Australian Government
Australian Transport Safety Bureau

Human Factors Investigation at the ATSB

Mike Walker

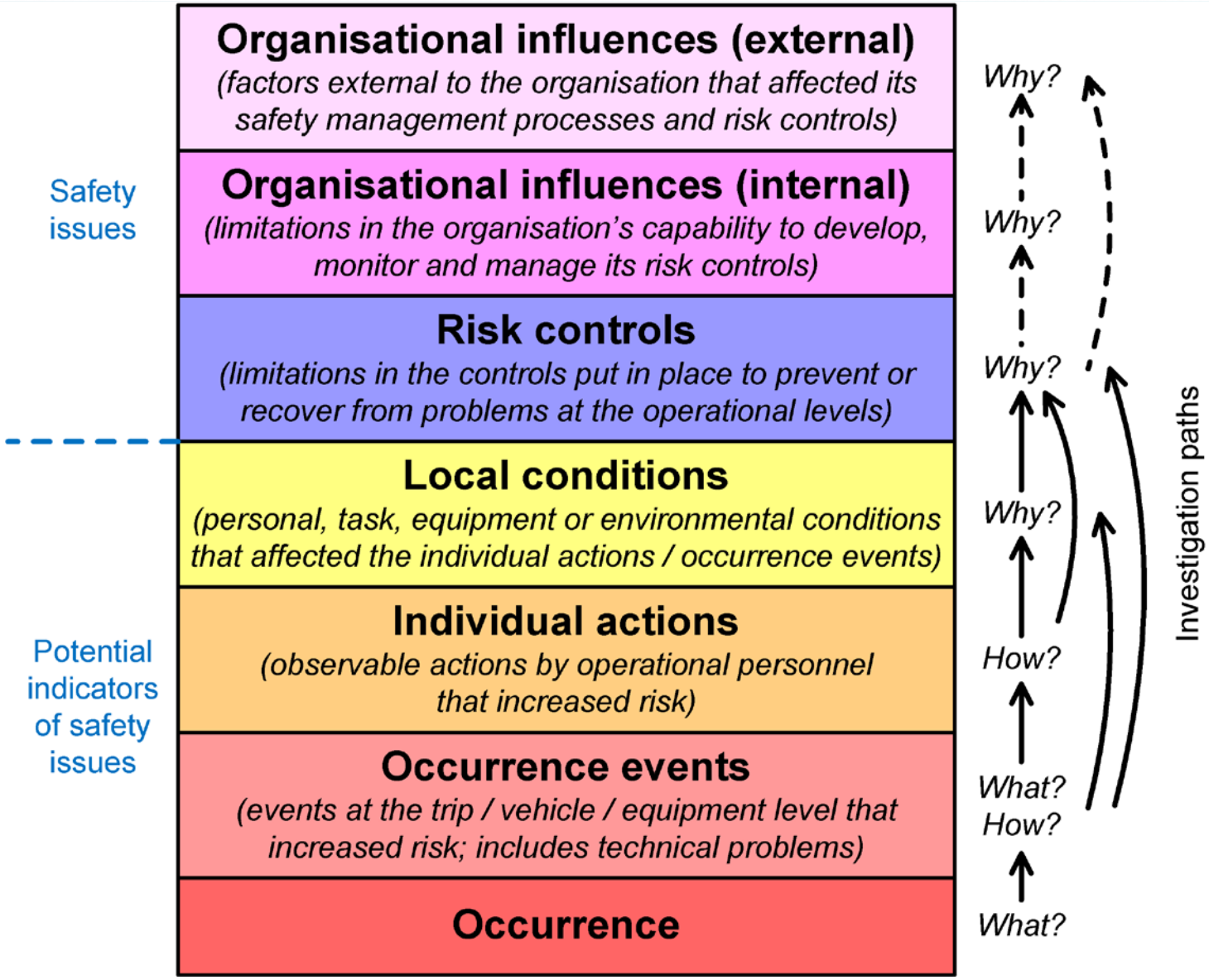
Australia's national transport safety investigator

