

# INCREASING DEPTH, FAIRNESS AND EFFECTIVENESS OF SAFETY INVESTIGATIONS

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# SAFETY INVESTIGATIONS: EXPECTATIONS & REALITY

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# SAFETY INVESTIGATIONS

- Implicit or explicit boundaries: scope, schedule and costs
- Scope: Can it include everything?
  - Yes, the scope is open, meaning:
    - no bottom, up, left, right, in, out limits
    - but, also no criteria to assess the depth and extent of the investigation
  - Is the scope really widely open?
    - Political influences
    - Emotional effects
    - Etc.
- Is there a schedule?
  - There is always a starting date
  - How is the completion date decided?

# SAFETY INVESTIGATIONS

- Are there any cost limits?
  - Yes and no: it depends on the State and the organisation
  - Isn't time investment a cost parameter?
  - Costs are not announced (even recorded?)
  - Do we then have a picture of total costs of safety occurrences?
- Any other limits?
  - Your and your team's skills and experience
  - The techniques and methods you use
  - The quality of non-hard data and their processing

# SAFETY INVESTIGATIONS

- In reality:
  - Boundaries exist but not explicitly stated: safety is over all – who dares to constrain the investigators?
  - All investigations have inherent, predefined or emerging limitations
  - Limitations means assumptions
  - Assumptions means imperfections



## SO WHAT...?

- If limitations and their corresponding assumptions are not documented:
  - We actually claim that you performed a perfect investigation
  - Our investigation report can be less credible and more open to disputes
  - We do not give the opportunity for meta-studies to collect information to be used for decreasing limitations
  - People involved do not understand why we stopped at them and we did not proceed further, deeper etc.: they view our report as “unfair”.

# LET'S BECOME PRAGMATIC

- What is the purpose of an investigation?
  - “A process conducted for the purpose of accident prevention which includes the gathering and analysis of information, the drawing of conclusions, including the determination of causes and, when appropriate, the making of safety recommendations”. (ICAO, Annex 13).
- What is the purpose of an investigator?
  - We can't prevent any accident or incident: we do not implement the recommendations!
  - Our ultimate purpose is to convince stakeholders that it's important to apply the safety recommendations.
  - We cannot fully convince anyone if our report is of poor quality: unless we write what the others want to read!



## EVEN FURTHER...

- Investigators hold in their hands a huge power and responsibility:
  - Their report is and will be the main source now and for the generations to come to learn from the past.
  - They actually write a piece of history!





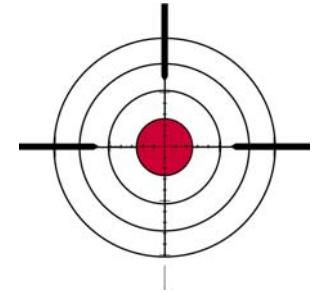
## HERE IS THE QUESTION

How can we improve the depth, fairness and effectiveness of investigations within given and emerging limitations?

# THE ROAD TO IMPROVEMENT

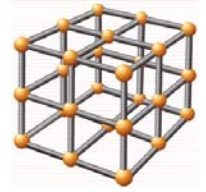
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# EVOLUTION IN SAFETY THINKING

- Accident causation models: from root cause, to epidemiological and systemic approaches.
- New views on human error: from blaming, to understanding end-user's decisions and actions.

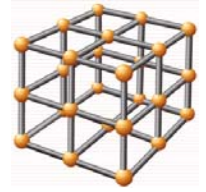


# HUMAN ERROR SEEN AS SYMPTOM

Old View	New View
Human Error is seen as the principal cause of accidents.	Search for factors that led to Human Error.

(Dekker, 2006)

- **Thinking further:** Traditionally, factors are named as causal or contributing.
  - What is the value of that distinction?
  - What does it imply?

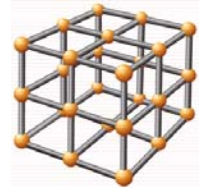


# HINDSIGHT BIAS AVOIDANCE

Old View	New View
Looking to the event backwards and simply recording errors, inaccurate assessments and wrong decisions.	Consider why choices made sense to users at that time, and what options they had prior to the accident.

