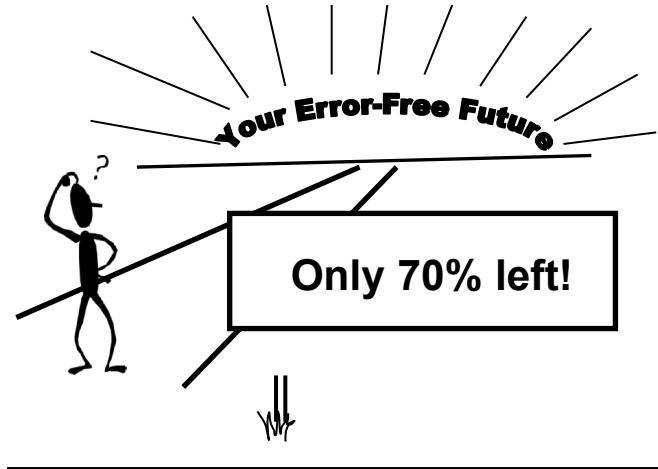


Systems investigations

ICAO/IFATCA Think Safety workshop

Two types of investigations

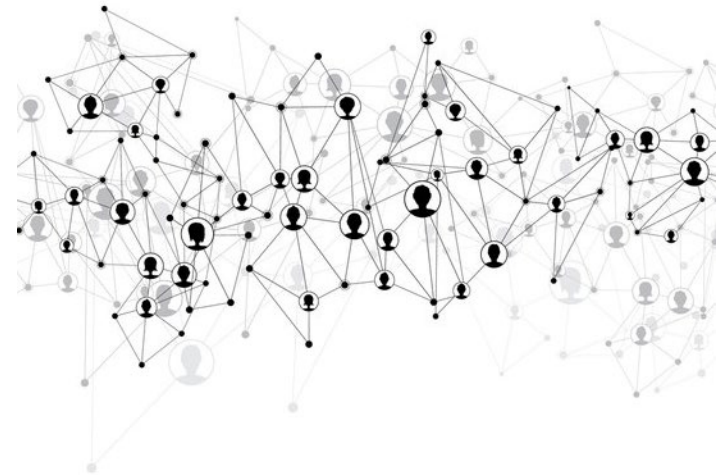
Traditional investigations



Cook, 2005

Outcome failure = $f(\text{failure} + \text{failure} + \text{failure} + \text{failure})$

Systems investigations



Investigation = Explain + explain + explain

The Contrasting Views

Traditional view

- Error is the cause of trouble
- Finding humans doing something wrong is the stopping point of investigations

The different view

- Error is a symptom of trouble deeper inside the system
- Error is the starting point of investigations

The Contrasting Views

Traditional view

- Errors is a results of unreliable humans
- Problems are individual
- Every event is unique.
Accidents are breakdowns of a well functioning process
- Fixing holes in the cheese

The different view

- Sources of error are structural, not personal
- Errors and accidents are only remotely related.
- Accidents are not the result of a breakdown of otherwise well functioning processes.

Beware: Traditional Investigation traps

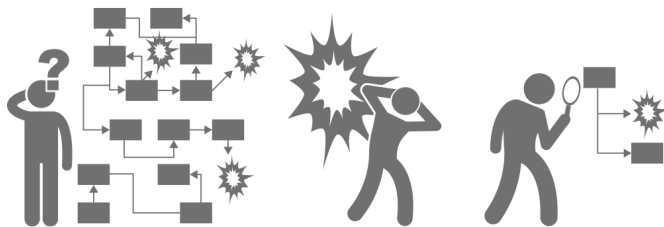
- Hindsight bias
- Counterfactual Reasoning
- Micro Matching
- Judgmental Language
- Proximal



Beware of Hindsight Bias

Before the accident

After the Accident



Bad outcome = Bad process

- We tend to judge the quality of a process by its outcome
- Given the knowledge we have now we tend to simplify the problem solving situation
- We oversimplify causality
 - We look at the sequence of events from the outcome and backwards

