

BCSEA Project

Training on IMO Code and EU Directive on Accident Investigation

Evidence analysis

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B.2.3 Marine Accident Investigation
Ship Safety

What is Analysis?

...A systematic approach to problem solving. Complex problems are made simpler by separating them into more understandable elements.

“Analysis is a disciplined activity that employs logic and reasoning to build a bridge between the factual information and the conclusions.”

Res.884 (21)



- Involves a Structured Systematic Approach
- Uses Critical Thinking Techniques
 - Applies logic
 - **Avoids Bias**
- Ensures complete/thorough investigation.

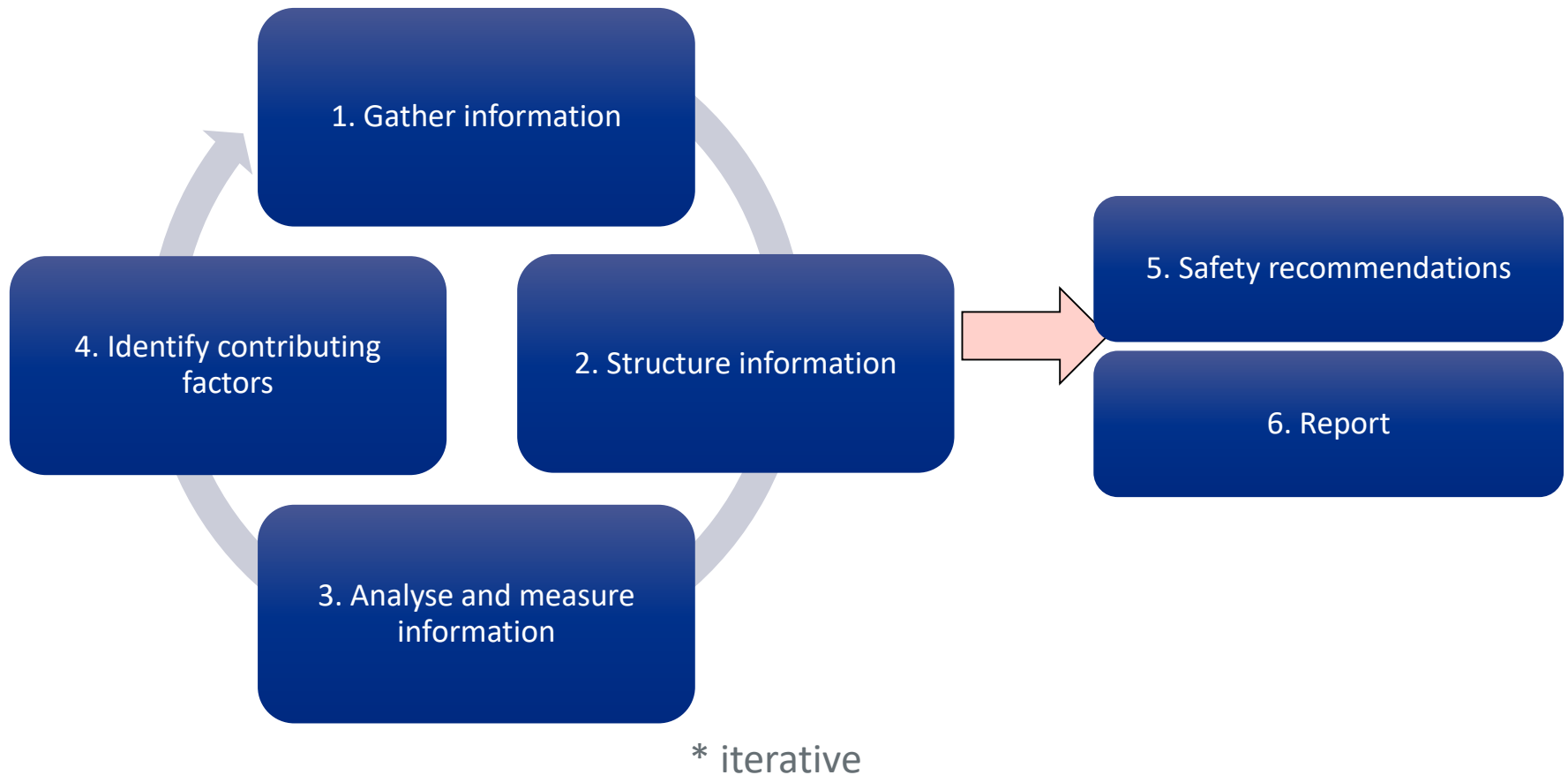
The initial focus of an accident investigation is obtaining the **evidence**

