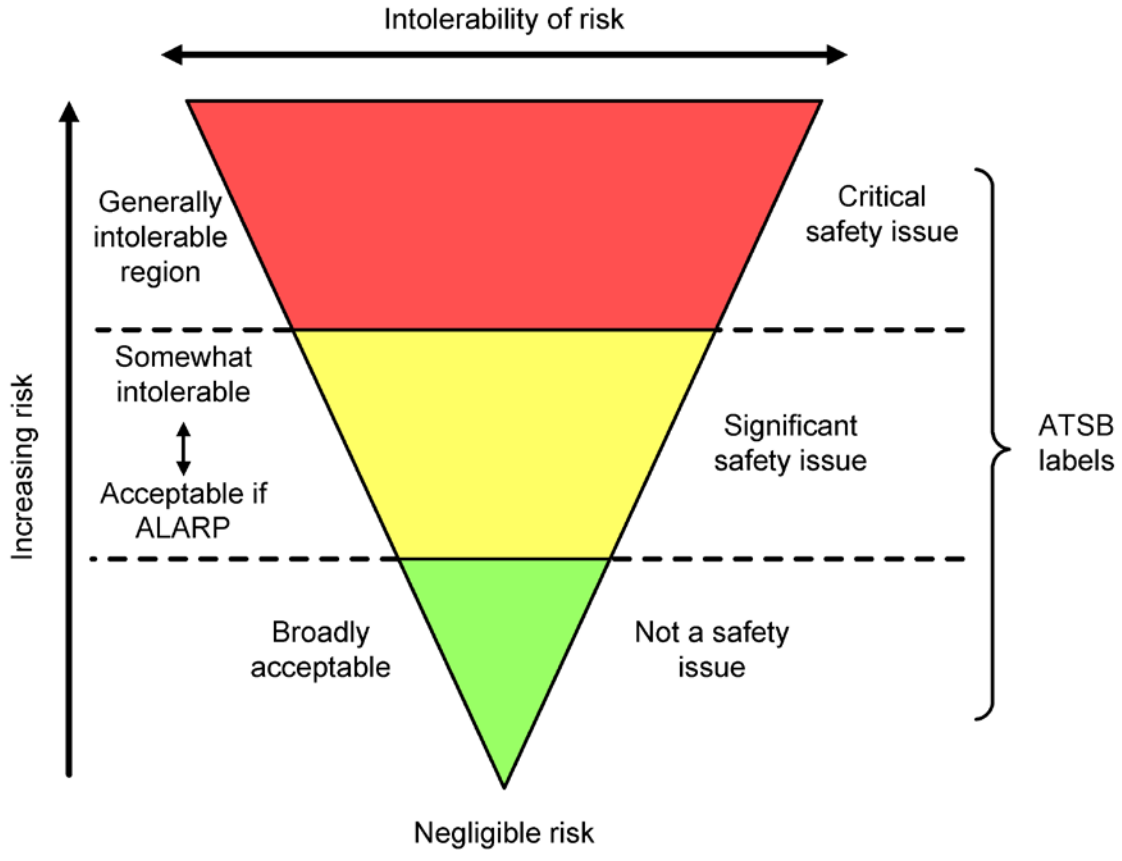
## Describing worst possible and worst credible scenarios

Describe:

- the key occurrence event(s)
- the level of adverse consequences associated with the scenario in general terms (e.g. multiple fatalities and aircraft destroyed, minor injuries)
- the types of events and conditions that must occur for the safety issue to result in these consequences.

## Reviewing existing risk controls

- Were there any risk controls or management processes that could have reduced the magnitude of the problems associated with the safety issue?
- Were there any risk controls or management processes that could have detected or corrected problems associated with the safety issue before they had an impact on operations?
- How effective were these additional risk controls or management processes?
- How reliable were these additional risk controls or management processes?
- To what extent were the different risk controls related? (If one control is dependent on another for its effectiveness, or both controls are able to be compromised by the same factor, it may be best to consider the two controls as one.)