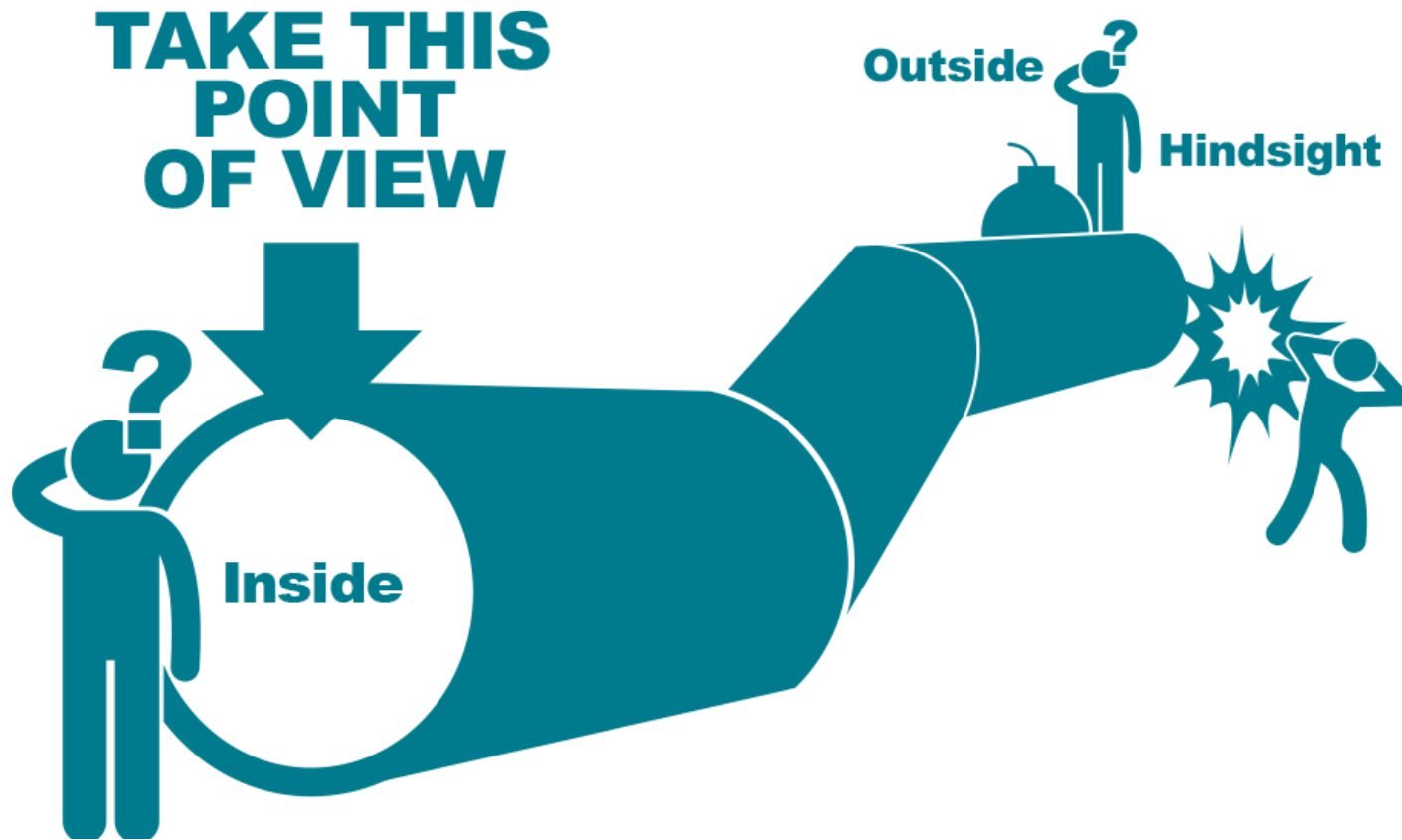
Beware of Hindsight

”Every scripture is entitled to be read in the light of circumstances that brought it forth.

To understand the choices open to people of another time, one must limit oneself to what they knew, see the past in its own clothes, not in ours.”