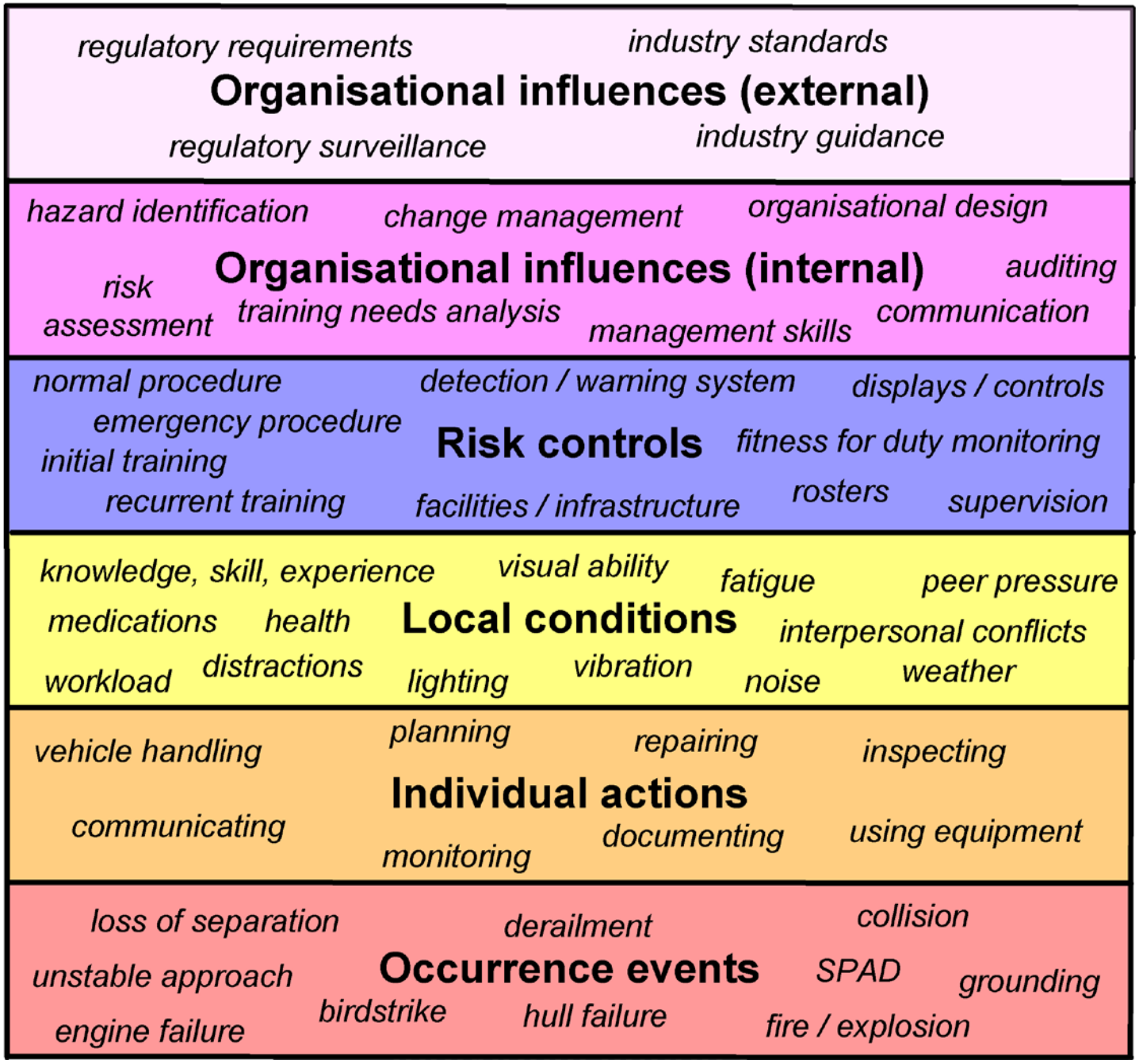
AVIATION | MARINE | RAIL

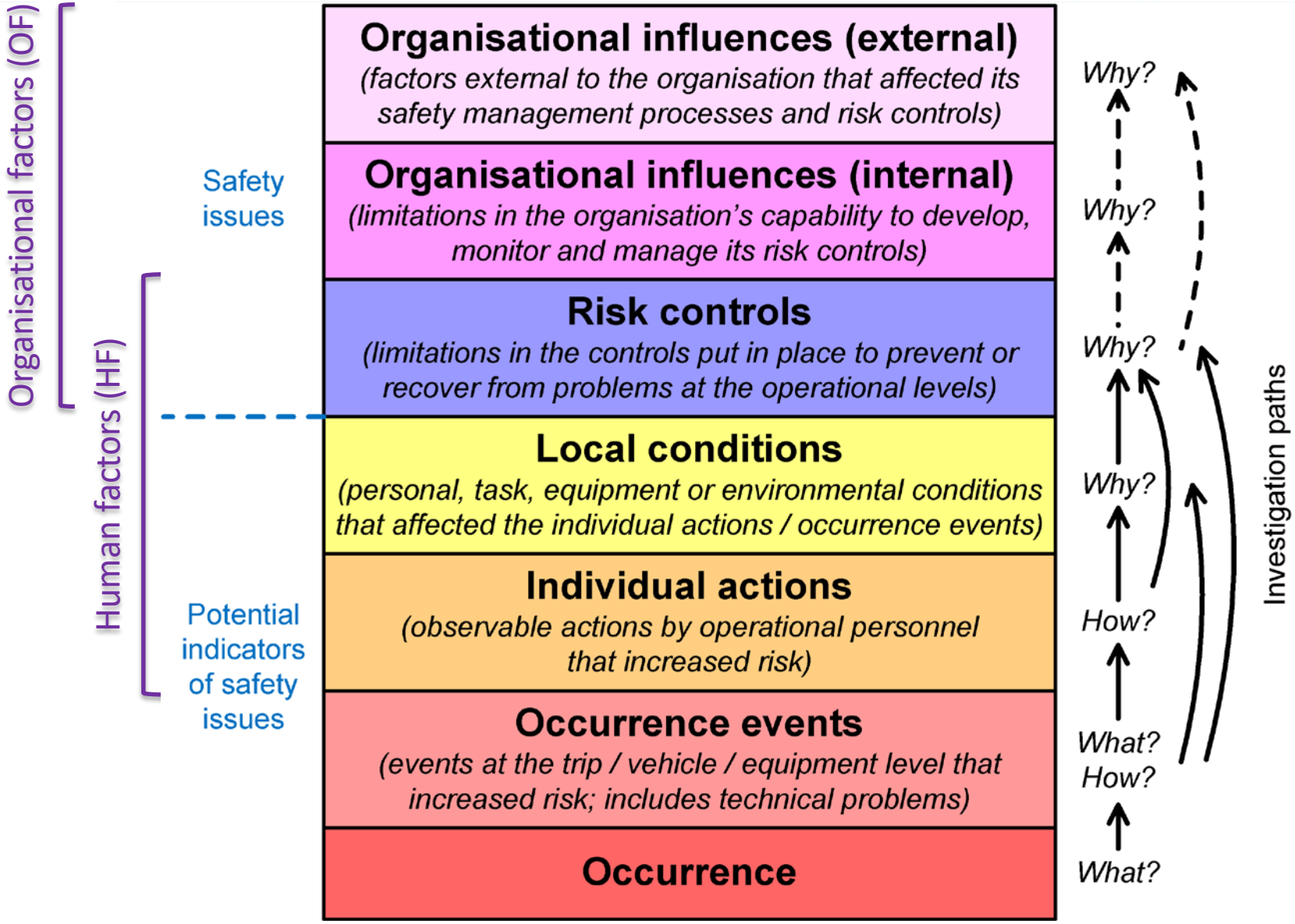
www.atsb.gov.au

Human factors (HF)

- Aims to improve the interaction between people and their work environment in order to enhance safety, system performance and well-being
- Involves considering many aspects – cognitive, task, physiological, emotional, social, environmental, …
- Overlaps with (but different to) the study of organisational factors (OF)


Organisational influences (external)
(factors external to the organisation that affected its safety management processes and risk controls)
Organisational influences (internal)
(limitations in the organisation's capability to develop, monitor and manage its risk controls)
Risk controls
(limitations in the controls put in place to prevent or recover from problems at the operational levels)
Local conditions
(personal, task, equipment or environmental conditions that affected the individual actions / occurrence events)
Individual actions
(observable actions by operational personnel that increased risk)
Occurrence events
(events at the trip / vehicle / equipment level that increased risk; includes technical problems)
Occurrence
Safety issues
Potential indicators of safety issues
Why?
Why?
Why?
Why?
How?
What?
How?
What?
Investigation paths


regulatory requirements
industry standards
Organisational influences (external)
regulatory surveillance
industry guidance
hazard identification
change management
organisational design
Organisational influences (internal)
auditing
risk assessment
training needs analysis
management skills
communication
normal procedure
detection / warning system
displays / controls
emergency procedure
Risk controls
fitness for duty monitoring
initial training
recurrent training
facilities / infrastructure
rosters
supervision
knowledge, skill, experience
visual ability
fatigue
peer pressure
medications
health
Local conditions
interpersonal conflicts
workload
distractions
lighting
vibration
noise
weather
vehicle handling
planning
repairing
inspecting
Individual actions
communicating
documenting
using equipment
monitoring
loss of separation
derailment
collision
unstable approach
Occurrence events
SPAD
grounding
birdstrike
hull failure
fire / explosion
engine failure


Organisational factors (OF)
Human factors (HF)
Safety issues
Potential indicators of safety issues
Organisational influences (external)
(factors external to the organisation that affected its safety management processes and risk controls)
Organisational influences (internal)
(limitations in the organisation's capability to develop, monitor and manage its risk controls)
Risk controls
(limitations in the controls put in place to prevent or recover from problems at the operational levels)
Local conditions
(personal, task, equipment or environmental conditions that affected the individual actions / occurrence events)
Individual actions
(observable actions by operational personnel that increased risk)
Occurrence events
(events at the trip / vehicle / equipment level that increased risk; includes technical problems)
Occurrence
Why?
Why?
Why?
Why?
How?
What?
How?
What?
Investigation paths

HF investigation

- Applies human factors knowledge, principles and methods to the investigation of accidents and incidents
- Seeks to explain the individual actions that increased risk
- Needs to be integrated with investigation of operational / technical factors
- Provides a different perspective
- Does not involve dream analysis, counselling, séances, or anything you see on TV shows like the *The Mentalist*

Who should do HF investigation?

- Domain investigator + HF investigator = best outcome
- Every trained investigator should be able to collect basic HF information
- For major investigations, or when there are significant HF aspects: HF investigator should be part of team as early as possible
- When there are potential HF findings: HF investigator should be involved in analysis and write-up of HF information

