



How to use ISO 14224 to achieve quality data when dealing with human factors in socio-technical and industrial systems

*International ISO Standardization Seminar for
the reliability technology and cost area*

NEN - Vlinderweg 6 - 2623 AX Delft

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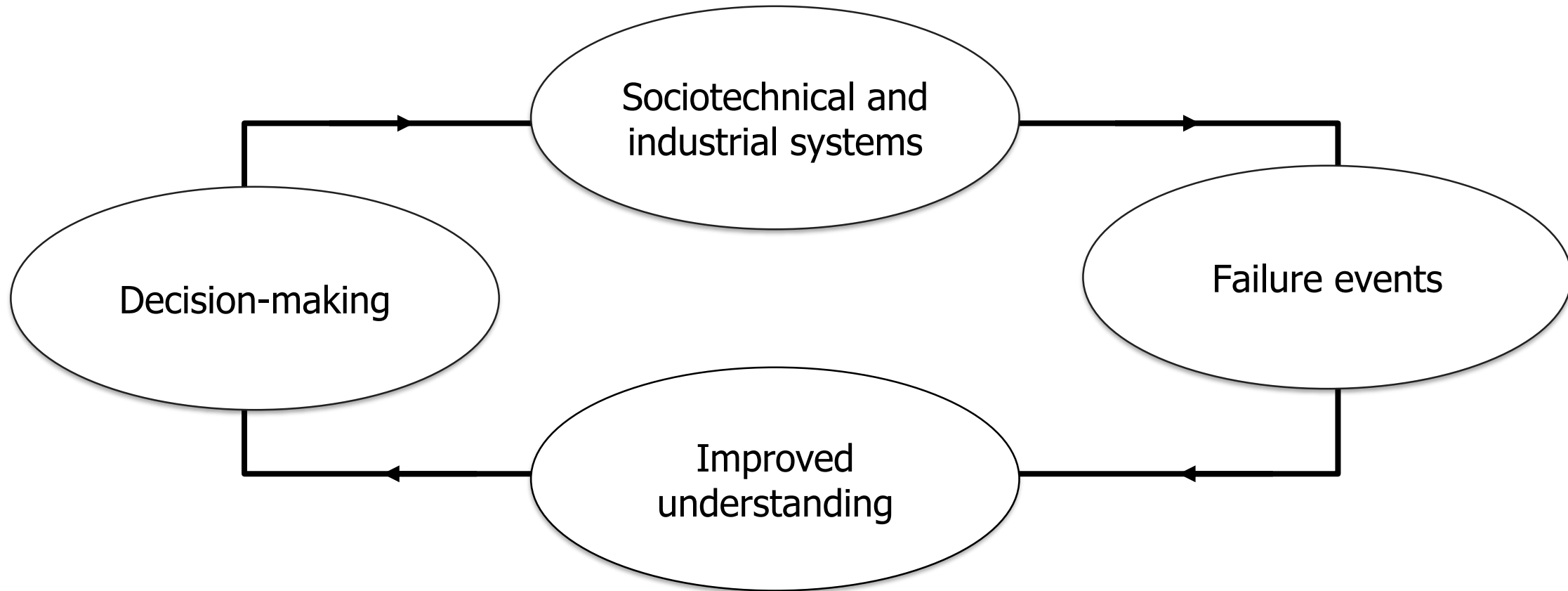
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ISO 14224 technical editor;*

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In this presentation

- ISO 14224:2016
- Socio-technical and industrial systems
- Human error and failure causes
- Focus on: Cost-efficient and safe solutions

Objective: Cost-efficient and safe solutions



System

“A set of things working together as parts of a mechanism or an interconnecting network; a complex whole” (Oxford online dictionary)

Key attributes of a system

A set of inter-related items with purpose & objective



Sociotechnical and industrial systems

Categories

- Technical systems (hardware, software)
 - Human actors and systems (incl. procedures, rules and regulations)
 - Sociotechnical systems
- Here within an industrial context

Sociotechnical systems

“Systems that involves complex interactions between technological, human and environmental aspects of the system”.

A term coined by Emery and Trist (1960)

‘A higher level of complexity’ due to interactions and dependencies between a wide range of system elements.

Is the system understandable as a ‘whole’?