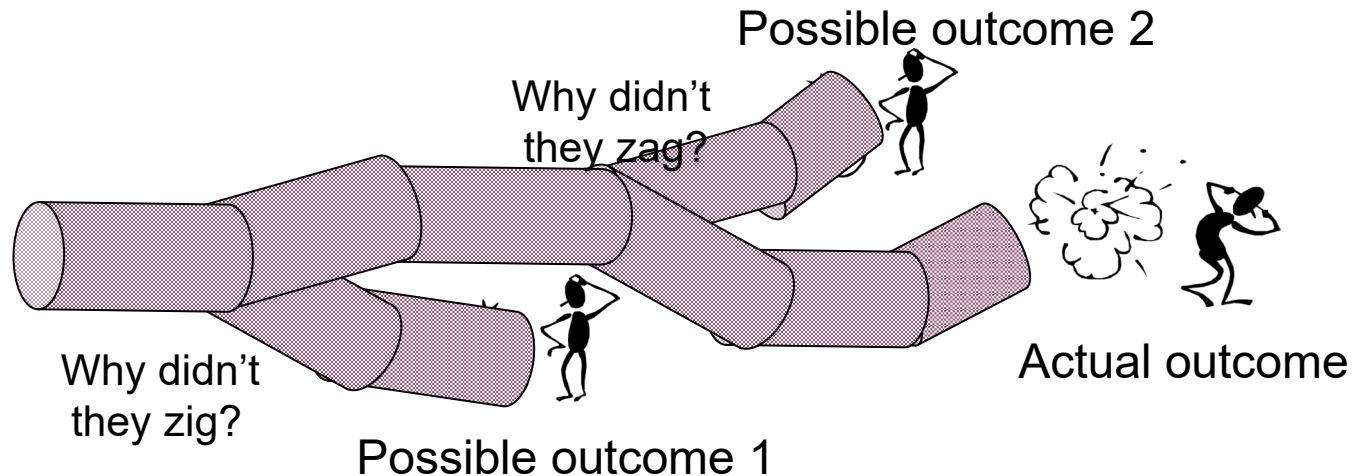
Barbara Tuchman

Go Inside the Tunnel

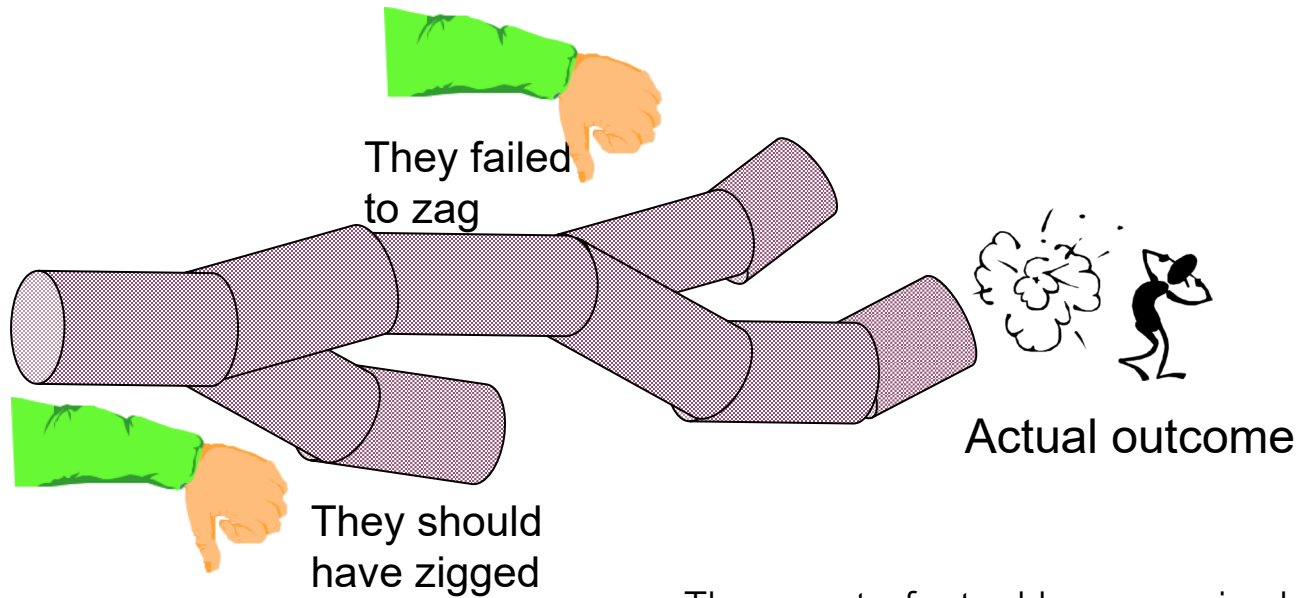


Counterfactual

Laying out in detail what people could or should have done



Counterfactual



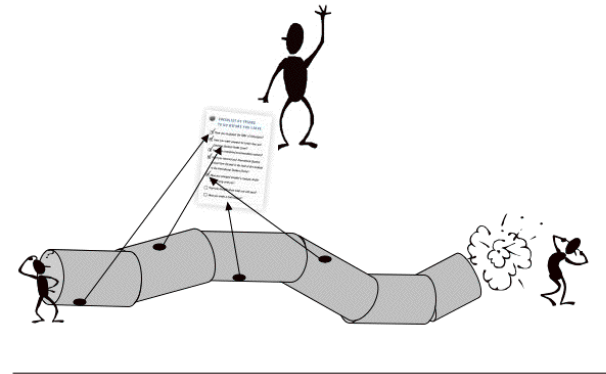
The counterfactual language is characterized by:

- "they shouldn't have..."
- "they could have..."
- "they didn't..."
- "they failed to..."
- "if only they had..."

Micro-Matching

A procedure or collection of rules: People's behavior was not in accordance with standard operating procedures that were found to be applicable for that situation afterward;

- A set of cues: People missed cues or data that turned out to be critical for understanding the true nature of the situation;
- Standards of good practice: People's behavior fall : practice in the particular industry.



Judgmental Language

- They should have...
- He failed to...
- This is a violation of the procedure...
- He became complacent
- He demonstrated a lack of vigilance...
- There was a lack of risk awareness
- They Lost Situation Awareness
- He admitted making a mistake
- They could have
- If only she had...



Exercise

Look into the investigation report. Identify in the text:

Counterfactual Reasoning:

They lay out in detail what these people could have done to prevent the mishap

Micro Matching

They match fragments of people's performance with all kinds of rules and procedures from written documentation or standards.

Judgmental Language:

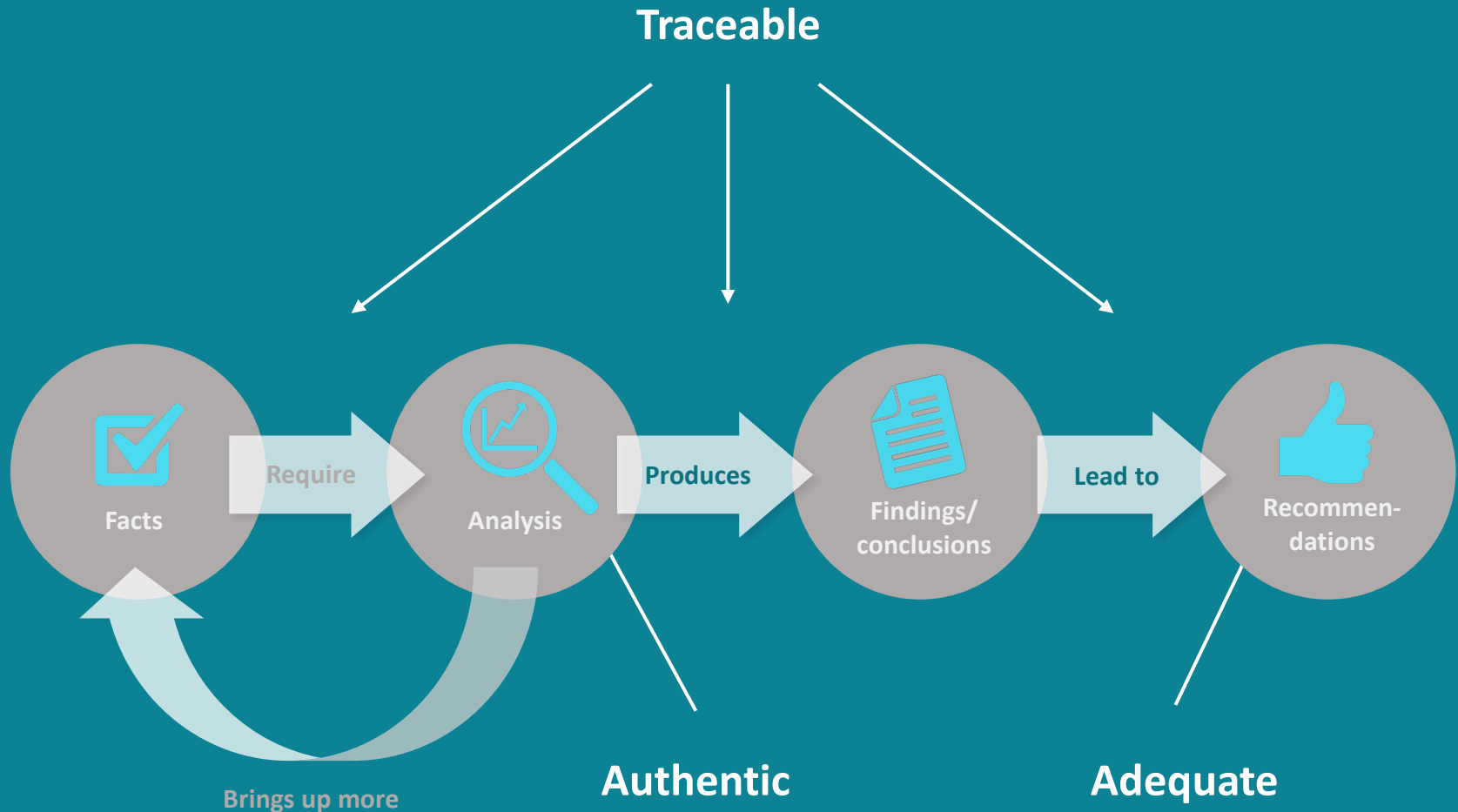
They say what people should have done, or failed to do, to prevent the mishap.