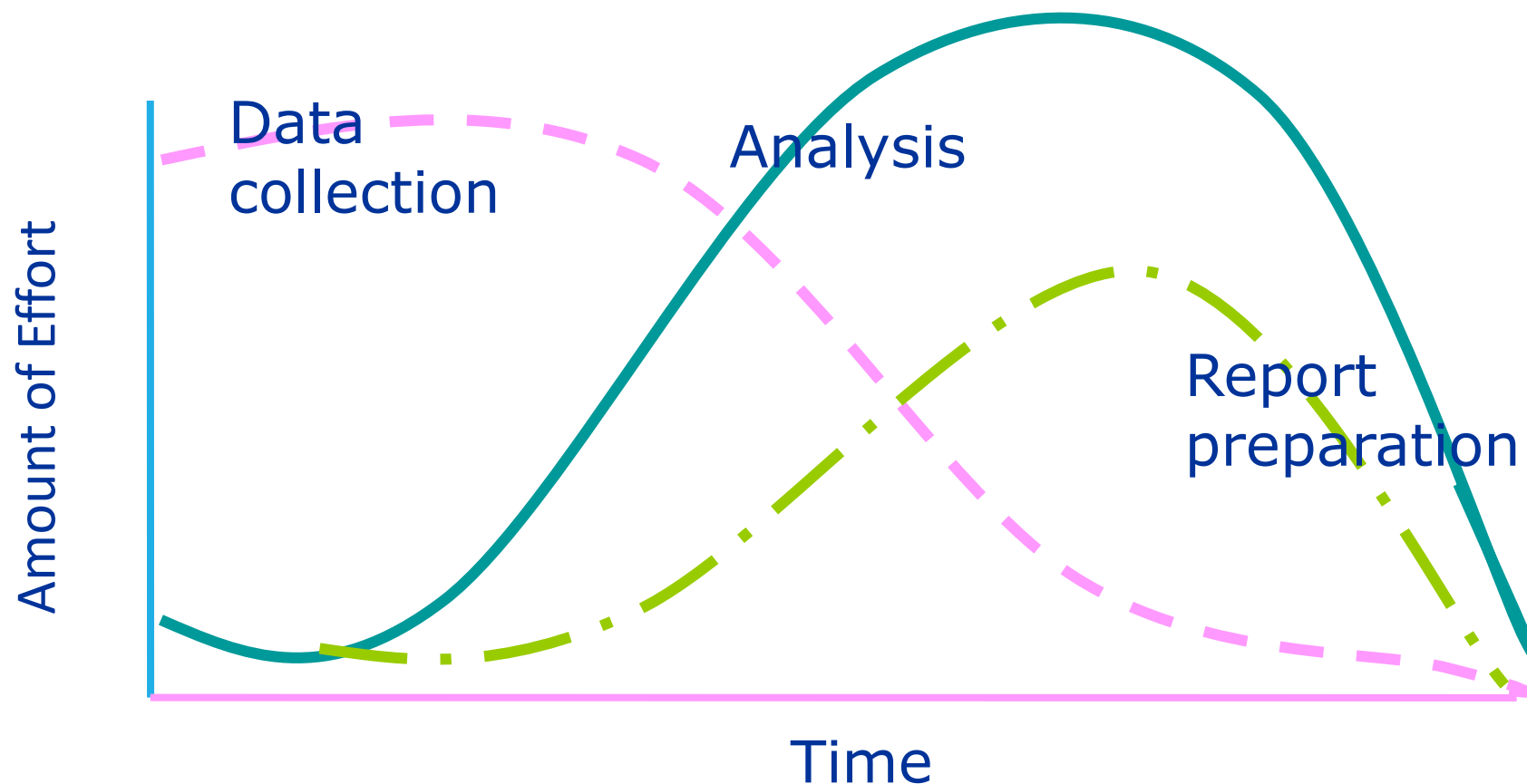
The evidence is subjected to rudimentary **analysis** as it is collected...

... indicating what **other evidence** needs to be collected

- and so on...

System is **iterative**.





Investigation is an iterative process

- Analysis methods reflect the nature of accident causation
- Accident causation has changed over time
- Increasing complexity of systems required new theories and methods
- Three generations of accident models:
 - Sequential
 - Epidemiological (Reason-based)
 - Systemic
- Well over 100 models available



- 5 –Whys
- Fault Tree Analysis
- STEP (Sequentially Timed Events Plotting)
- Barrier Analysis
- Change Analysis
- SHELL
- ATSB method
- MAIIF/IMO method
- ...