Reliability actors



Failure events

➤ Equipment

Time to and between failures, and time to achieve repair of the items.

➤ Software

Issues concerning whether a software product produces erroneous output (software error). Typically not so relevant with degradation of software.

➤ Humans

The probability that an operator will make an error: HEP

Error

“discrepancy between a computed, observed or measured value or condition and the true, specified or theoretically correct value or condition”
(IEC 60050-192:2015)

Human error information useful for human error modelling

A commonly used measure is the 'Human error probability', HEP:
“probability that an operator will fail in an assigned task” (IEC 62508)

h: number of human errors (within a certain task)

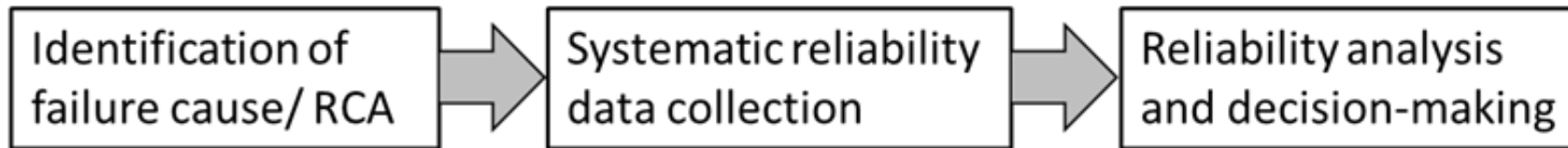
n: number of opportunities for error

$$\text{HEP} = h/n$$

› Note that human can also be initiators of failure events without there being a demand

How to get the relevant information

Improved
understanding



IEC 62740: 2015 - *Root cause analysis (RCA)*

/Human error identification

Operation, maintenance and investigation activities

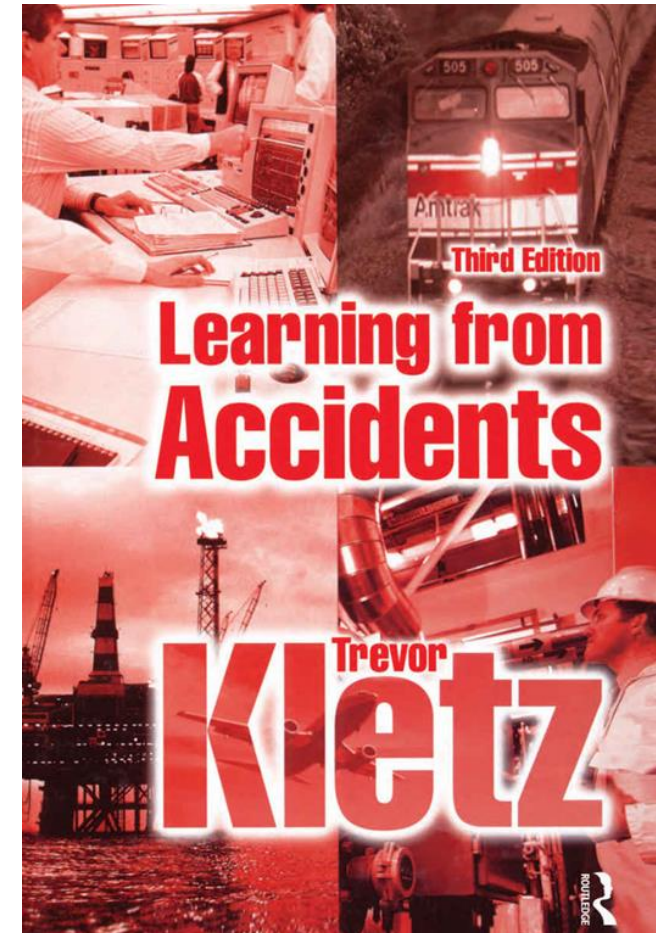
e.g. how to reduce human errors linked to safety critical failures

Purpose of RCA: Understanding of why failures occur

Kletz (2001):

“The underlying causes must be analysed in order to identify recommendations on how to prevent reoccurrence of the events or the occurrence of similar events”.