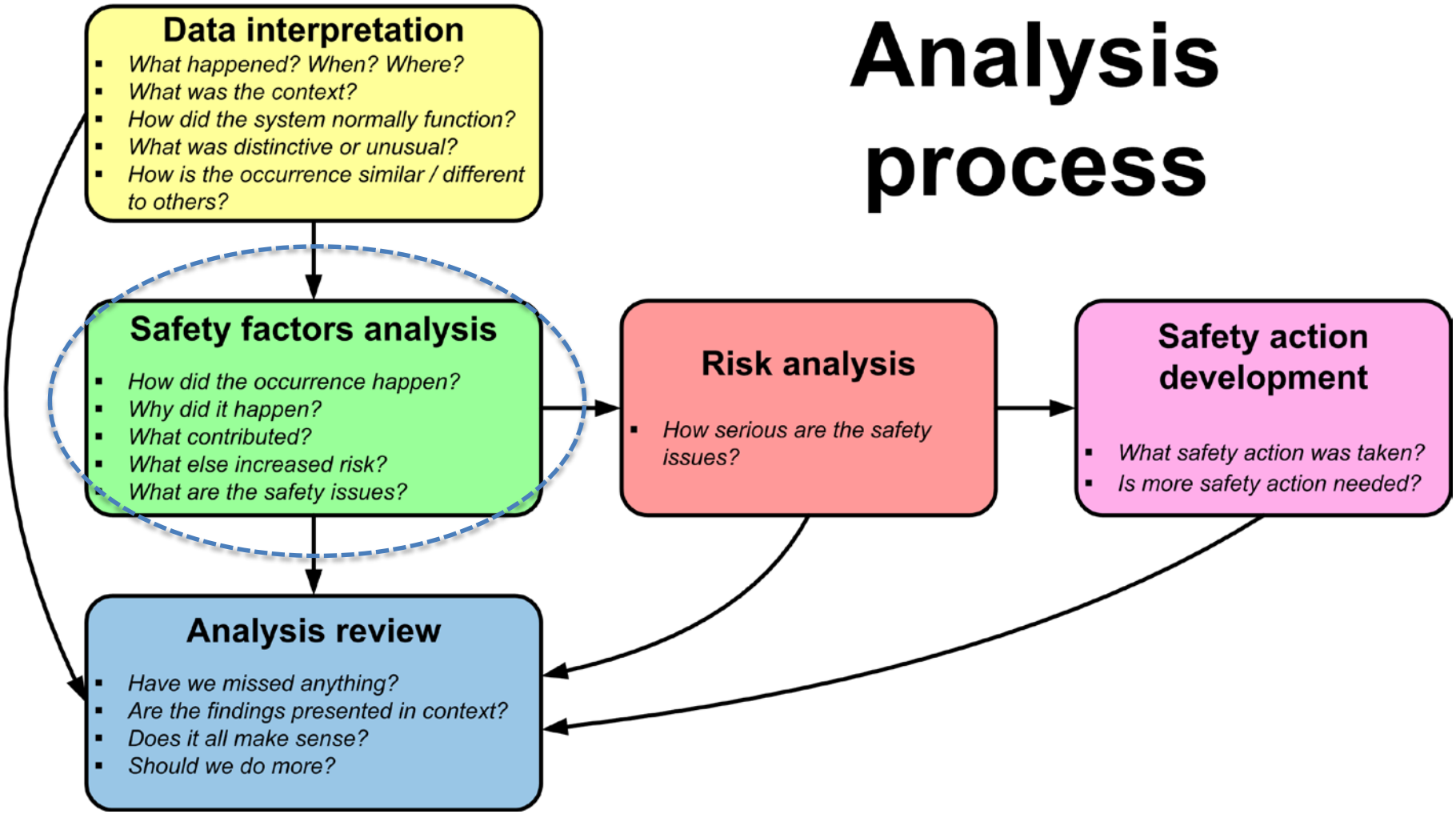
ATSB HF investigators

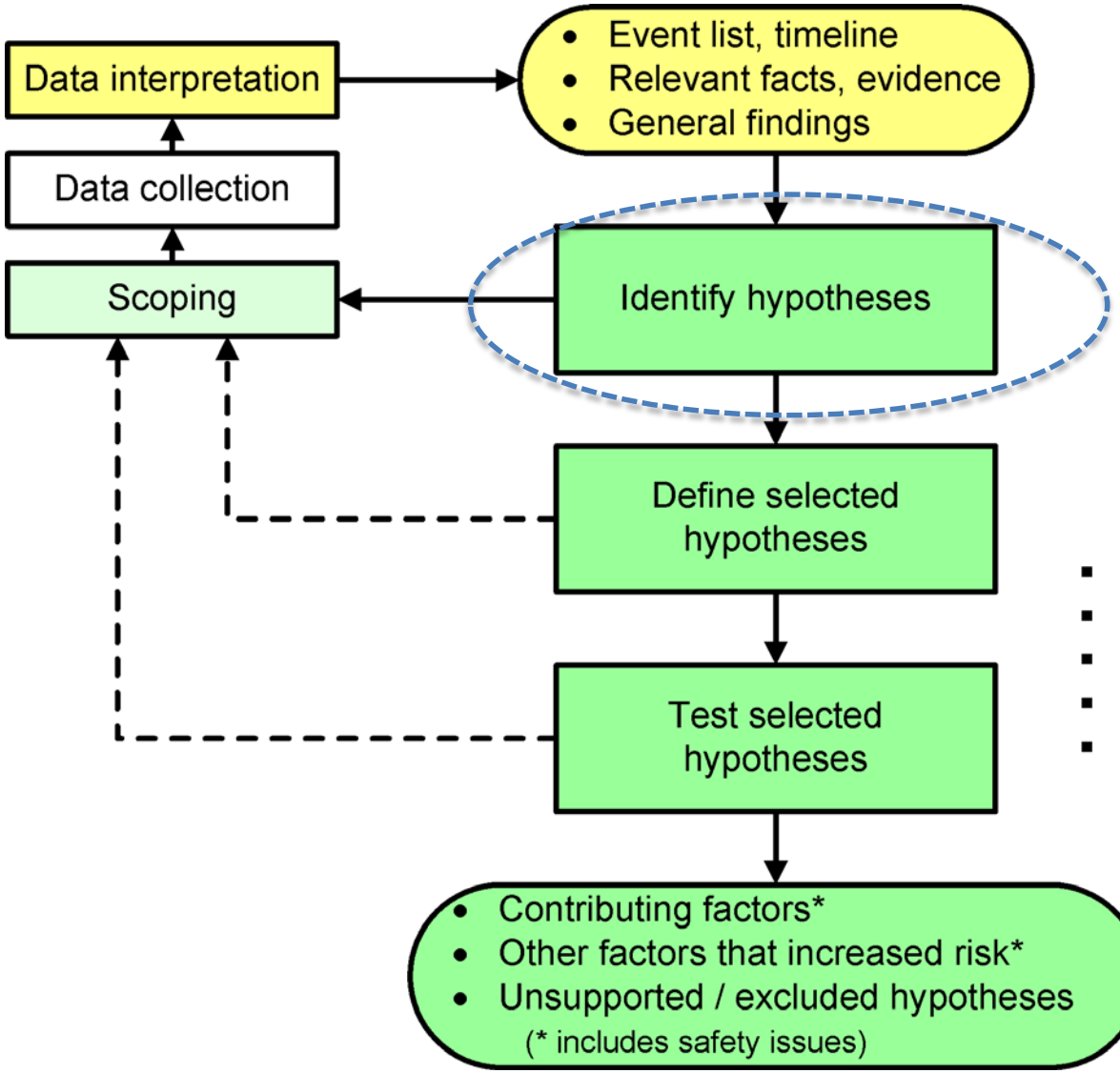
- 5 HF investigators (+3 in management roles)
- Distributed throughout 8 investigation teams
- Variety of skills and backgrounds
- Work on aviation, marine, rail investigations
- Can be IIC, team member, reviewer
- Often involved in training, research, other projects

HF analysis

- Need a structured, systematic method to conduct analysis of evidence
  - definitions of key terms
  - a model of accident development
  - defined process for identifying and testing hypotheses
  - guidance, tools
  - policies, management support