- Many to choose from
- Select according to specific requirements – the evidence
- Time/Event line basic requirement of every investigation
- Suggest use a charting tool – e.g. Event and Contributing Factors Chart



**Unless proficient in the use of other tools....
Use IMO Res. A.1075(28) method**

1. Construct a time/event line
2. Identify the casualty and accident events
3. Analyse each accident event – asking Why? – through several layers to uncover failure mechanisms and operational and organizational factors
4. Identify safety issues and safety deficiencies



Illustrate analysis on an Event and Contributory Factors chart

Definitions and Symbols

From (IMO Res. A. 1075(28))

Keeping it simple...

Event

Casualty event

Accident event

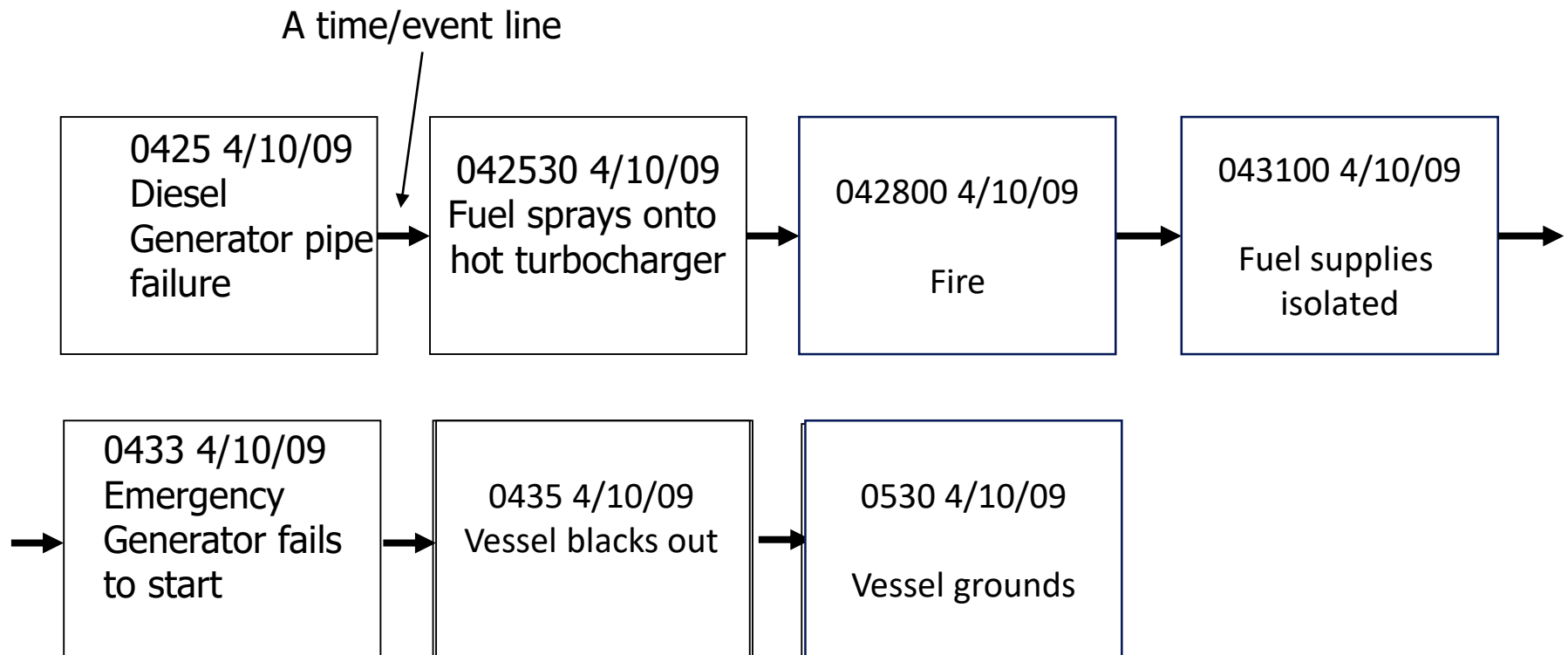
Contributing factor

Safety issue

Safety deficiency

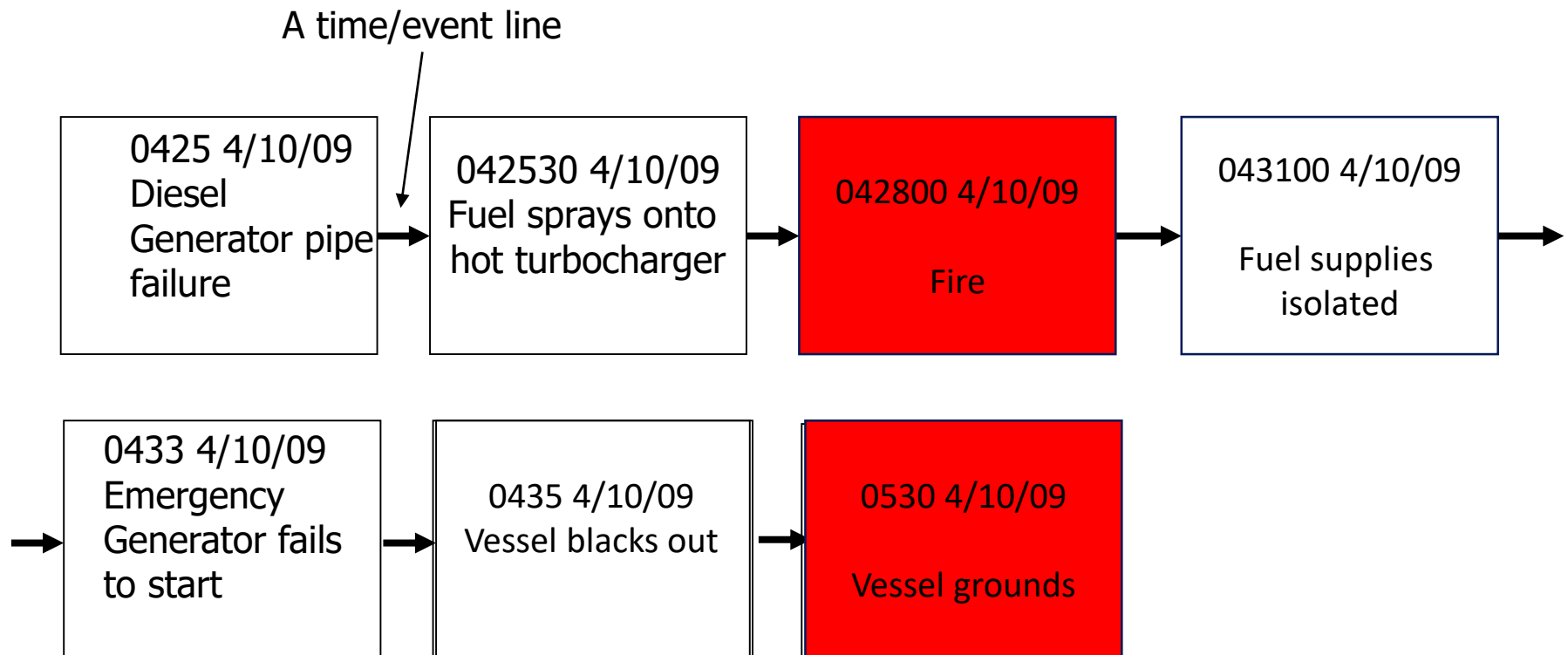


An action, omission or other occurrence.