Proximal:

They focus on those people who were closest in time and space to causing or potentially preventing the mishap;

Systems Investigations

Create Authentic and Traceable Accounts

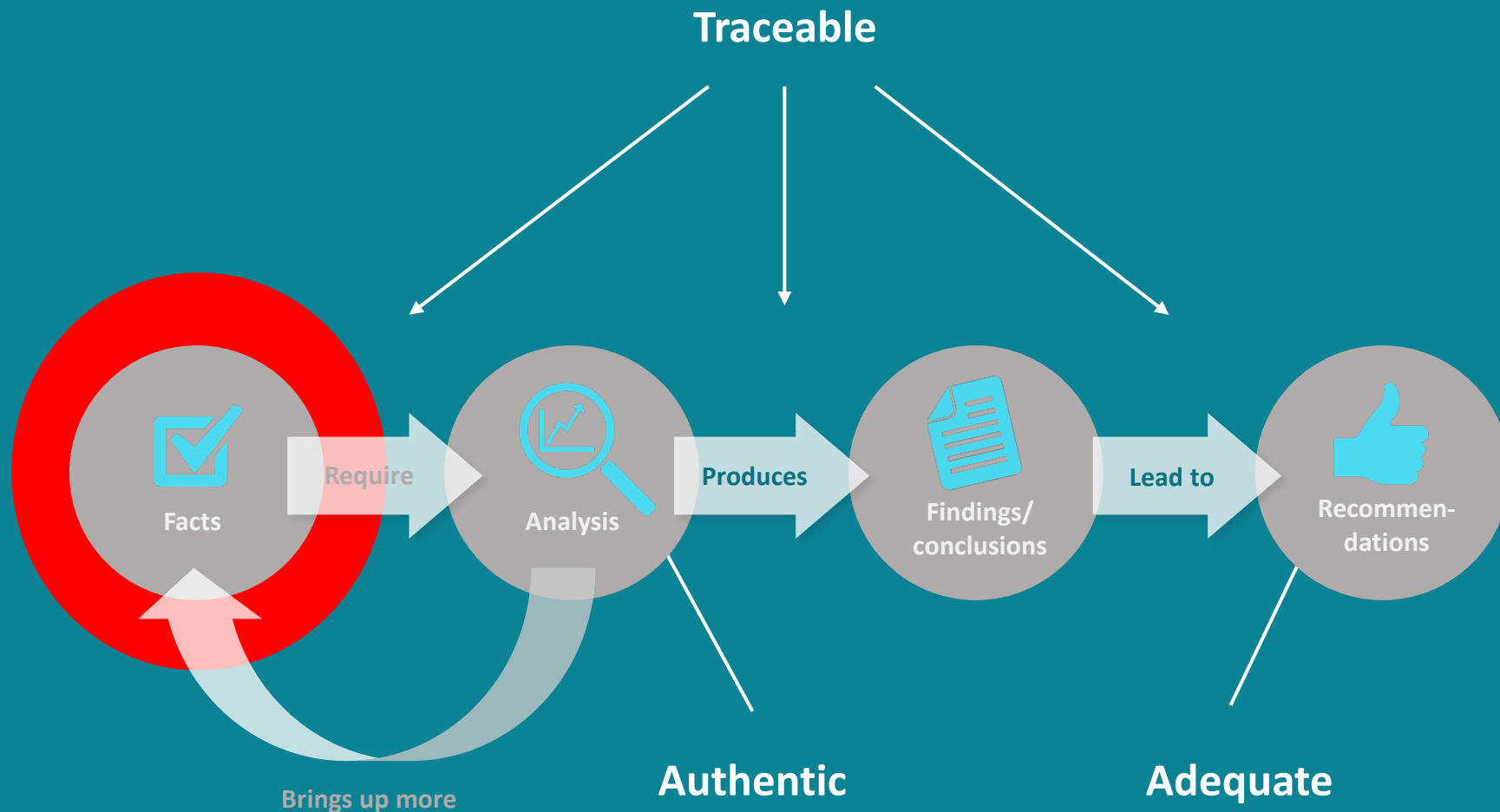


What is the point of an investigation?

- It is to find out how people's assessments, actions and decisions could have made sense to them at the time
- Is not to find out where other people went wrong

Systems Investigations

Create Authentic and Traceable Accounts



What are facts?