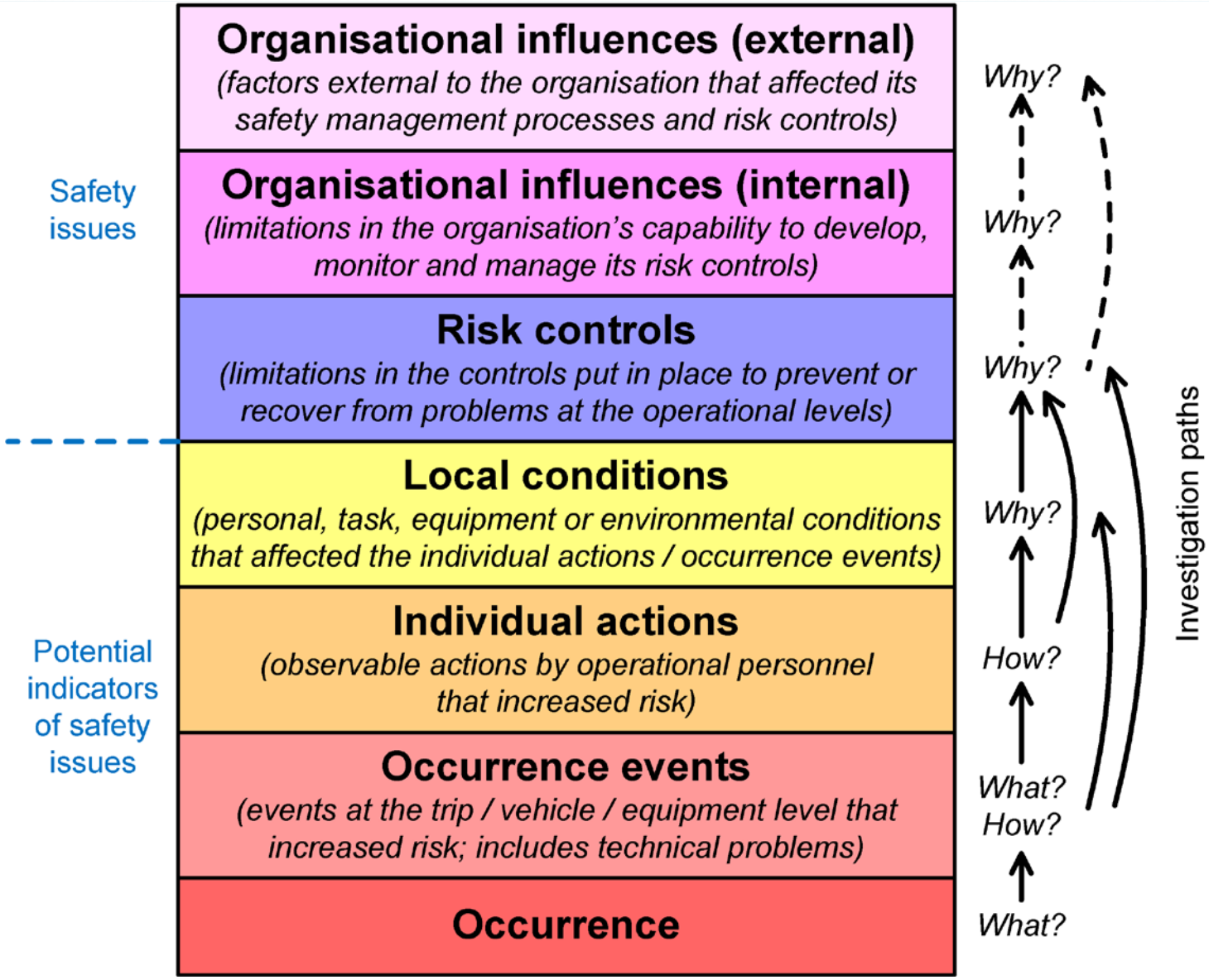
Analysis process





Safety factors analysis

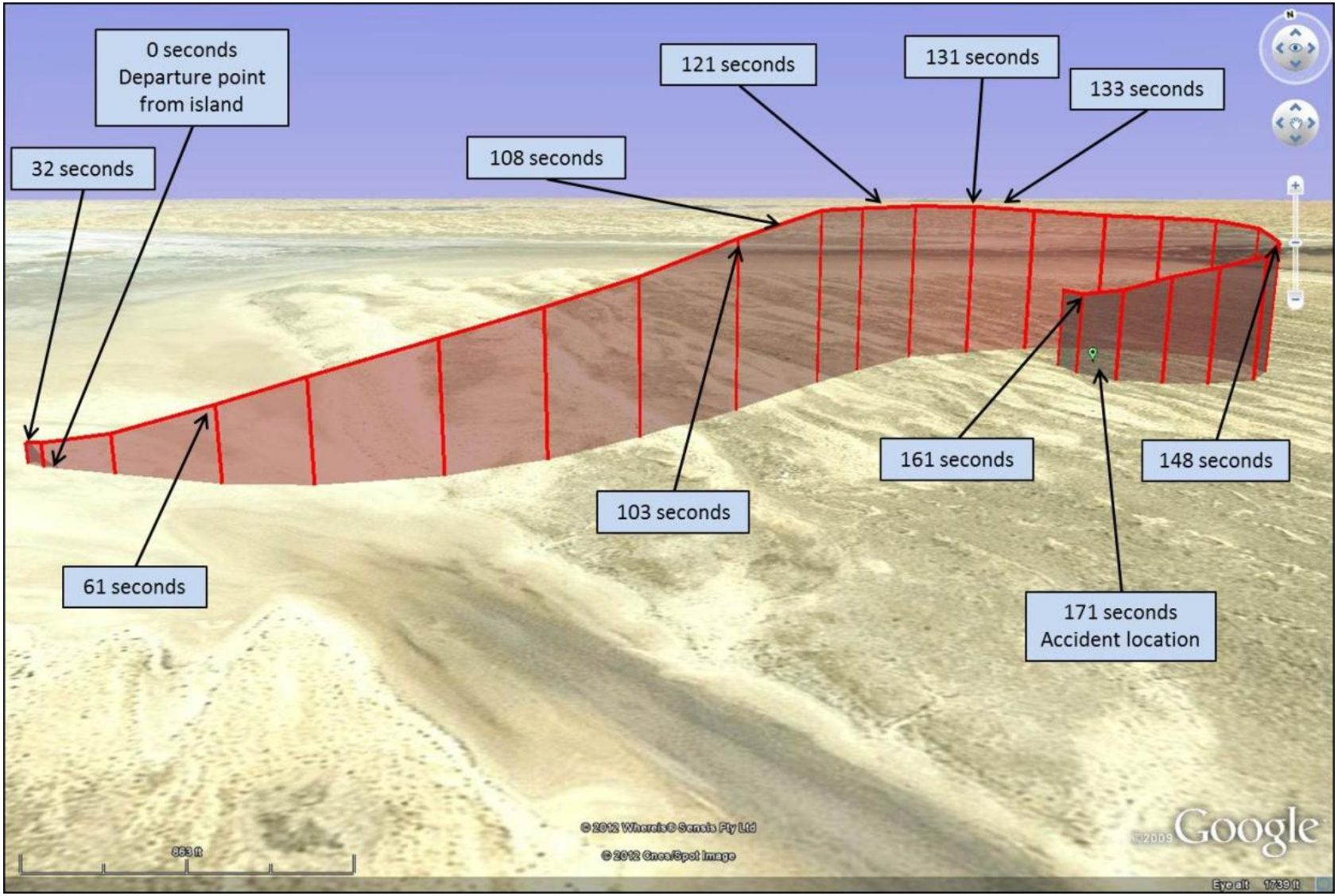
- *How did the occurrence happen?*
- *Why did it happen?*
- *What contributed?*
- *What else increased risk?*
- *What are the safety issues?*