Always timed - if possible

The event(s) which best describe the casualty

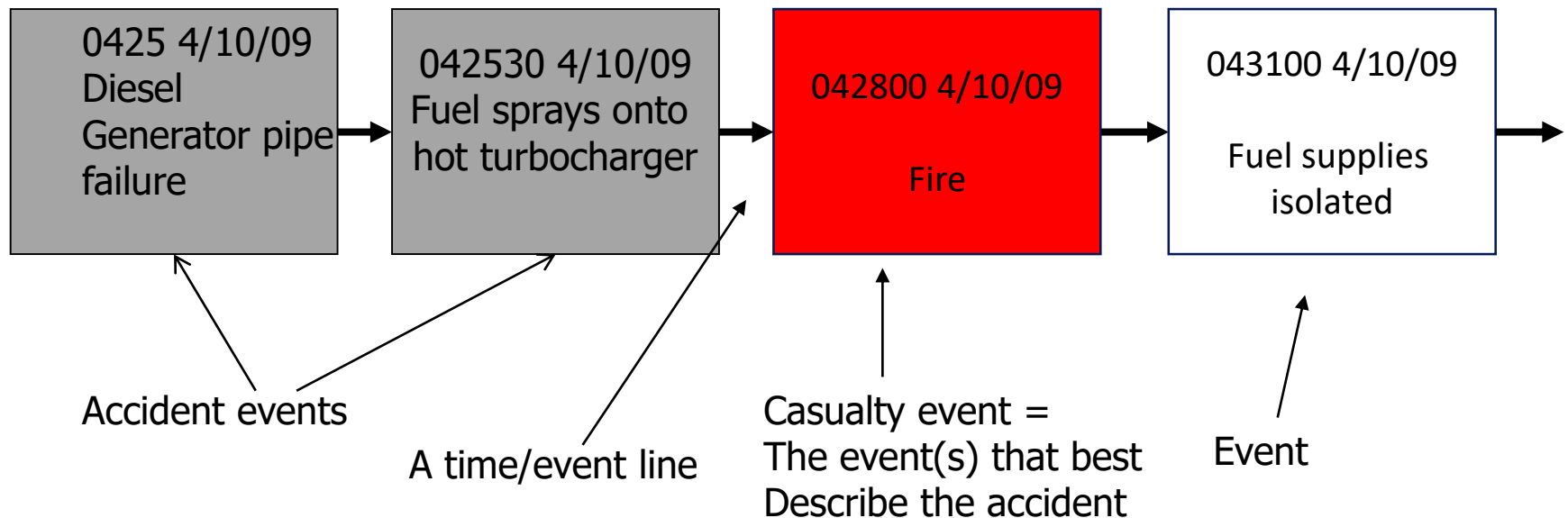


An event that is assessed to be **inappropriate** and **significant** in the sequence of events that led to the marine casualty or marine incident. (e.g. human error, equipment failure, etc.)

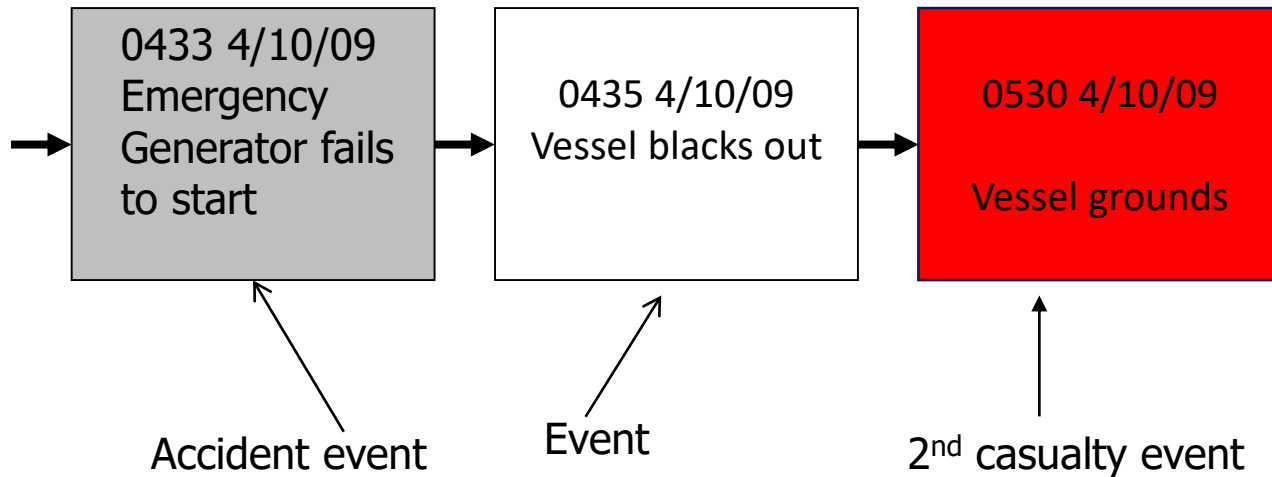
0433 4/10/09
Emergency
Generator fails
to start

Shaded to indicate Accident Event

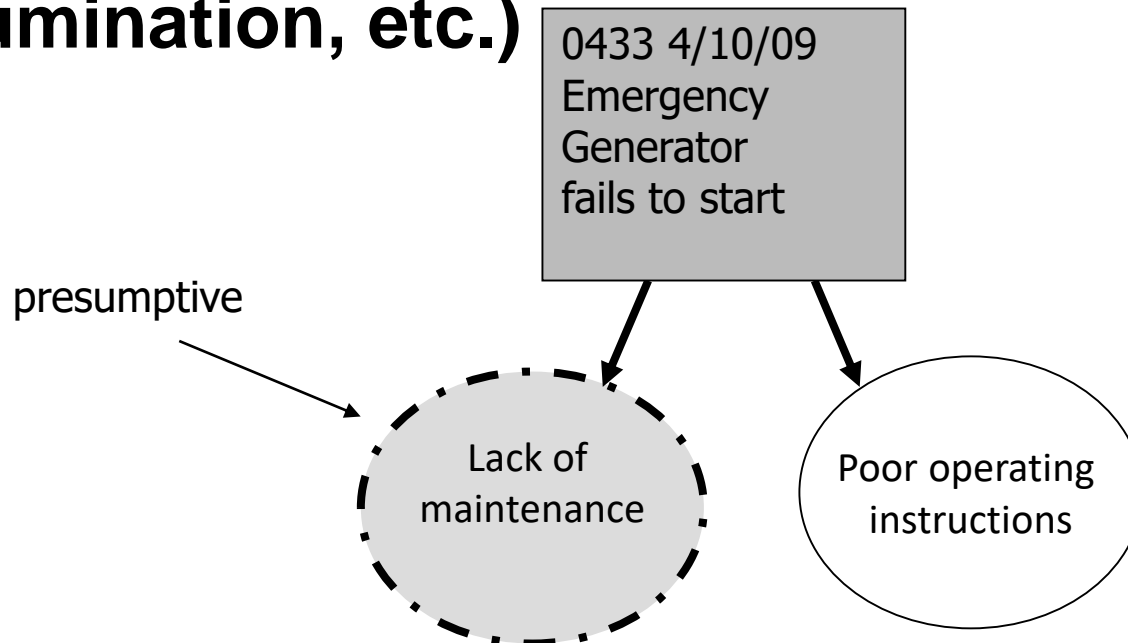
Significant and Inappropriate.