- Safety critical systems
- High reliability performance
- Design, operation and maintenance



Output from a typical RCA process

- › The root cause analysis may identify multiple root causes
- › Human + technical (equipment) aspects

Root cause = failure cause:

“circumstances associated with design, manufacture, installation, use and maintenance that have led to a failure”
(ISO 14224:2016, 3.24)

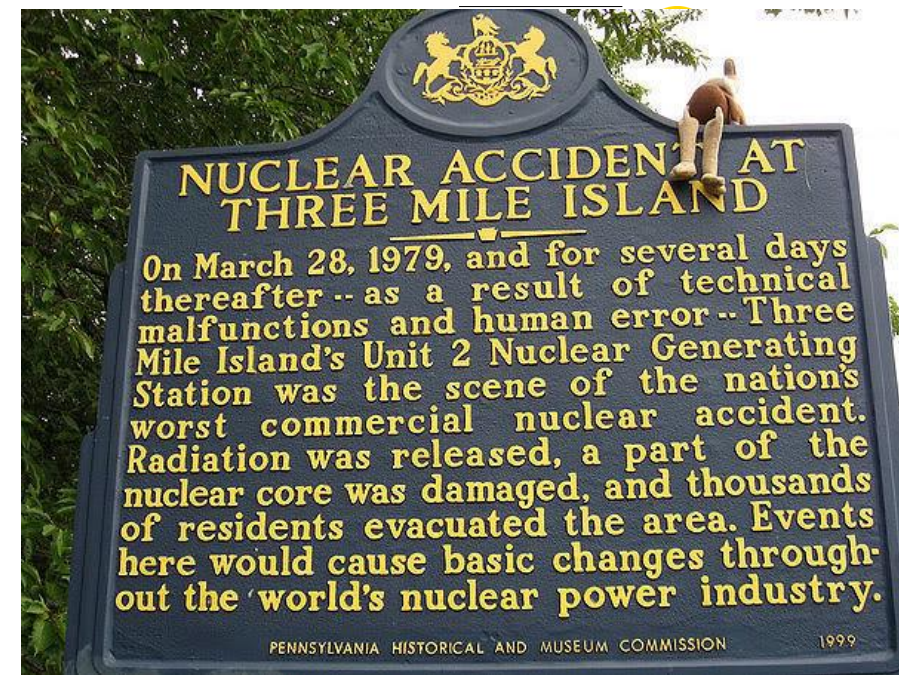


http://www.nytimes.com/interactive/2016/01/29/science/space/challenger-explosion-30-year-anniversary.html?_r=0

Challenge: Failures often caused from a combination of both technical and human aspects



<http://theamericanenergynews.com/wp-content/uploads/2016/02/Deepwater-Horizon.jpg>



http://www.nytimes.com/interactive/2016/01/29/science/space/challenger-explosion-30-year-anniversary.html?_r=0

The human contribution should not be ignored

Human error is identified as a root cause in the majority (between 60% and 80%) of industrial accidents and incidents

Boschee (2014), Aas (2008)

More than 50% of hydrocarbon leaks on offshore installations in the Norwegian sector are caused by human error

Vinnem et al. (2007)

Question:

When collecting information about failure events in the oil and gas industry:

To what extent are relevant information about human errors captured?



http://www.nytimes.com/interactive/2016/01/29/science/space/challenger-explosion-30-year-anniversary.html?_r=0