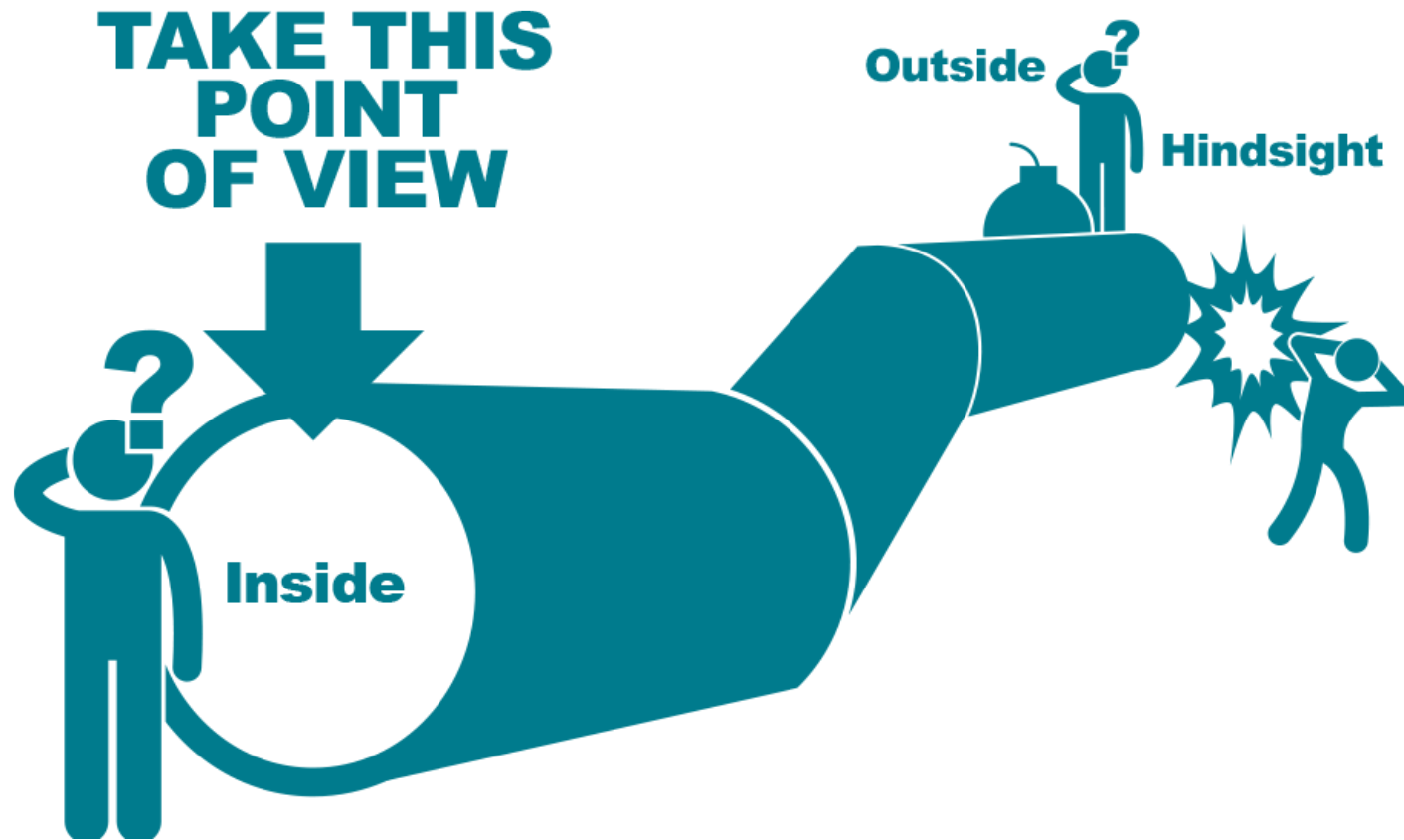
Facts or available data

What facts and data is available after an incident?

- Transcripts, radar and voice
- Flight plans
- Weather information
- Briefing notes
- Traffic numbers
- Etc.

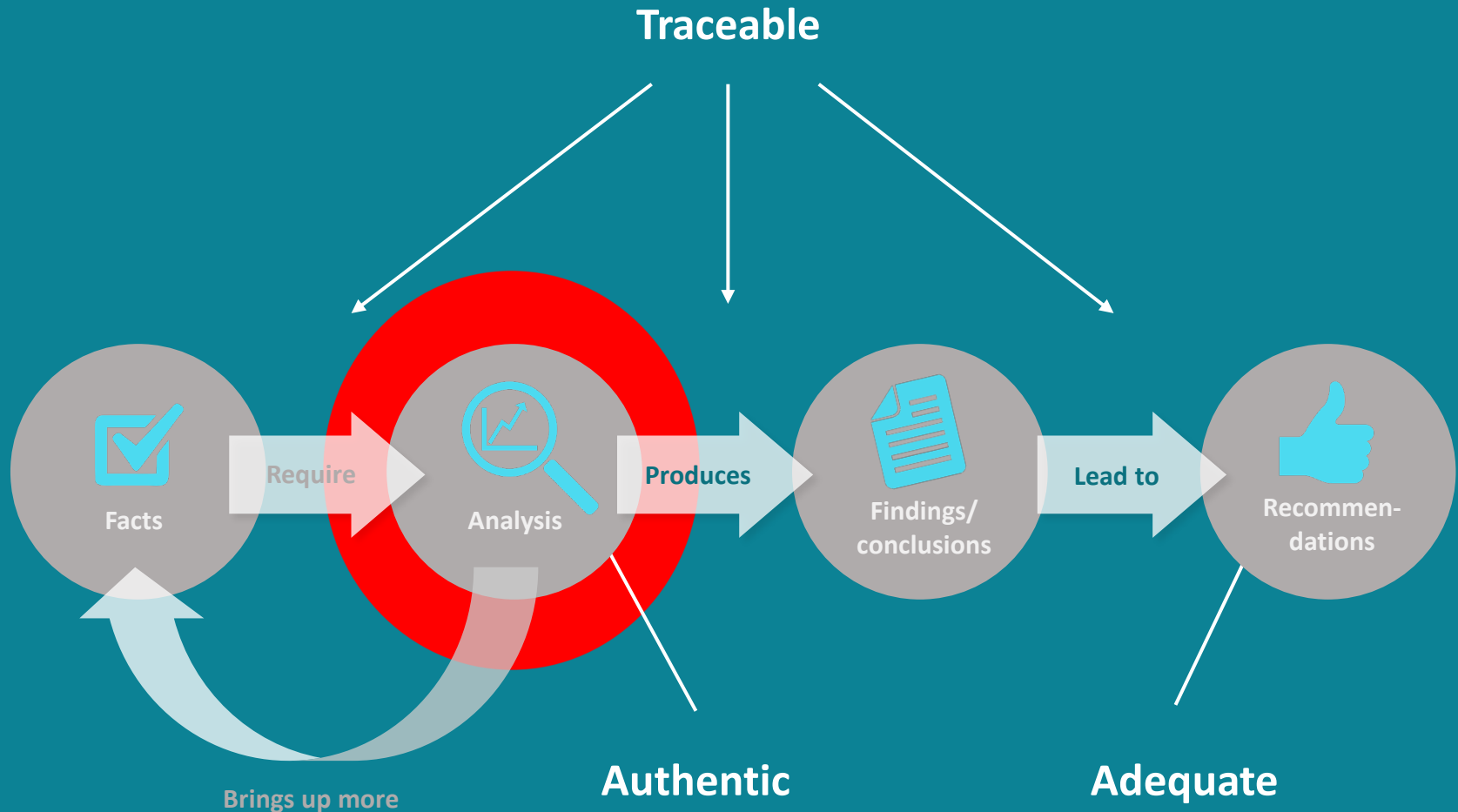
What do we do with the available facts and data?