# Consequence levels

| | Negligible (F) | Minor (E) | Major (D) | Hazardous (C) | Catastrophic (B) | Very large vehicle catastrophic (A) |
|---|---|---|---|---|---|---|
| Level 1 (passenger) activity.<br>• Fare-paying passenger operations;<br>• Other commercial transport operations that carry persons other than crew (i.e. EMS, commercial scenic flights);<br>• Corporate transport operations that carry employees. | | | | | | |
| >100 People | Little consequences on safety margins | No injuries or damage likely. Slight reduction in safety margins or functional capabilities | Minor injuries, occasional serious injury, physical distress to occupants (code as hazardous) | Serious or fatal injury to small proportion of occupants; major damage; Large reduction in safety margin | Fatalities to significant proportion of occupants; loss of vehicle; All safety margins lost | |
| 10-99 People | Little consequences on safety margins | No injuries or damage likely. Slight reduction in safety margins or functional capabilities | Minor injuries, occasional serious injury, physical distress to occupants | Serious or fatal injury to small proportion of occupants; major damage; Large reduction in safety margin | Fatalities to significant proportion of occupants; loss of vehicle; All safety margins lost | |
| <10 People | No injuries or damage likely. Slight reduction in safety margins or functional capabilities | Minor injuries, occasional serious injury, physical distress to occupants | Serious injury to small proportion of occupants; major damage; Large reduction in safety margin | Fatalities to a proportion of occupants; loss of vehicle; All safety margins lost | | |

| | Negligible (F) | Minor (E) | Major (D) | Hazardous (C) | Catastrophic (B) | Very large vehicle catastrophic (A) |
|---|---|---|---|---|---|---|
| Level 2 (work-related) activity.<br>• Freight operations;<br>• Agricultural/mustering aviation (including when done under Private CASA Regulations) and other aerial work aviation with no POB other than crew (including commercial test flights);<br>• All marine operations without fare-paying passengers;<br>• WH&S tasks (e.g. workers on ship, flight attendant tasks, track-side work). | | | | | | |
| >5 People | No injuries or damage likely. Slight reduction in safety margins or functional capabilities | Minor injuries, occasional serious injury, physical distress to occupants | Serious or fatal injury to small proportion of occupants; major damage; Large reduction in safety margin | Fatalities to significant proportion of occupants; loss of vehicle; All safety margins lost | | |
| 1-4 People | Minor injuries, physical distress to occupants | Serious injury; major damage; Large reduction in safety margin | Fatalities; loss of vehicle; All safety margins lost | | | |

| | Negligible (F) | Minor (E) | Major (D) | Hazardous (C) | Catastrophic (B) | Very large vehicle catastrophic (A) |
|---|---|---|---|---|---|---|
| Level 3 (private) activity:<br>• Private aviation (including amateur-built VH registration);<br>• Higher risk aviation with paying customers (parachutes, adventure flights/ Warbirds)<br>• Private marine vessels<br>• Road users | | | | | | |
| All | Serious injury; major damage; Large reduction in safety margin | Serious injury; major damage; Large reduction in safety margin | | | | |
| Level 4 (high risk private) activity:<br>• Sports (aerobatics) aviation (including VH), RA-Aus aeroplanes, gyrocopters, paragliders, hand glider, gliders;<br>• Other activities involving a significant amount of voluntary risk (eg. Private experimental). | | | | | | |
| All | Fatalities; loss of vehicle; All safety margins lost | | | | | |

| | Negligible (F) | Minor (E) | Major (D) | Hazardous (C) | Catastrophic (B) | Very large vehicle catastrophic (A) |
|---|---|---|---|---|---|---|
| Non-transport consequences | | | | | | |
| Environment | No environmental impact | Minimal environmental impact | Serious local medium-term | Long-term, either serious or widespread | Serious, widespread and long-term | Serious long-term impact of sensitive or world heritage environments |
| Property damage / economic costs | < $50,000 | > $50,000 | > $500,000 | > $5 million | > $50 million | > $500 million |
| Public confidence | No public confidence impact | Minor public concerns in safety of transport mode. Loss of confidence in single operator. | Localised loss of public confidence in safety of transport mode | Widespread and short-term loss of public confidence in safety of transport mode | Widespread and short-term loss of public confidence in safety of transport mode | Widespread and long-term loss of public confidence in safety of transport mode |