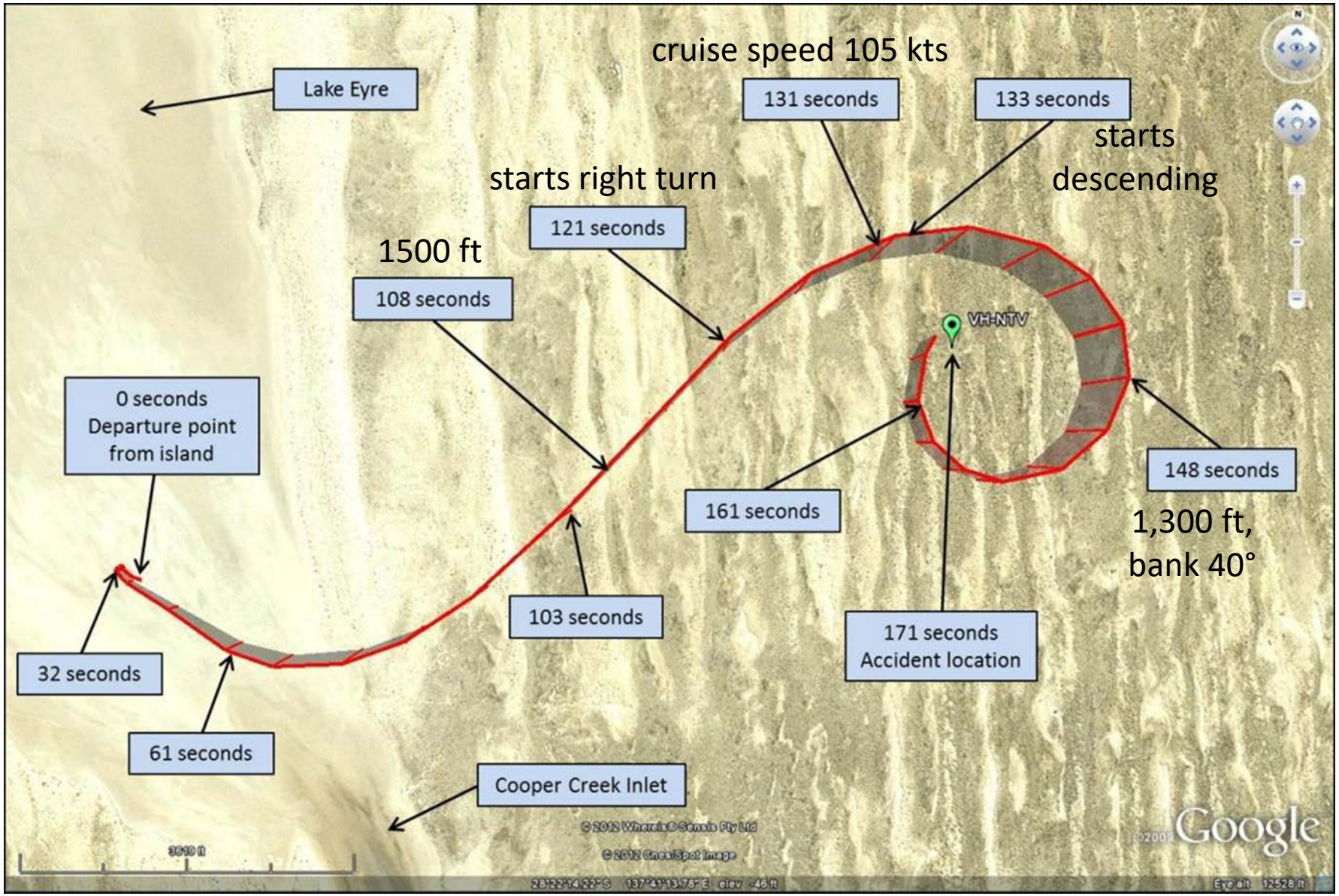

Organisational influences (external)
(factors external to the organisation that affected its safety management processes and risk controls)
Organisational influences (internal)
(limitations in the organisation's capability to develop, monitor and manage its risk controls)
Risk controls
(limitations in the controls put in place to prevent or recover from problems at the operational levels)
Local conditions
(personal, task, equipment or environmental conditions that affected the individual actions / occurrence events)
Individual actions
(observable actions by operational personnel that increased risk)
Occurrence events
(events at the trip / vehicle / equipment level that increased risk; includes technical problems)
Occurrence
Safety issues
Potential indicators of safety issues
Why?
Why?
Why?
Why?
How?
What?
How?
What?
Investigation paths

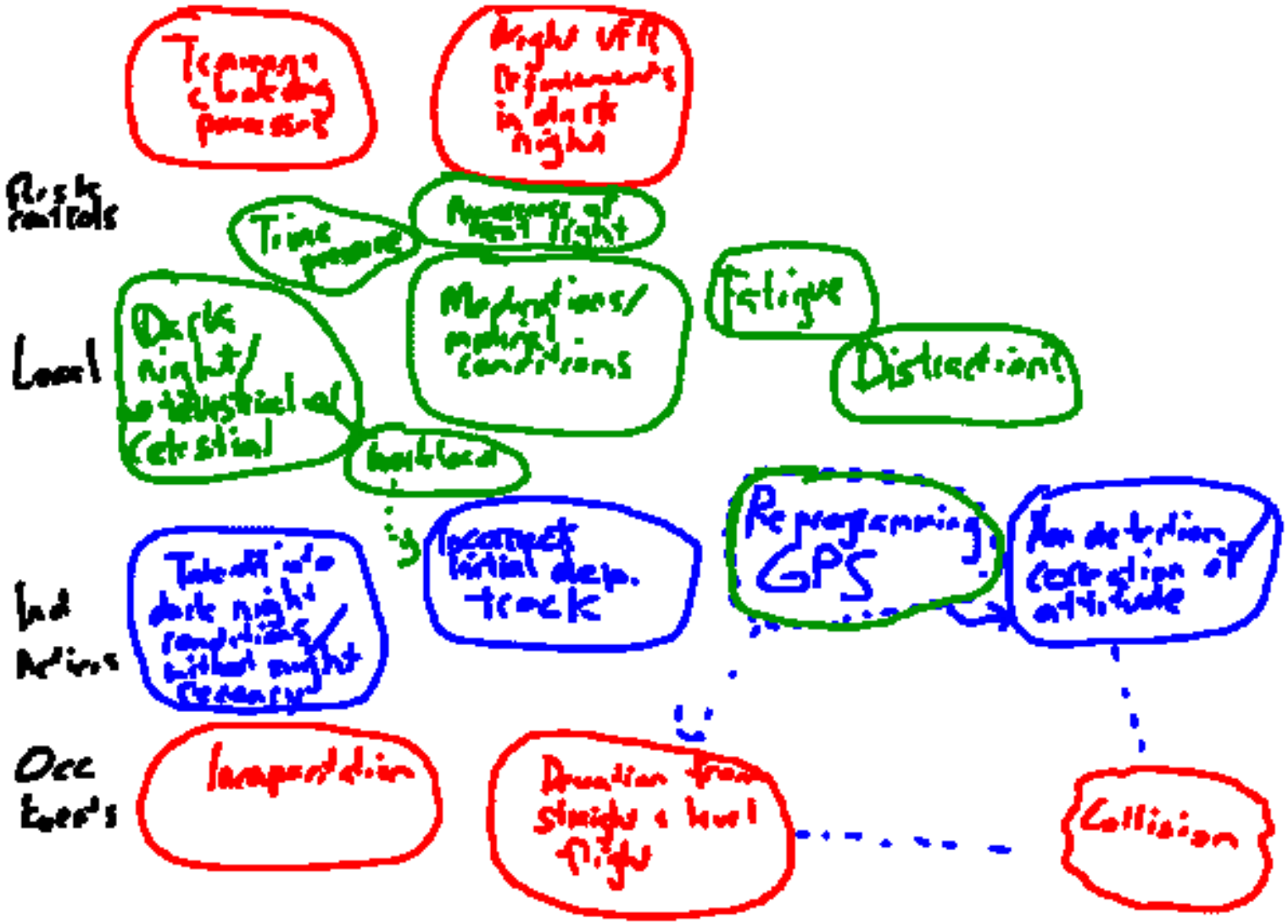
Sample questions

- *Why did the action make sense to the person at the time?*
- *What aspects of the local context made it difficult to perform tasks effectively?*
- *What was the 'error type'? What factors are commonly associated with this error type and were potentially relevant this time?*
- *What local conditions were unusual (compared to normal operations)?*
- *What local conditions changed in the period prior to when the action occurred?*
- *Would other individuals in the same type of situation perform the same way?*
  - *Yes: what task / environmental / system conditions make us think this?*
  - *No: what differences between this individual and others make us think this?*

VH-NTV, AS355
18 Aug 2011
VFR at night
3 POB


0 seconds
Departure point
from island
32 seconds
61 seconds
108 seconds
121 seconds
131 seconds
133 seconds
103 seconds
161 seconds
148 seconds
171 seconds
Accident location
© 2012 Whereis® Sensis Pty Ltd
© 2012 Cnes/Spot Image
Google
863 ft
Eye alt 1739 ft


cruise speed 105 kts
Lake Eyre
131 seconds
133 seconds
starts descending
starts right turn
121 seconds
1500 ft
108 seconds
VH-NTV
0 seconds
Departure point
from island
148 seconds
161 seconds
1,300 ft,
bank 40°
103 seconds
171 seconds
Accident location
32 seconds
61 seconds
Cooper Creek Inlet
Google


Risk controls
Level
Ind Actions
Occ Events
Fatigue
Distraction?
Reprogramming GPS
Collision