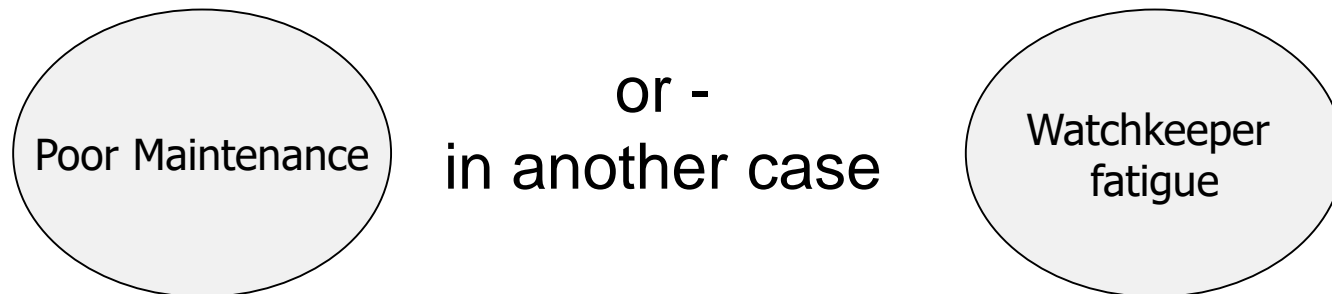
Significant and Inappropriate



**A condition that may have contributed to an accident event or worsened its consequence.
(e.g. man/machine interaction, inadequate illumination, etc.)**