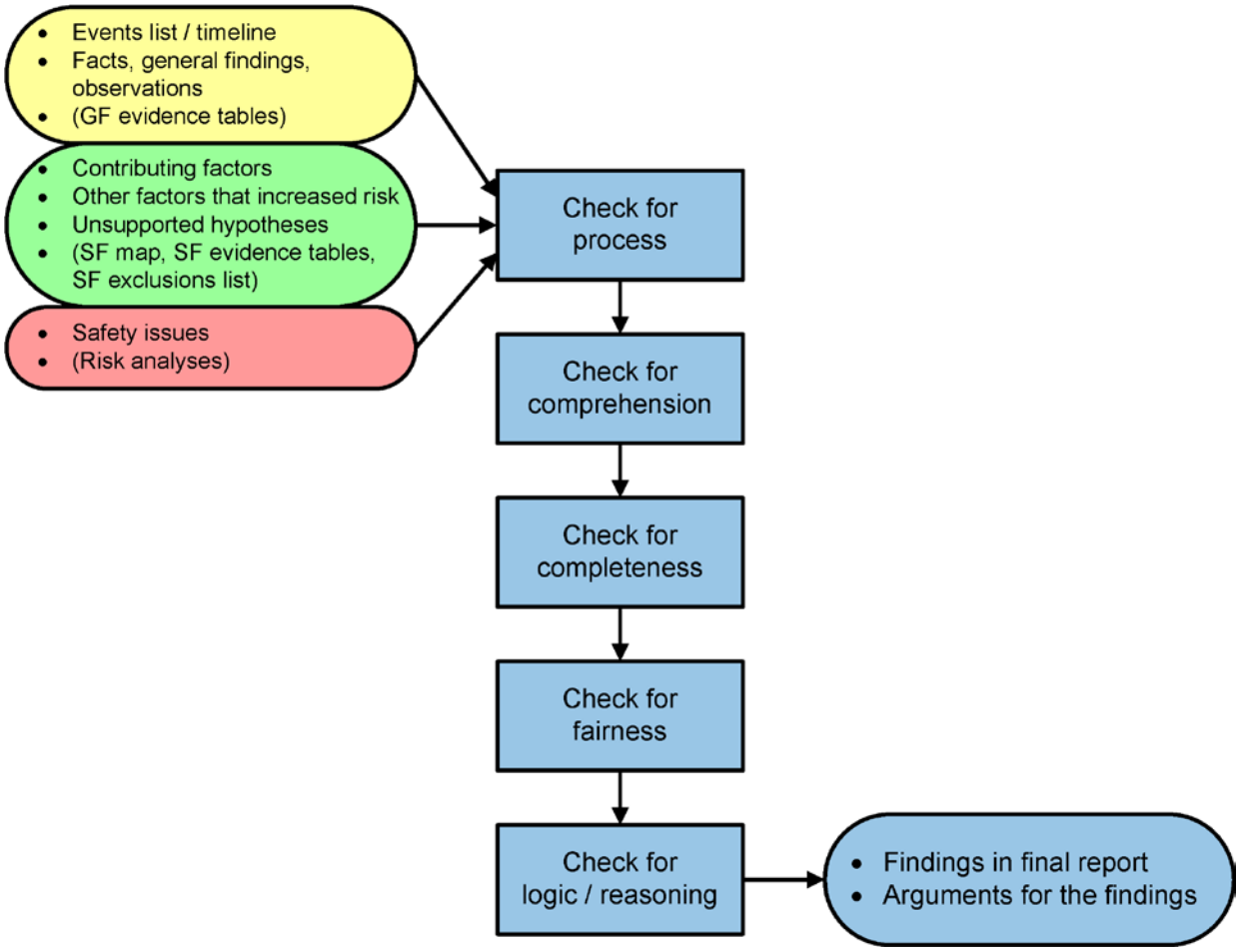
# Likelihood levels

| Level | Descriptor | Description | Indicative likelihood (exposure x frequency) |
|---|---|---|---|
| 6 | Very frequent | Very likely to occur many times (occurring all the time) | At least 10 times a year |
| 5 | Frequent | Likely to occur many times (has occurred frequently) | At least once a year |
| 4 | Occasional | Likely to occur sometimes (has occurred infrequently) | At least once every 10 years |
| 3 | Remote | Unlikely to occur but possible (has occurred rarely) | At least once every 100 years |
| 2 | Improbable | Very unlikely to occur (not know to have occurred). For example, may occur a few times during the entire operations life of all vehicles of one type or in one fleet. | At least once every 1,000 years |
| 1 | Extremely improbable | Almost inconceivable that the event will occur. For example, not expected to ever occur during the entire operational life of all vehicles of one type or in one fleet. | Virtually never |

## Risk levels

| LIKELIHOOD \ CONSEQUENCES | Negligible | Minor | Major | Hazardous | Catastrophic | Very large vehicle catastrophic |
|---|---|---|---|---|---|---|
| Very frequent | 6F | 6E | 6D | 6C | 6B | 6A |
| Frequent | 5F | 5E | 5D | 5C | 5B | 5A |
| Occasional | 4F | 4E | 4D | 4C | 4B | 4A |
| Remote | 3F | 3E | 3D | 3C | 3B | 3A |
| Improbable | 2F | 2E | 2D | 2C | 2B | 2A |
| Extremely improbable | 1F | 1E | 1D | 1C | 1B | 1A |

# Analysis review




## Check for process

- Are all the required forms and tools complete and up to date? In particular:
  - event list / timeline
  - SF map
  - SF evidence tables
  - SF exclusions list
  - risk analyses (where required).
- Have all relevant team members been involved in relvant parts of the analysis process?

## Check for comprehension

- Does each safety factor as written make sense?
- Is the safety-related problem in each safety factor finding easy to understand?
- Is each finding written in a manner consistent with the ATSB criteria?
- Could any of the findings be reorganised, combined or decombined to provide a better description of the problem(s)?
- Are the findings presented in a logical order?
- Do the findings for each theme or topic make sense when read together?
- Does the overall set of findings make sense?
- Do any findings appear to contradict any of the other findings?

## Check for completeness

- Have we missed anything?
- Has the occurrence been adequately explained?