(Dekker, 2006)

- **Reminder:** People act under given resources and capacity
- Maybe if they hadn't done something wrong, they could have done something else wrong, which now was performed right!

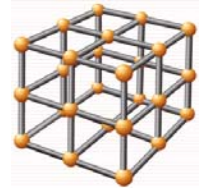


# SHARED RESPONSIBILITY

Old View	New View
Focus on end-user(s) without exploring influences of other organizational levels.	End-user is not the focal point; organizational factors are also investigated.

(Catino, 2008; Dekker, 2006)

- **Reminder:** Rasmussen discussed also about the effects of regulators, authorities and governments
- It is time to include international bodies and the market?

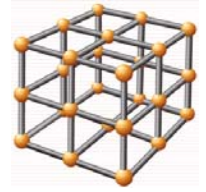


## NON-PROXIMAL APPROACH

Old View	New View
Shared responsibility might be discussed, but investigators persist on investigating in detail the end-user level.	Proportional investigation depth of all organizational functions.

(Dekker, 2006)

- **Reflect:** How much time have you spent and how much space have you devoted in the reports when addressing organisational and other layers?
- Are these equivalent to the ones regarding the lower levels?



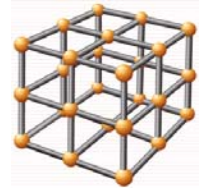
## DECOMPOSITION OF FOLK MODELS

Old View	New View
Abstract statements are named as causes (e.g., loss of situation awareness, complacency).	Decomposing and explaining the problems.

(Dekker & Hollnagel, 2004; Dekker, 2006)

- **Advise:** there is almost no value to name constructs as causes: they don't really exist, so they cannot cause anything.
- It's convenient to use folk models as scapegoats, but this does not add anything to our knowledge.



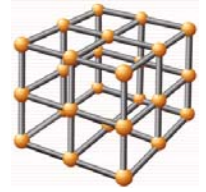


## NON-COUNTERFACTUAL APPROACH

Old View	New View
Merely comparing human performance against standards and procedures.	Exploring the reasons for deviating from standards. Examining the assumptions that the standards were based on.

(Dekker, 2006)

- **Reminder:** standards cannot change with the pace of real life and cannot capture dynamic behaviours.
- There is little value in shifting the blame from end-users to managers and regulators: help the system understand and evolve safely!

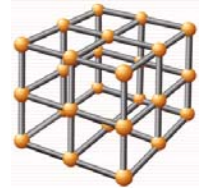


## NON-JUDGMENTAL APPROACH

Old View	New View
Actions are compared with norms and expectations (e.g., knowledge, experience and training).	Exploring the reasons for not meeting expectations. Examining the validity of established norms and expectations.

(Dekker, 2006)

- **Reflect:** How frequently do you judge people based on unspoken and unwritten expectations?
- Remember that past success does not guarantee future performance.

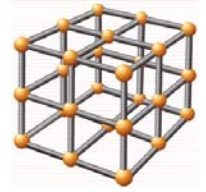


## SAFETY-I TOGETHER WITH SAFETY-II

Old View	New View
Humans are predominantly seen as a hazard. Emphasis is on explaining failures.	Humans are seen as a resource necessary for system flexibility and resilience. Need to explain successes in addition to failures.

(Hollnagel, 2014)

- **Attention:** Safety-II can be misused!
- Since other people succeeded in the past under same conditions, then you are the problem!

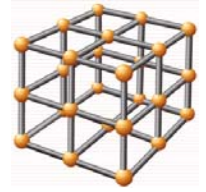


# FEEDBACK LOOPS

Old View	New View
Feedback mechanisms not systematically investigated.	Feedback mechanisms are considered, so to examine whether/how system awareness and control were maintained.

(Leveson, 2011)

- **Attention:** Need for feedback does not mean bombarding the user with data/information and then blame for insufficient awareness and control!
- **Recall:** people have capacity limitations



# ACCIDENT MODELS

	Sequential models	Epidemiological models	Systemic models
<b>Search principle</b>	Specific causes and well-defined links.	Carriers, barriers and latent conditions.	Tight couplings and complex interactions.
<b>Analysis goals</b>	Eliminate or contain causes.	Make defences and barriers stronger.	Monitor and control performance variability.