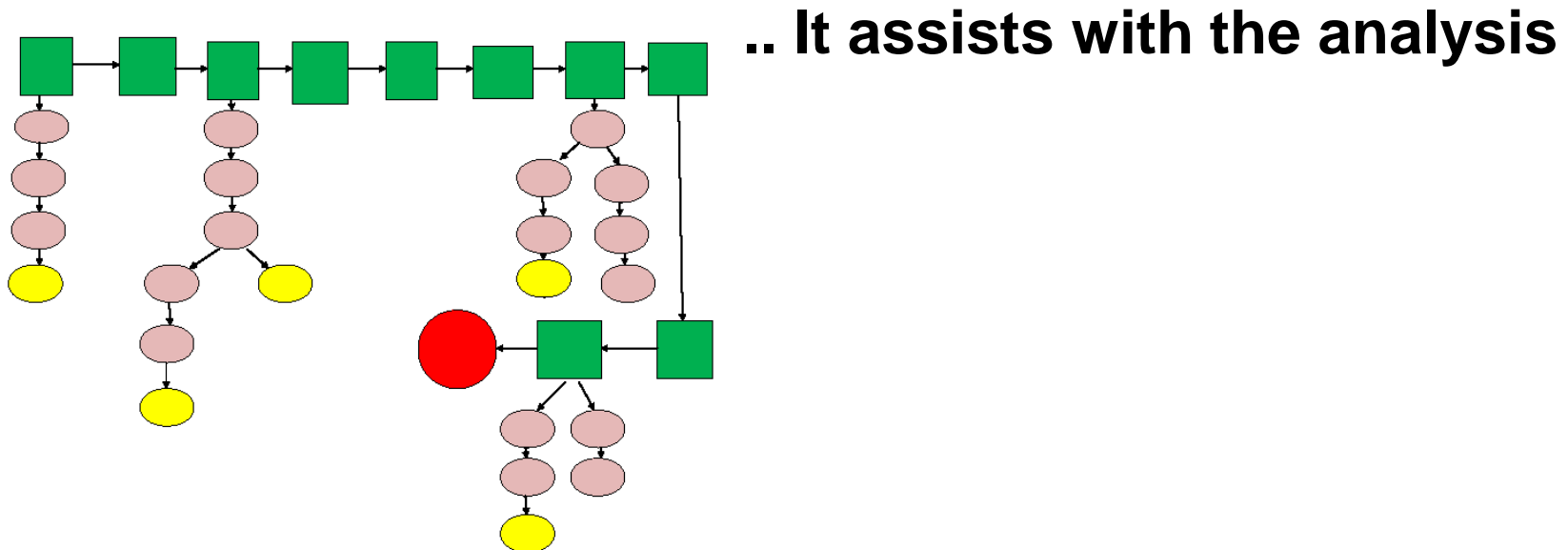


An issue that encompasses one or more contributing factors and/or other unsafe conditions.



Recommendations for change usually arise from these

An analysis charting tool which helps focus the investigation in the key areas. It brings together many elements of the investigation in a graphic form, indicating the links between the contributing factors and the accident..



- Guides the investigation
- Illustrates the chronology of events
- Helps identify accident events - safety significant events
- Helps determine contributing factors
- Clarifies reasoning
- Highlights gaps for further investigation
- Helps identify safety issues arising
- Provides a check for the investigation logic
- Illustrates the relevance of recommendations