Go Inside the Tunnel



Systems Investigations

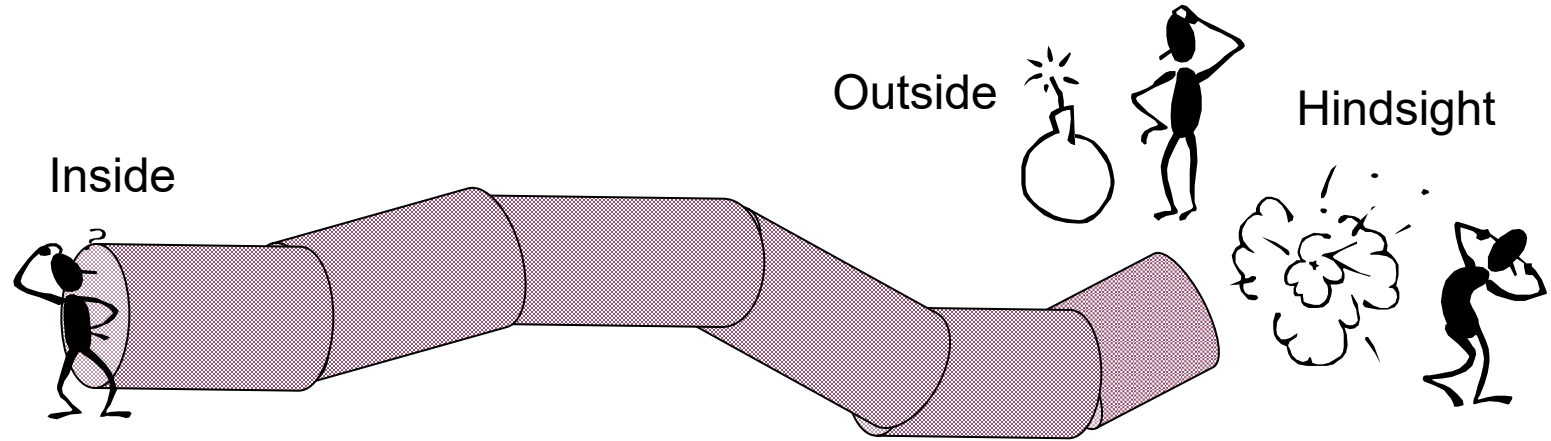
Create Authentic and Traceable Accounts



Human factors analysis

- In order to understand *why* people did what they did...
 - You first have to understand the situation in which they found themselves
- Investigation must reconstruct the situation in which people found themselves as accurately and completely as possible

Inside the tunnel



Questioning Strategy Compass

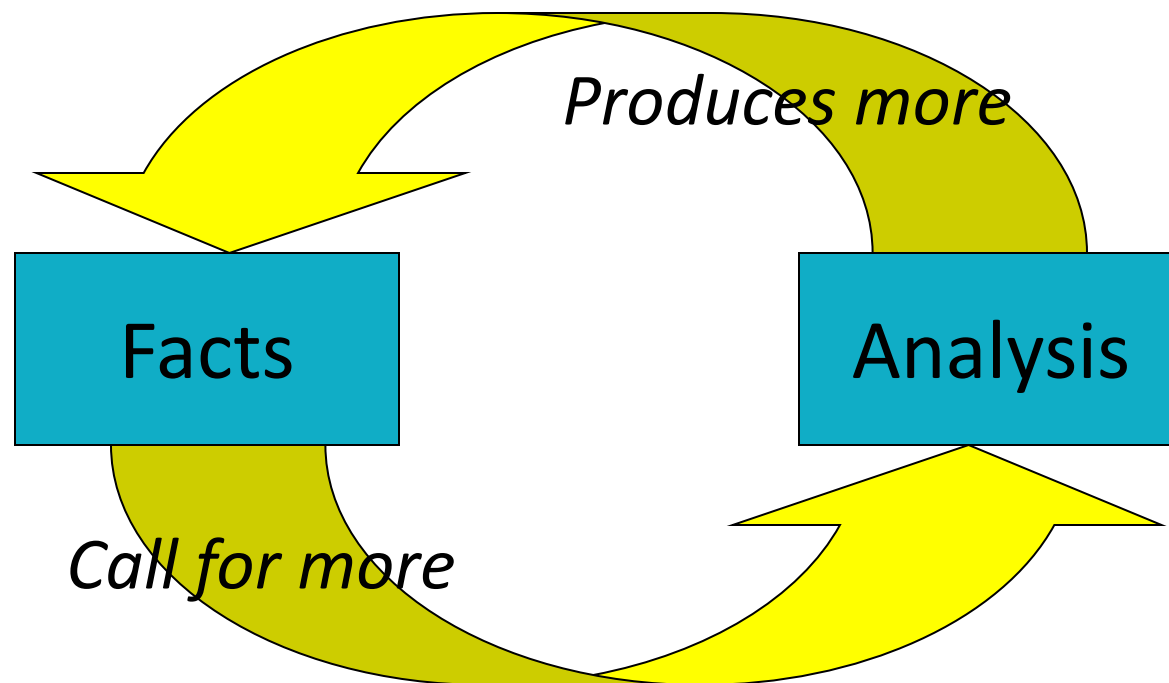


15 USEFUL QUESTIONS

1. What did you see?
2. What were you focussing on?
3. What was your perception of the situation?
4. What was the workload?
5. What tools did you use?
6. What was your plan?
7. How were you prepared for handling this task?
8. What were you trying to achieve?
9. What were your expectations in the situation?
10. Were you reminded of any previous experience?
11. What could have helped you avoid this situation?
12. Tell me about normal work (no incident occurred).
13. What is difficult here?
14. What problems are likely to occur in this task?
15. What helps you foresee and manage risk in your work?