- Have each of the important safety factors been adequately explained? If not, is an explanation reasonably able to be found?
- Is there something that played an important role but has not been included?
- Given the priority and profile of the investigation, are the findings sufficient?
- Has the investigation identified factors that can enhance safety?
- Is a good safety message able to be derived from the findings?
- Can other personnel / organisations learn from these findings?
- Have safety factor findings been written in a manner consistent with previous ATSB reports that have dealt with similar factors? If not, are these differences able to be justified?
- Are there findings in external investigation reports about this occurrence that have not been included? Are these omissions justifiable?

## Check for fairness

- For findings about individual actions:
  - Do the findings appear to be allocating blame to an individual? Can the language be made less pejoratively and the finding have the same safety value?
  - Have we been fair to each of the individuals?
  - Have safety factors associated with individuals been placed in relevant context? That is, have we also included explanations for such actions?
- For findings about risk controls or organisational influences:
  - Do the findings appear to be allocating blame to the organisation? Can the language be made less pejoratively and the finding have the same safety value?
  - Have we been fair to each of the organisations?
  - Have safety factors associated with organisations been placed in relevant context?
  - Has the investigation considered practicability when making findings about organisations?

## Check for logic / reasoning

- Does each SF evidence table include relevant supporting and opposing evidence / reasons?
- Are the overall arguments (for existence, influence and/or importance) able to be understood?
- Are the overall arguments (for existence, influence and/or importance) sufficient to support each SF finding?
- Is the description of each finding consistent with the presented evidence / reasons?
- Has sufficient justification been provided for SF hypotheses that are unsupported or excluded?
- Does the risk analysis for each safety issue (and each finding that looks like a safety issue) provide sufficient justification of the risk level?

**Australian Transport Safety Bureau**

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