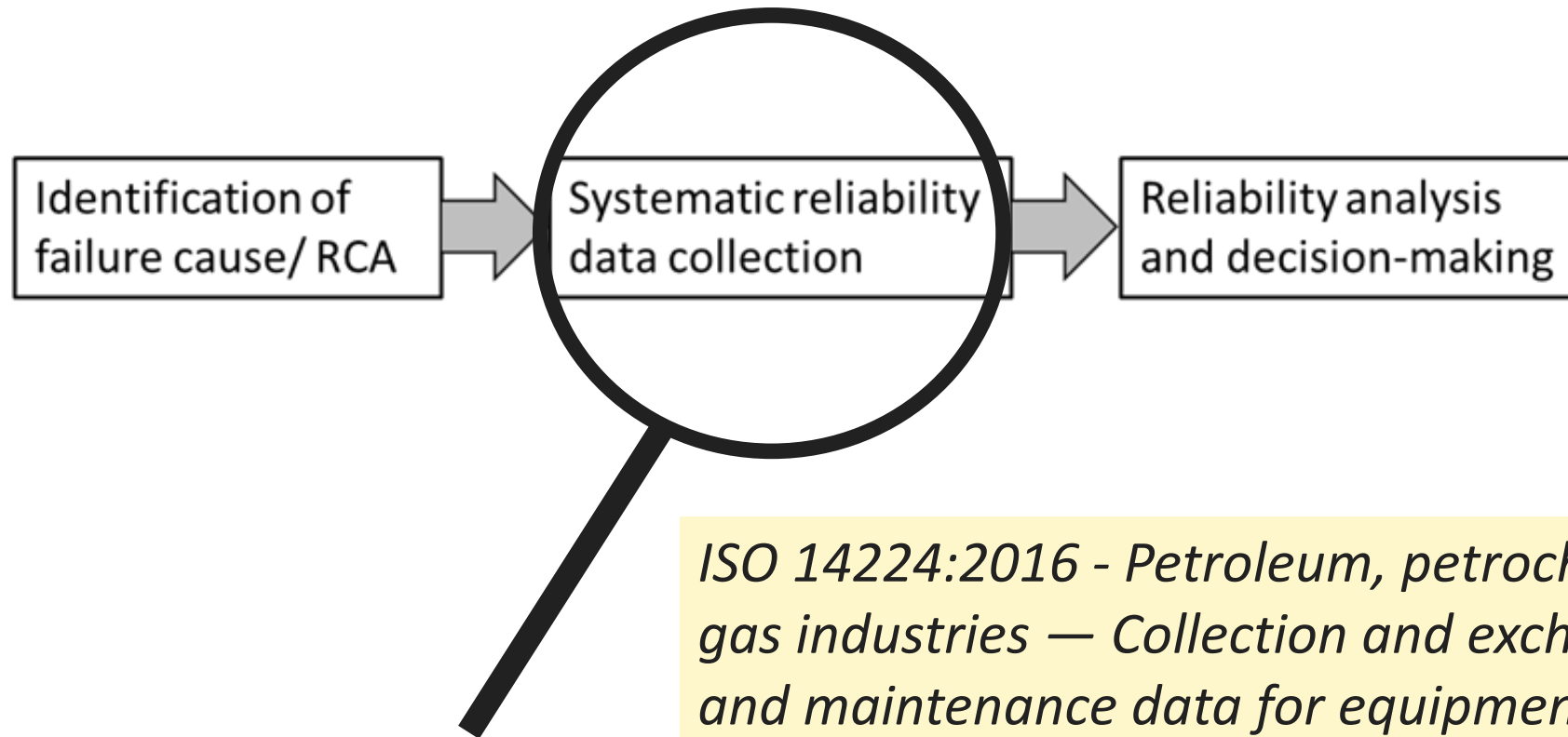
Relevant information

High data quality involves the need of the users and applicability

We need data in a standard format that provides information about:

- › Design-related causes
- › Fabrication/installation-related causes
- › Failures related to operation/maintenance
- › Failures related to management

Are we collecting this information:
What guides the data collection process?



ISO 14224 objective revisited

A main objective is to have a common platform for collecting and exchanging reliability data, where it is important that the data can be analysed and compared in a consistent way.



BSEE warns offshore industry of 'potentially catastrophic' bolt failures



The U.S. Bureau of Safety and Environmental Enforcement has warned the oil and gas industry of a recurring problem with connector and bolt failures in various components used in risers and subsea blowout preventers used in offshore operations.

"These failures are of great concern to BSEE due to their frequency and the potential for a catastrophic event. A previous occurrence of bolt failures in December 2012 prompted a global recall of the bolts associated and a temporary cessation of drilling activities," the BSEE said in a safety alert on Tuesday.

The BSEE said that fact that these failures involved equipment from three primary manufacturers suggests that issue may be a systemic industry

problem that requires immediate attention.

<http://www.offshoreenergytoday.com/bsee-warns-offshore-industry-of-potentially-catastrophic-bolt-failures/> (Posted on February 3, 2016)

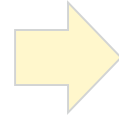
Consistency - “Reliability language”

‘error’ (3.22)

‘human error’ (3.36)

What is an error?