- Gives guide to a possible report structure



- **Start to develop from notification of accident**
- **May cover before, during and after an accident or incident**
- **Fill in the gaps in the time/event line during interviews and by analysis of VDR and other evidence**
- **Use computer software or “Post-It” notes**
- **As contributing factors and accident events identified – other topics and questioning areas may be needed.**

...the analysis process is iterative



For each accident eventconsider all possible reasons ‘Why’ it occurred to uncover the failure mechanisms and contributing factors. Continue to ask “Why” to uncover safety issues and safety deficiencies connected with :

Shipboard operations

Shore management or

Regulatory/other matters

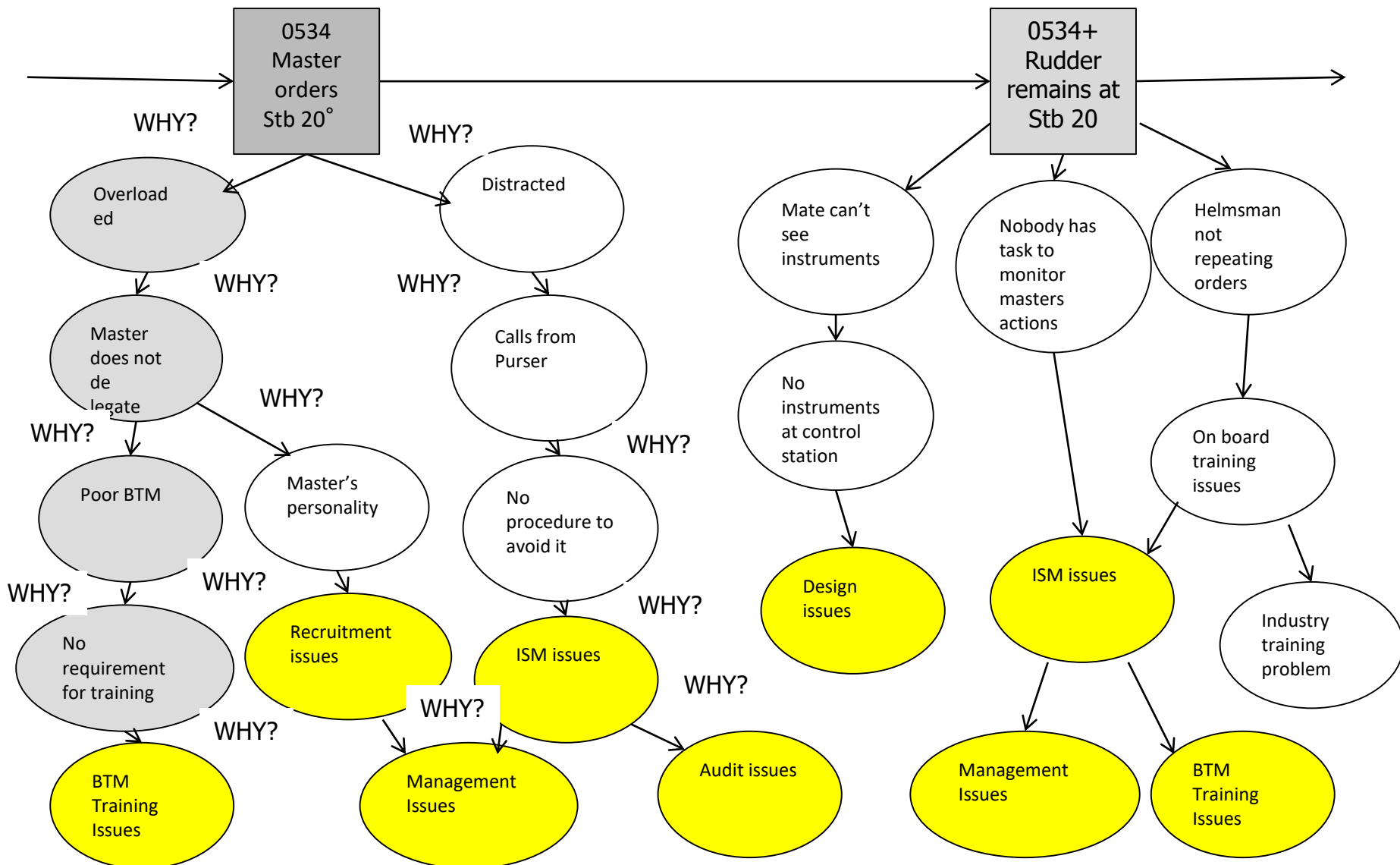
Why did something happen?