WHEN ANALYSIS TRIES TO EXPLAIN *WHY*

- It typically leads to *more* facts; *new* facts
 - Iterative loop:



Look into the Organization

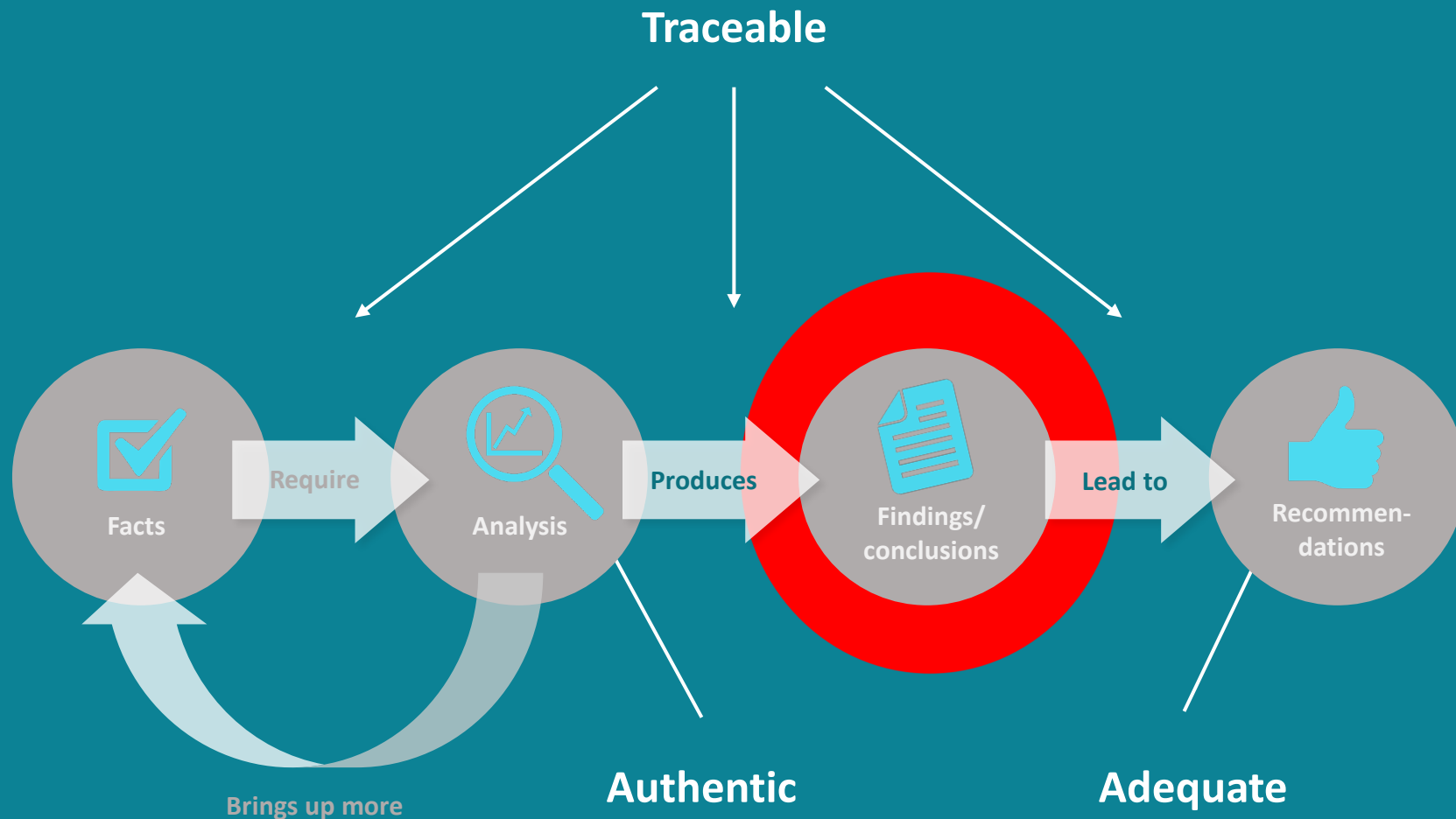


What shall we look for in incident investigations?

Gordon Graham movie

Systemic Investigations

Create Authentic and Traceable Accounts



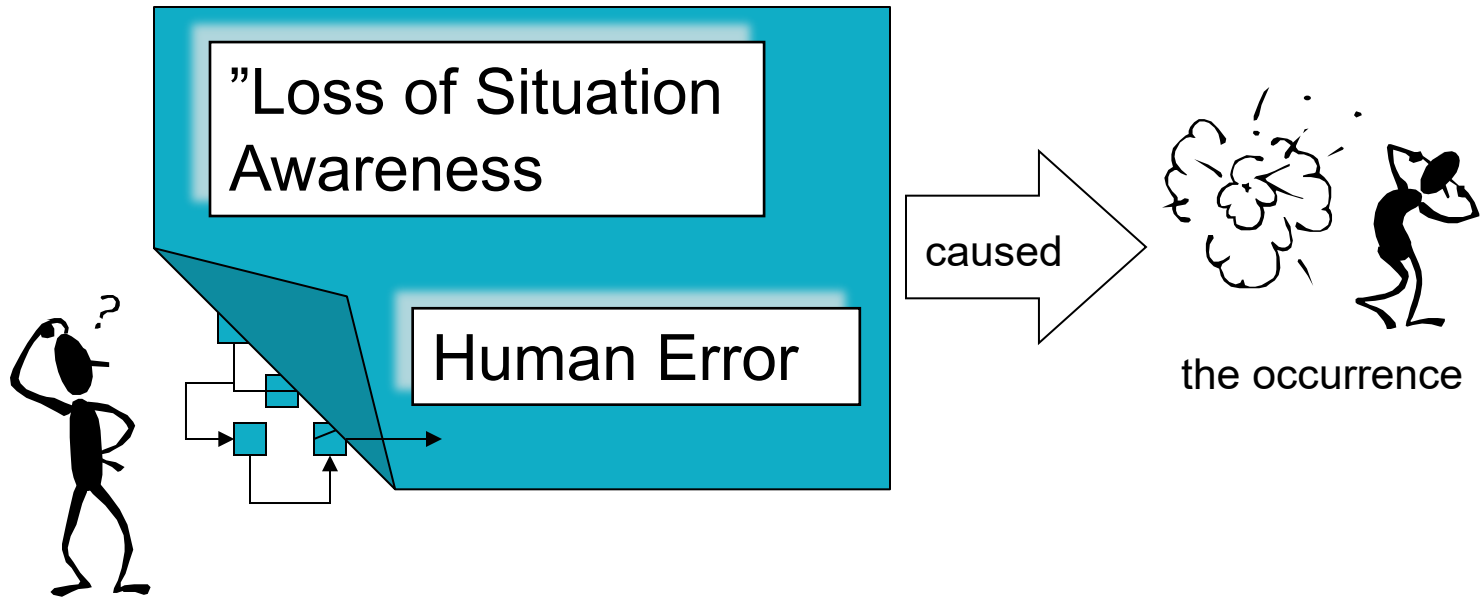
Understand how to move from analysis of facts to findings/conclusions

- leave a trace so others can
 - Understand how you got to your findings
 - Verify your conclusions
- Learn how not to oversimplify causal statements

Conclusions are about *how*

- *How* did the facts combine in a way that led to the outcome?
 - Conclusions tell a second story of the sequence of events
 - in more abstract language (less domain language)
 - E.g.” the student controller became task-saturated”
 - Second story explains *how* the outcome came about

Labels may hide a lot



Are these good findings/conclusions?