AO-2011-102, VH-NTV

External org influences

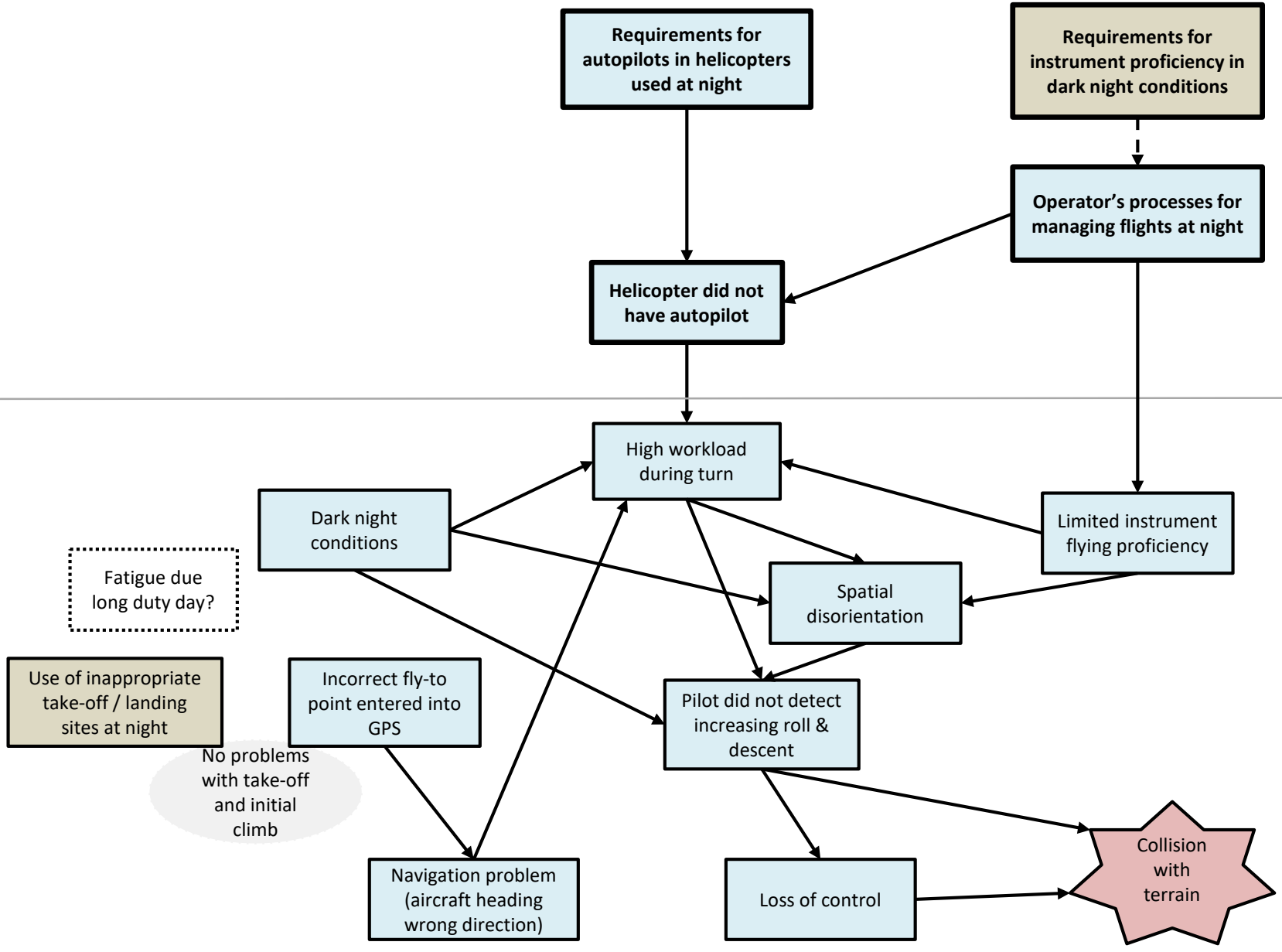
Internal org influences

Risk controls

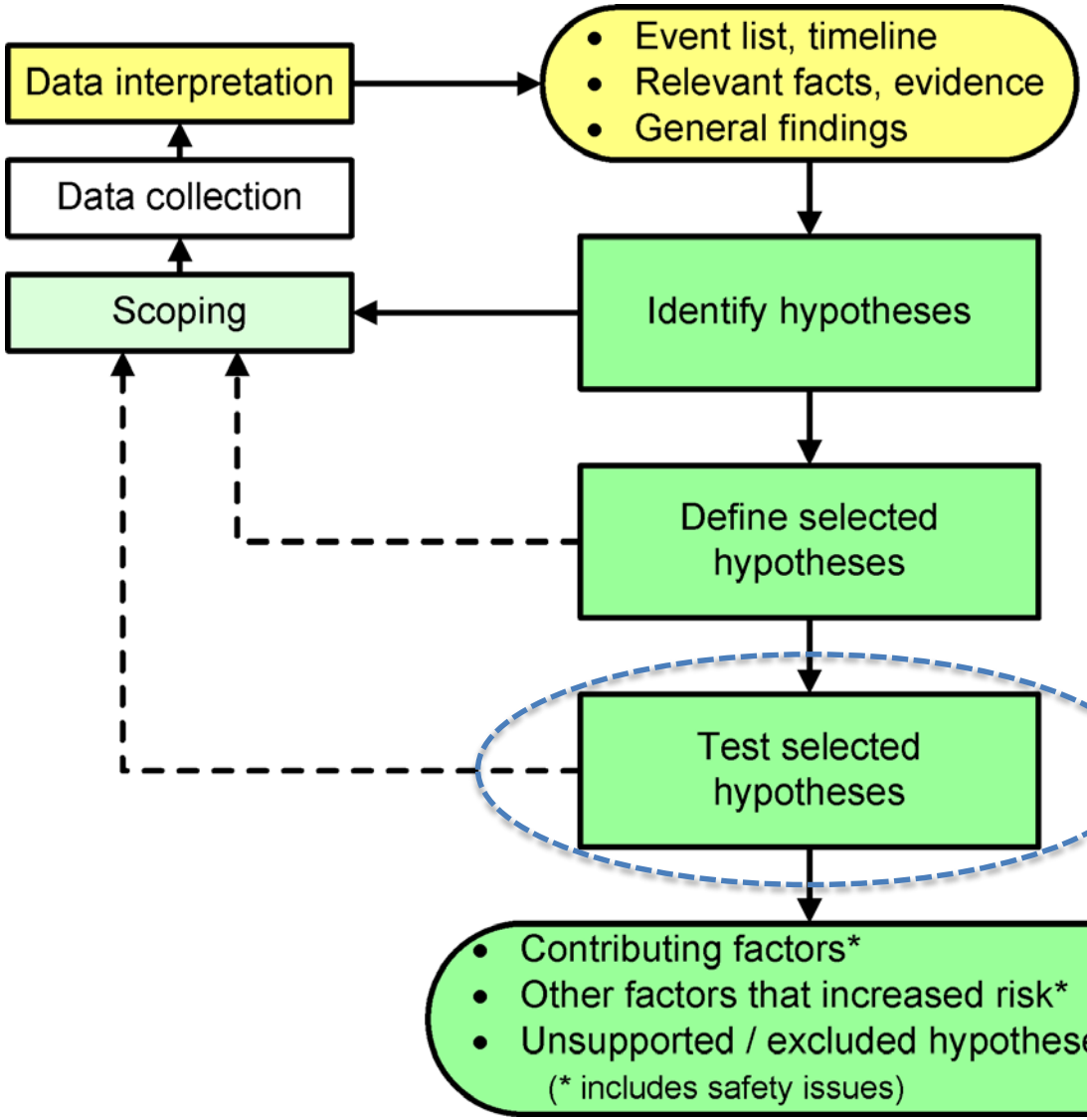
Local conditions

Ind. actions

Occurrence events

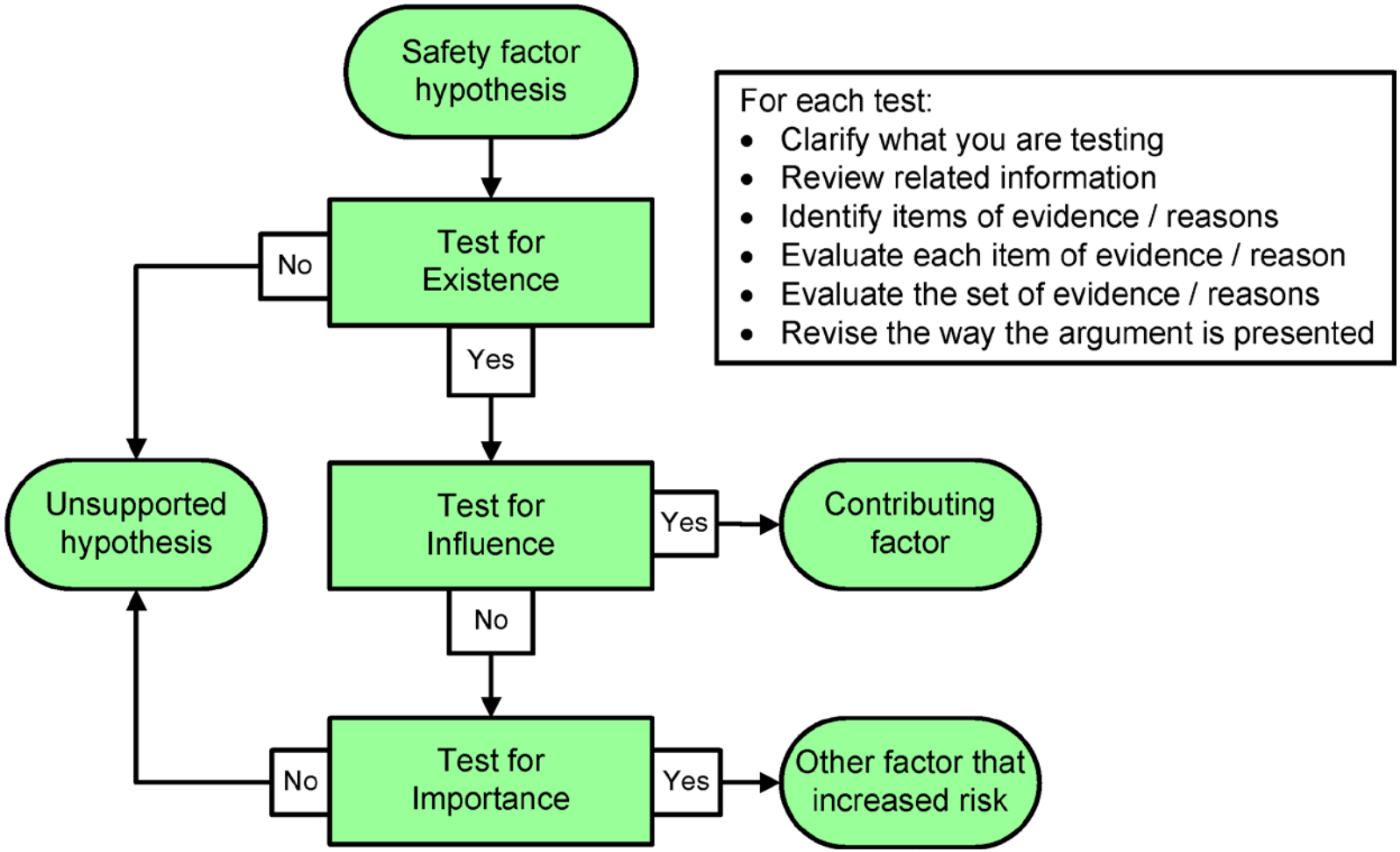


Safety factors analysis



- *How did the occurrence happen?*
- *Why did it happen?*
- *What contributed?*
- *What else increased risk?*