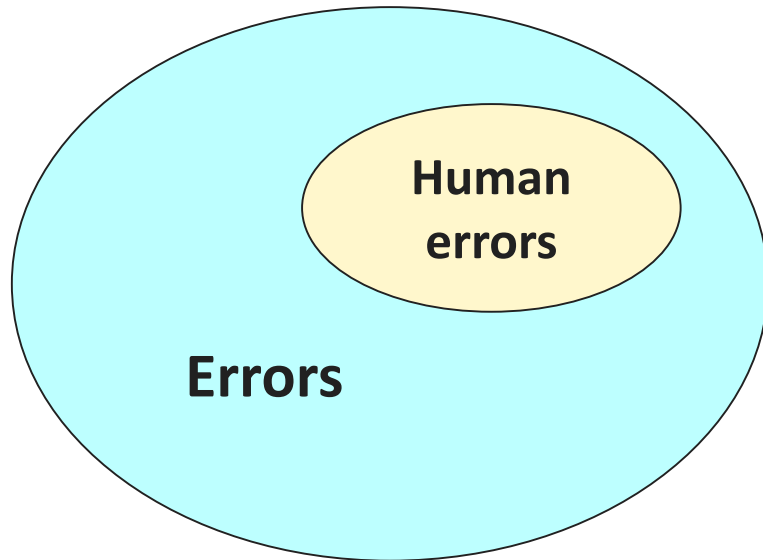
The term 'error' is defined in 45 different ISO standards



Error

“discrepancy between a computed, observed or measured value or condition and the true, specified or theoretically correct value or condition”

IEC 60050-192:2015



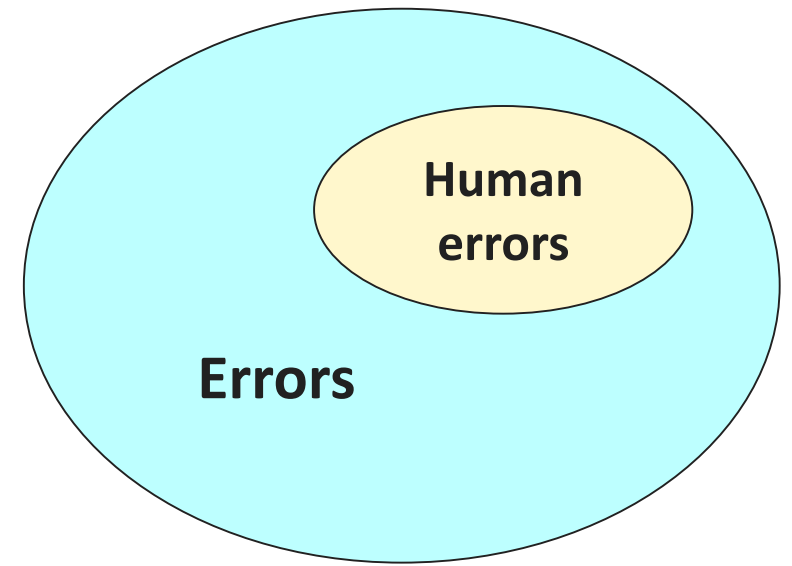
What is a human error?

Error

“discrepancy between a computed, observed or measured value or condition and the true, specified or theoretically correct value or condition” (IEC 60050-192:2015)

Human error:

“discrepancy between the human action taken or omitted and that intended” (ISO 14224:2016, 3.36)



Is violation not a human error?

Human error:

“discrepancy between the human action taken or omitted and that intended”

Reason (1990): Is the intention appropriate?

Yes

Wrongly carried out: Slip

No

Mistake

How are errors collected according to the ISO 14224?

A standard format is specified:

Causes	Subdivision
Design-related	General
Fabrication-related	Fabrication failure/error
	Installation failure/error
Operation/maintenance-related	Operating error*
	Maintenance error*
Management-related	Documentation error*
	Management error
Miscellaneous	Common cause
	Combined causes

* This failure cause relates to human errors.



More detailed information should be collected

Decision-making

A standard format is specified for consistency purposes,
but this is not sufficiently detailed to capture the underlying failure causes from a human error perspective

Additional data collection may be performed to achieve appropriate information for human reliability assessment (HRA) decision-support

› Ref. ISO/TR 12489:2013, Annex H, for more information on HEP and performance shaping factors



Lack of breakdown into human error categories

The ISO 14224:2016 (Annex B) indicates which of the failure causes involve human error, but does not in general guide a further breakdown:

- › No breakdown into skill, rules, knowledge dimensions
- › No breakdown into mistakes, lapses, slips (or violations)
- › Reference is made to ISO/TR 12489:2013 (5.5 Human factors)

Difficult to assess why the human errors occur, which have effect on data quality!