- The controllers lost effective team resource management
- The controller lost situation awareness
- The controller had become complacent
- The controller did not comply with written rules and regulations

Asking “what is the cause of this occurrence?”

- Is just as bizarre as asking “what is *the* cause of not having an occurrence?”
- **Multiple factors, each necessary and only jointly sufficient, are responsible for “causing” the occurrence**

Probable cause examples

- Not:

- The student controller failed to communicate to the assistant controller
- Controllers failed to take corrective action

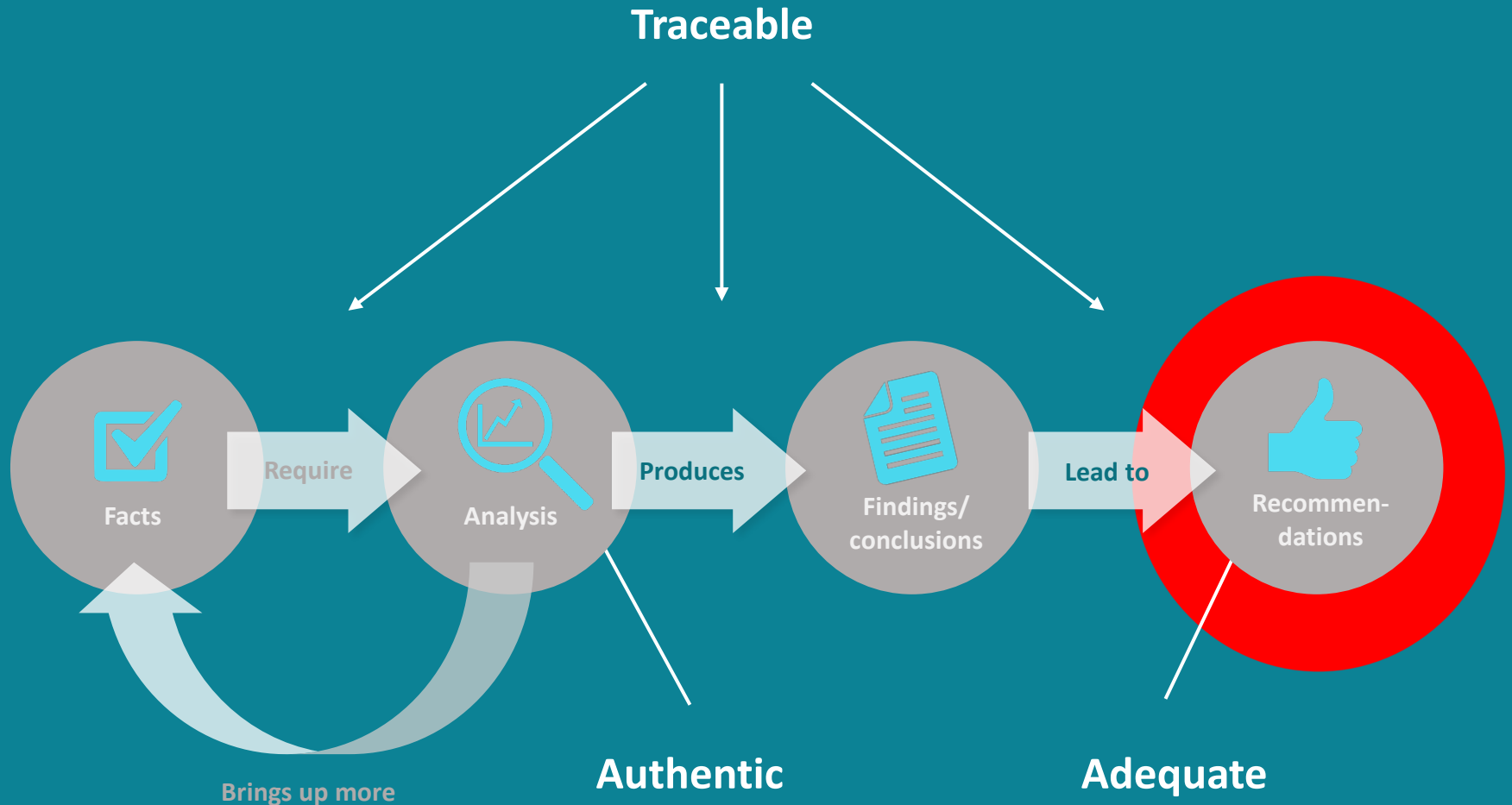
- But rather:

The loss of separation occurred when the student controller understood the approach situation differently from the assistant controller, their reaching of a common goal was hampered by intruding communications and task saturation, and the controllers jointly did not succeed in coordinating effective actions to avoid the separation loss.

Example from my experience

Systemic Investigations

Create Authentic and Traceable Accounts



From diagnosis to learning

- Facts, analysis and findings are all about diagnosis
 - What went wrong, why, and how
- Recommendations are for learning
 - What the system should do now
 - To avoid exactly this occurrence
 - To become wiser as a whole

How wise is the system after the investigation?

- Recommendations should reflect deeper, broader understanding of the vulnerability of the system investigated
 - Not just pot-shots at each individual findings
- Recommendations are both:
 - Countermeasures against failures identified in the occurrence
 - Broader investments in safety that result from deeper insight into the workings of the system

Aim High but Within Reason With Recommendations