- *What are the safety issues?*

Testing a safety factor hypothesis



AO-2011-102, VH-NTV

External org influences

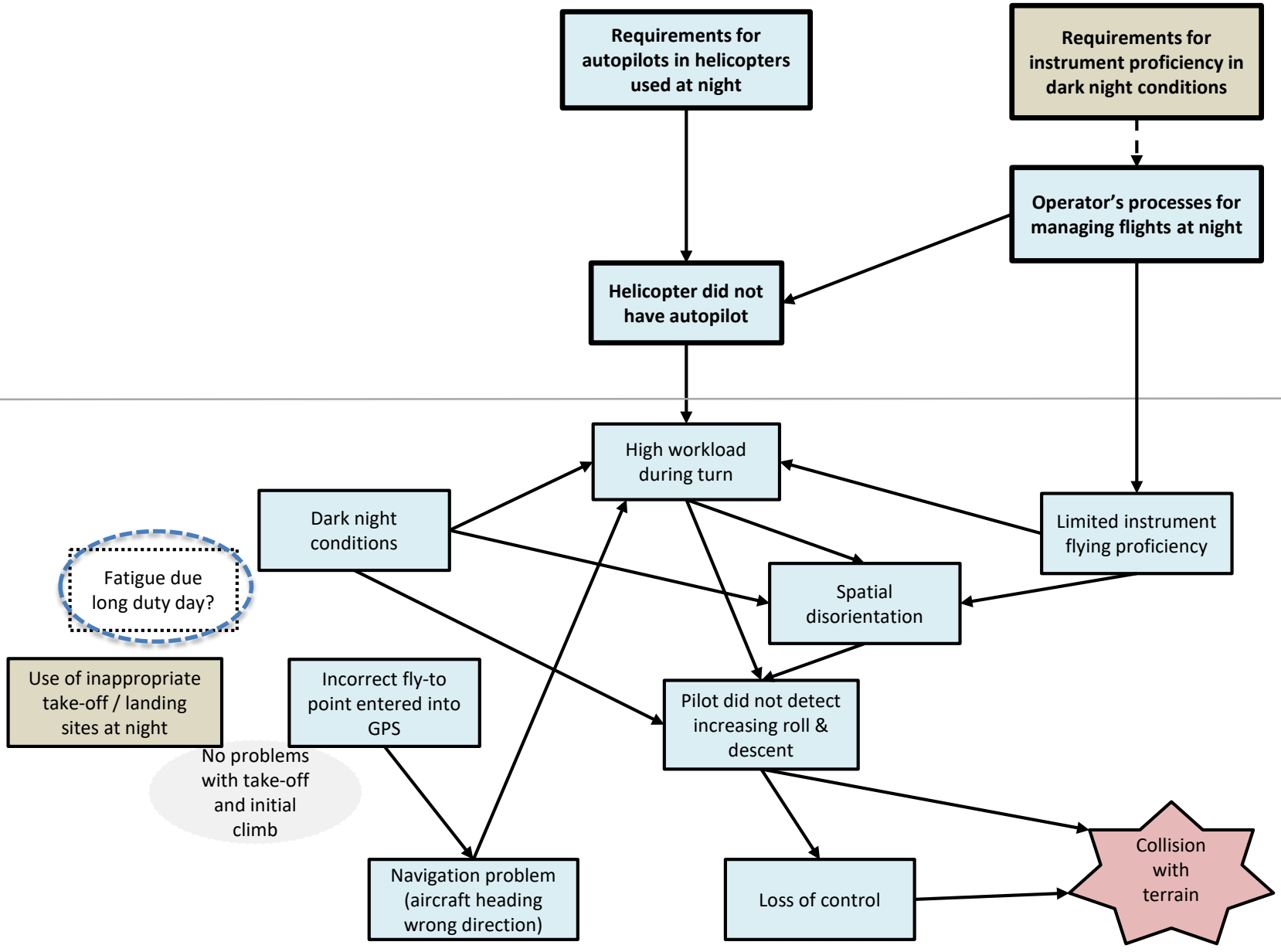
Internal org influences

Risk controls

Local conditions

Ind. actions

Occurrence events



Safety factor hypothesis	The pilot was experiencing a level of fatigue that has been demonstrated to have an influence on performance.