(Underwood & Waterson, 2013; Hollnagel & Goteman, 2004; Leveson, 2004, 2011; Reason et al., 2006)

- **Attention:** Application of simple models to events just confirms that the events were simple!
- Everything can be as much complex or simple as much you want to see it.

# WHAT ABOUT SOME PRACTICE?

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# IS THERE ROOM FOR IMPROVEMENT?

- Read the investigation report you brought and use the “check-list” provided to:
  - Detect points that new views on safety and human error were applied (or attempted!)
  - Indicate signals of traditional views and suggest how those would be improved.
- On the interest of time, note just 1-2 points from each case (new or old view).
- We will discuss your findings with the class.

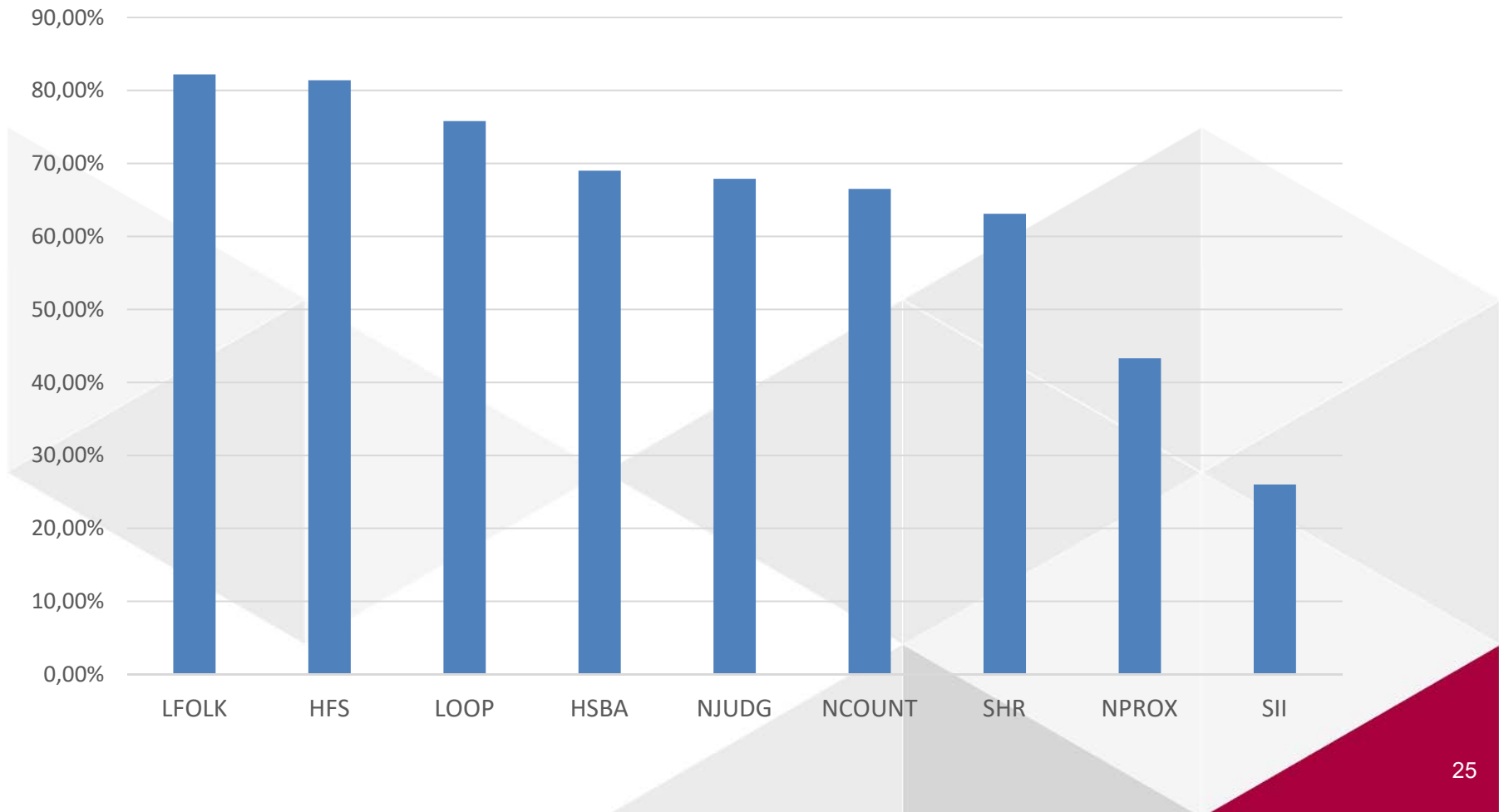
# RESEARCH METHODOLOGY

- Method
  - Analysis of safety investigation reports in order to identify statements that represent new safety thinking.
  - In cases of mixture of old and new views on a specific aspect of the framework, the aspect was considered as present.
- Sample: In total 217 safety investigation reports published by the Dutch Safety Board (DSB), Australian Transport Safety Bureau (ATSB), UK Civil Aviation Authority (UKCAA), and Transport Canada (TCA).
- Variables for statistical tests: Time period (1996-2006, 2007-2014), End-user involvement (YES/NO), Fatalities (YES/NO).