What is the most important cause?

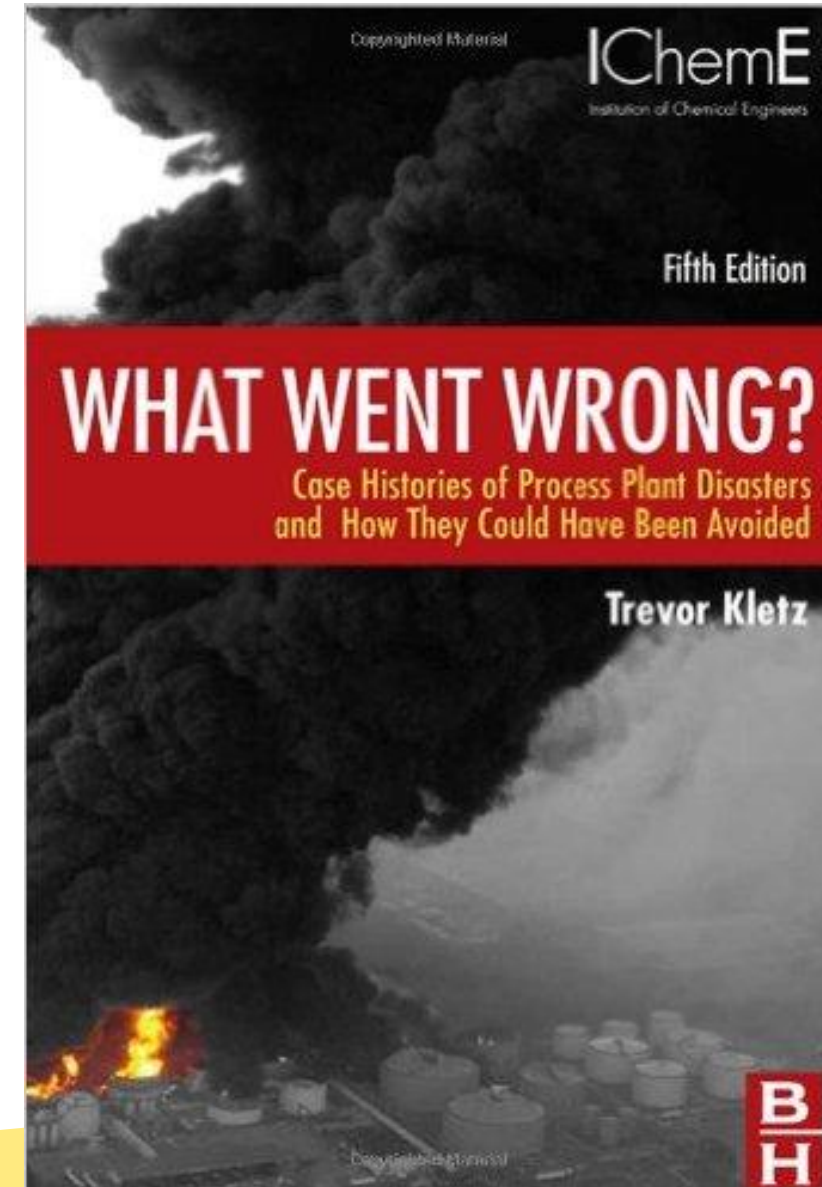
ISO 14224:2016, C.7 - Human error as underlying contributor to equipment performance:

“Human error as an underlying cause of an equipment failure can always be considered as a possibility”

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Trevor Kletz (2009):

“To say accidents are due to human failing is like saying falls are due to gravity. It is true but it does not help us prevent them”



Some final remarks

ISO 14224 gives solid guidance for which failure causes are to be collected, but it is not considered within the scope of this international standard to capture a full human error picture.

The new ISO 14224 gives more focus on “human errors” compared with the 2006 edition:

- › Clarification of which failure causes relate to human errors
- › Provides a consistent “reliability language” linking the terms “error” and “human error” in an appropriate way.

Thank you for the attention!