Evidence / reason	Strengths / limitations	Rating
Long duty day, first flight starting 0716 with 8 flights (4.3 hours flight time). Previous day 5 flights and 7.5 hours flight time, ending 1637.	Based on GPS. Regular short breaks on day of accident, including prior to accident flight. Flying conditions were not problematic for previous flights.	Supports
8 hours + sleep opportunity night before; at least 7 hours sleep previous night and normal (8 hours, well) nights before that.	Exact sleep in last 24 hours unknown. Sleep for previous nights reported by partner.	Opposes
No-one reported noticing any problems with pilot's health or behaviour.	Pilot interacted with many people, including just prior to accident flight. All reports consistent. Ability to detect fatigue would be limited.	Opposes
Accident at 1900; had been awake at least 12.5 hours.	Time of day not that significant; time awake a concern but not excessive.	No effect

Overall evaluation	No other exacerbating factors. Long duty day is a concern. However, without evidence of affected sleep or high workload with the flights it is difficult to conclude the pilot was experiencing a sufficient level of fatigue.
Existence?	No

AO-2011-102, VH-NTV

External org influences

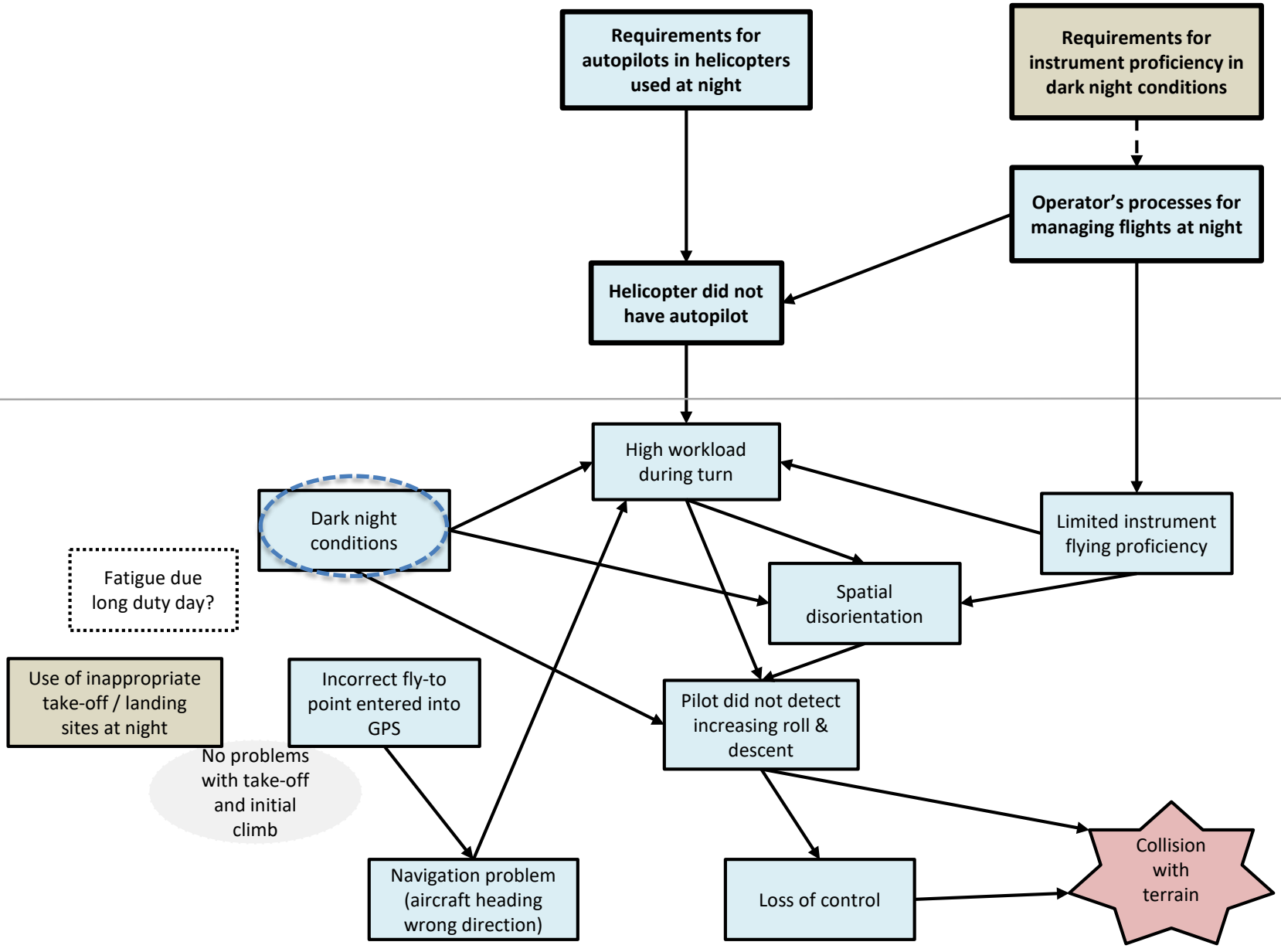
Internal org influences

Risk controls

Local conditions

Ind. actions

Occurrence events



Safety factor hypothesis	The flight was conducted in dark night conditions, with no visible horizon and minimal celestial and terrestrial lighting.

Evidence / reason	Strengths / limitations	Rating
Some witness reported being able to see some terrain features and the horizon.	Others reported it being dark. May be due to starlight and well adapted. Maybe recalling earlier in night.	Opposes
Geoscience states nautical twilight 1850, astronomical twilight 1917 (accident was 1902).	Very reliable. Means 'it is dark for practical purposes'.	Strongly supports
Geoscience states moon rise 2158.	Very reliable; therefore no celestial lighting. Confirmed by witnesses.	Supports
Witnesses reported no terrestrial light sources in area (other than their camp fire).	Reports all consistent. Confirmed by other sources and visit to the area.	Supports
Ability for dark adaptation reduced due exposure to cockpit lighting, landing lights, and pilot was 60 years old.	Effects of lighting confirmed by reference sources / experienced pilots. Effects of age confirmed by multiple, reputable sources.	Supports

Overall evaluation	Unclear what some witnesses were describing. However, even with starlight available, very unlikely could see terrain features from inside a helicopter.
Existence?	Yes

Safety factor hypothesis	The flight was conducted in dark night conditions, with no visible horizon and minimal celestial and terrestrial lighting.
What did it influence?	Spatial disorientation (SD); Ability to recognise descent and increasing bank angle

Evidence / reason	Strengths / limitations	Rating
No external cues reduces likelihood pilot or passengers could detect descent and increasing bank (plausible mechanism).	Pilot focussed on instruments during initial departure, then probably GPS in turn. Easier to check external cues than instruments for VFR pilot; also peripheral vision useful.	Supports
Many SD accidents with similar flight path have occurred in dark night conditions (co-variation).	Includes helicopters. Also includes multi-crew operations with pilots with instrument ratings.	Supports
If problem was detected, presence of external cues would have made it much easier to regain orientation.	Unclear whether pilot did detect problem or not during the descent.	No effect

Overall evaluation	Sufficient reasons to support influence, and no notable reasons opposing. Limited external cues generally a pre-condition for SD (with other factors). Alternative explanations where external cues not relevant are complicated.
Influence?	Yes

Existence items

- Clearly supporting
- Clearly opposing
- Expectations

- Direct observation
- Symptoms
- Sources
- Predictions

- Frequency
- Relative strength

- Other perspectives
- Generally relevant

Influence items

- Clearly supporting
- Clearly opposing

- Reversibility
- Plausibility
- Covariation
- Alternative explanations

- Expectations
- Key aspects

- Timing
- Location
- Magnitude
- Enhancers
- Inhibitors

- Other perspectives
- Generally relevant

Importance items

- Risk level (safety issues)
- Risk-related aspects (not safety issues)

- Relationship to change
- Potential for learning
- Completeness
- Consistency
- Scope
- Other perspectives

Evaluate item

- Relevance
- Credibility

- Other strengths
- Other limitations
- Other perspectives
- Appropriateness

Evaluate set

- Required assumptions
- Account for all parts
- Extent of support
- Extent of opposition

- Sufficiency
- Gross error check

HF investigation challenges

- Everyone thinks they are a HF specialist
- Finding good quality, applied research studies
- Insufficient HF data collected
  - HF investigators not always involved early enough
  - limited HF data collection guidance/tools
- Balancing generalist versus specialist approaches
- Convincing some people that:
  - pilots can sometimes do a very strange thing
  - there can be valid reasons why a pilot does a very strange thing

Thank you

Dank u wel

mike.walker@atsb.gov.au