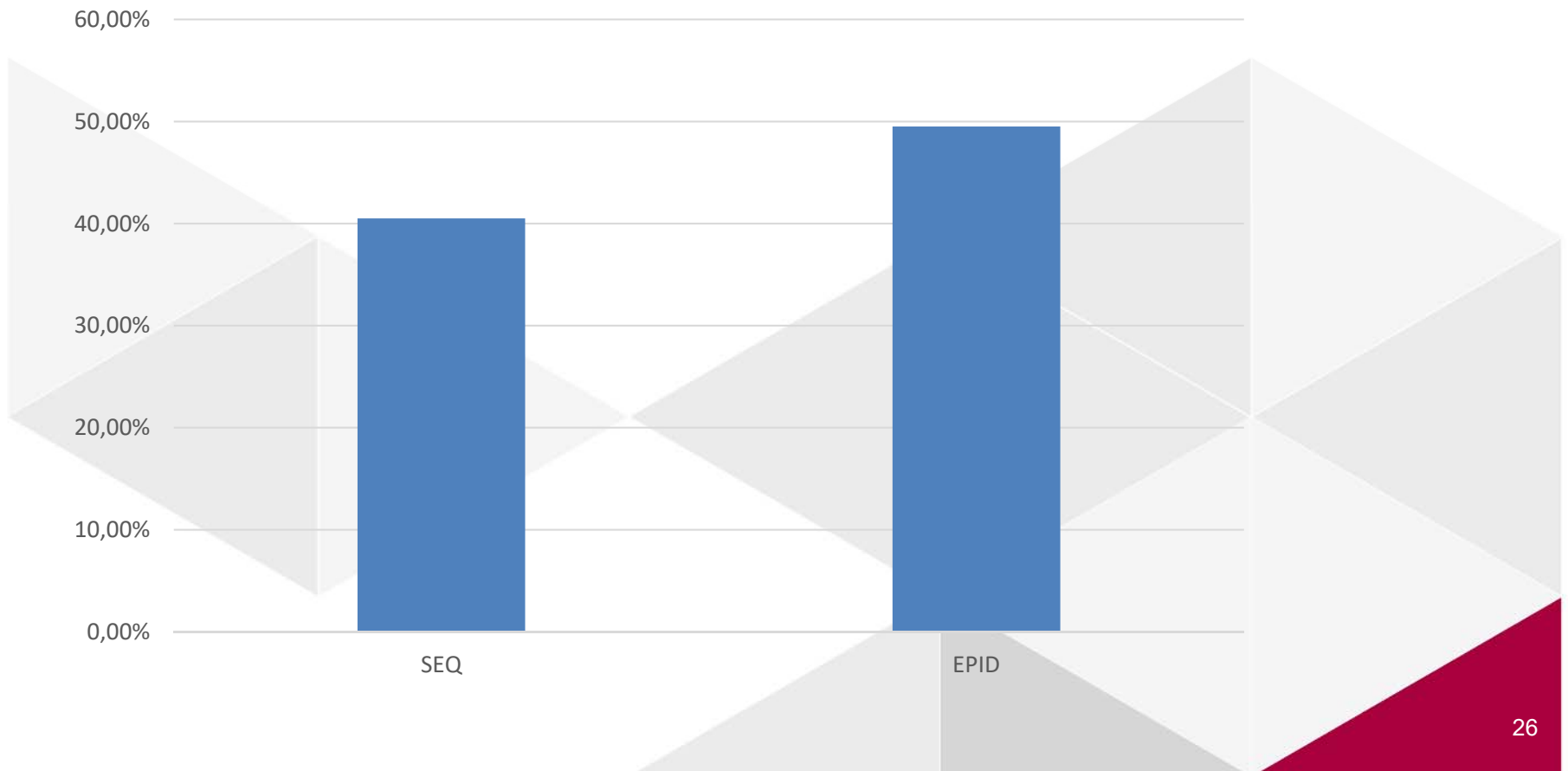
# NEW VIEWS ON HUMAN ERROR

FREQUENCIES OF SAFETY THINKING ASPECTS



# ACCIDENT MODELS

FREQUENCIES OF ACCIDENT MODELS



# SIGNIFICANT DIFFERENCES AMONGST AUTHORITIES

Framework Aspect	ATSB	DSB	TCA	UK CAA
Human Error Seen as Symptom	78%	69%	79%	96%
Hindsight bias avoidance	93%	46%	55%	78%
Shared responsibility	77%	59%	45%	75%
Non counterfactual	82%	66%	50%	66%
Safety-II	53%	14%	13%	28%
Non judgemental	86%	63%	62%	60%
Non proximal	75%	54%	20%	38%

# SIGNIFICANT DIFFERENCES OVER TIME

	Time period with significantly higher frequencies				
Framework Aspect	WHOLE SAMPLE	ATSB	DSB	TCA	UK CAA
Human Error Seen as Symptom				2	
Non proximal		2			
Lack of folk models		2	2		1

# SIGNIFICANT DIFFERENCES FOR END-USER INVOLVEMENT

	Significantly higher frequencies for EU				
Framework Aspect	WHOLE SAMPLE	ATSB	DSB	TCA	UK CAA
Non judgemental	LOWER				
Safety-II	LOWER	LOWER			
Control loops		HIGHER			
Accident model	EPID	EPID			

## SIGNIFICANT DIFFERENCES FOR FATALITIES

	Significantly higher frequencies for fatalities				
Framework Aspect	WHOLE SAMPLE	ATSB	DSB	TCA	UK CAA
Shared responsibility				LOWER	
Non proximal	LOWER				
Safety-II	LOWER	LOWER			
Control loops	LOWER			LOWER	

## CONCLUSIONS (1/2)

- The framework can be used for:
  - uncovering the extent to which new views on human error and accident models have been embraced by organizations
  - evaluating the distance between theory and practice
  - assessing differences among authorities, companies etc.
- Epidemiological models are used more frequently than sequential models, a transition to systemic models is not visible.
- Analysis of success not much applied in accident investigation.
- Although authorities recognize the contribution of various organizational factors, there is tendency to analyze mostly the sharp-end.

## CONCLUSIONS (2/2)

- When considering the whole sample:
  - Safety thinking of the authorities considered in the researched has not significantly changed over time.
  - Authorities tend to be more judgmental and address successes less when there has been end-user involvement in the accident course.
  - Safety II, control loops and non-proximal aspects scored lower when the accidents resulted to fatalities.





## CALL TO ACTION

- There is no right or wrong way of investigating as long as you state your limitations and assumptions.
- The application of new safety thinking means increased investment of resources: everything in life is a matter of trade-offs!
- You can use the safety thinking aspects to “self-check” your investigation process and report.
- Use the results of your self-check to improve the investigation (within the external boundaries!) and formulate the boundaries of your own work.
- New safety thinking is not only about investigations: it is about shifting our minds and changing ourselves and extents across all personal and vocational activities!

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# Thank you!

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