BECAUSE...

but Why did that happen?

BECAUSE...

but Why.....?



IMO Model

Contributing factors?

Why?

Emergency proc's Training Policy Recruitment Policy Scheduling Regulations Circulars
Maintenance policy **Manag't/Organizational Factors?** Spares policy VTS Practices
Safety Manag't Equipment design Pilots Supply of Tugs Safety Audits Safety Policy

Why?

Supervision Noise Poor maintenance Familiarisation Training Communications Heat
Safety Manag't Drills Master/Pilot Workload SOPs Vibration
Health Use of Tugs **Operational Factors?** Stability Spares handling
Cleanliness BRM Food Navigation Manag't. Culture Weather routing

Why?

Lapse Planning error Error in intention Chemical reaction Experience
Fatigue **Human Error and Other Failure Mechanisms?** Omission Corrosion
Oxygenation Observation error Error in action Interpretation error Brittle fracture Wave on board
Wear Slip

Why/How?

Human error Pipe failure Monitoring failure Human error
Position error **Accident Events?** Communication failure
Environmental effect Equipment Failure Human error Hazardous Material effect

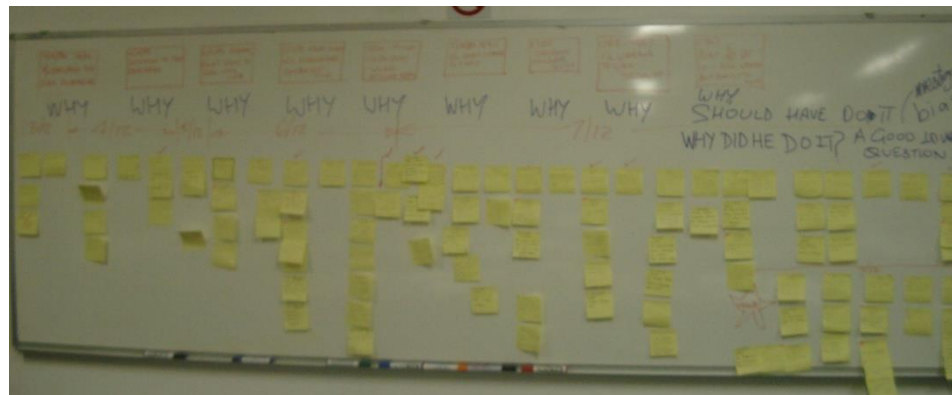
What?

Collision Structural failure Capsize Fatality
Grounding Flooding **Casualty Events?** Fire Injury
Loss of control

Fire on board Ro-Ro “Ocean Trader”

Read the summary report and information about the Marine casualty and:

- firstly, form a time line of events
- then consider which are the possible Accident Events and Contributing Factors



Proposed analysis

No reserve power supply board available on board

CF

Leak not detected during recent maintenance tests

CF

No process in place for handling the occurrence of both circ. pumps out of order

CF

Operational pressure for keeping voyage schedule

CF

08/03/2019 – 14:45

Failure of circ.pump nr.2

AE

08/03/2019 – 15:00

Failure of circ.pump nr.1

AE

08/03/2019 – 15:00

C/E does not reduce the thermal load

AE

08/03/2019 – 15:05

FIRE

AE



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European Maritime Safety Agency