Human error and recovery

in the chemical process industry

- the positive contribution of human operators during incidents

Tjerk van der Schaaf & Lisette Kanse

Eindhoven University of Technology

Human Performance Management Group

/faculteit technologie management

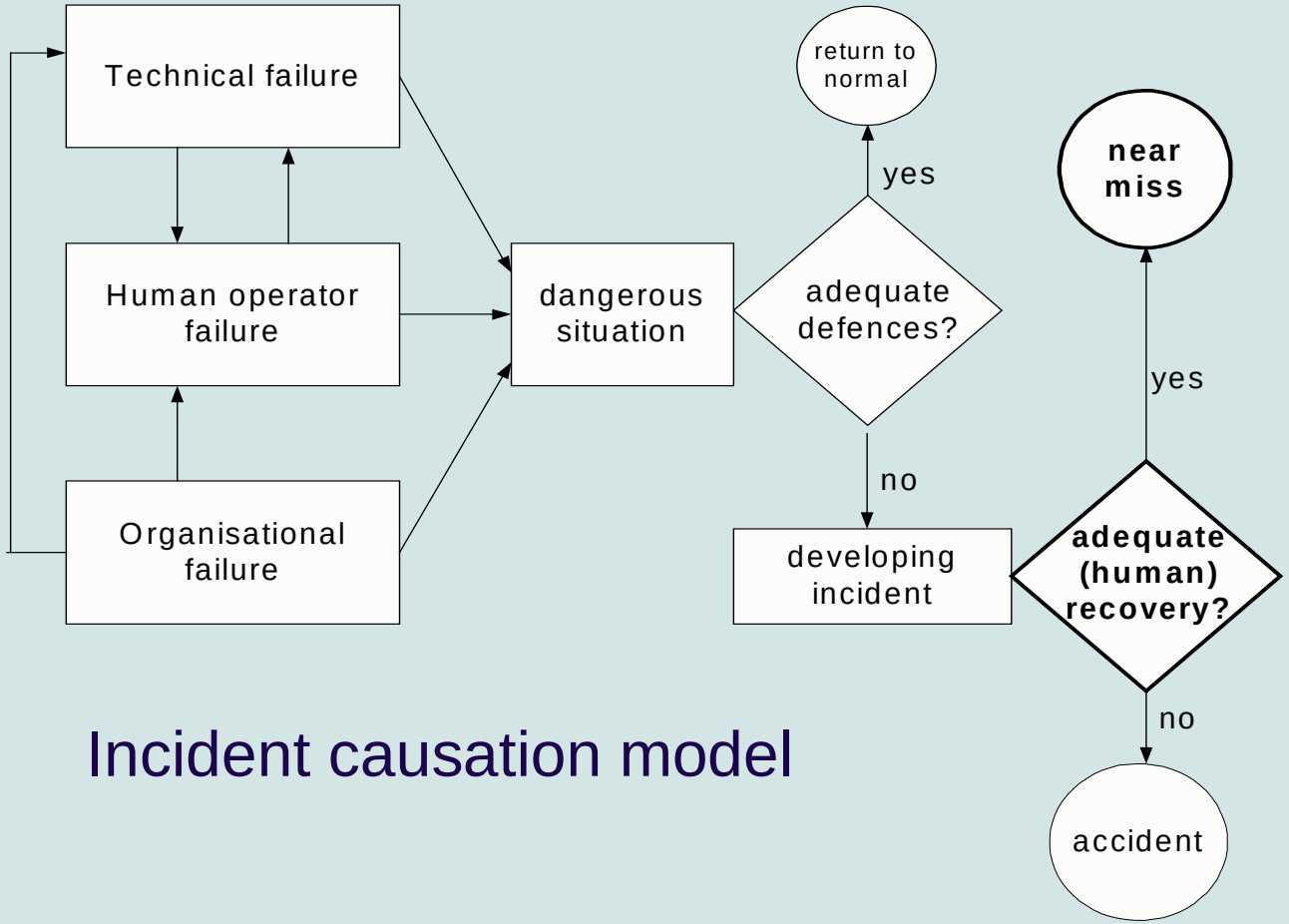
Overview

- Why recovery?
- Modelling recovery behaviour
  - failures, consequences and recovery
  - actions involved in recovery
- Recovery, near misses and reporting systems
  - learning about recovery from near misses
  - reporting biases
  - analysing recovery root causes

Why recovery?

- Not all failures can be foreseen
- Even foreseen failures can not always be prevented
  - measures impossible
  - measures not cost-effective

Failures, consequences and recovery



Incident causation model

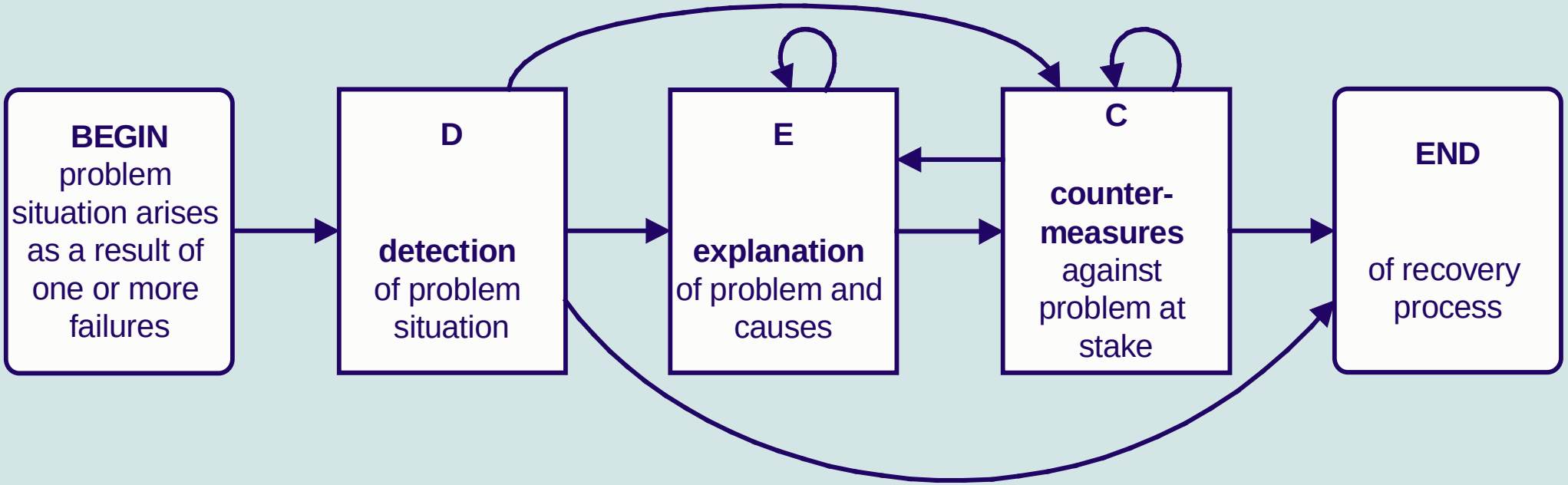
failures

deviation

planned recovery

unplanned (ad-hoc) recovery

Actions involved in recovery

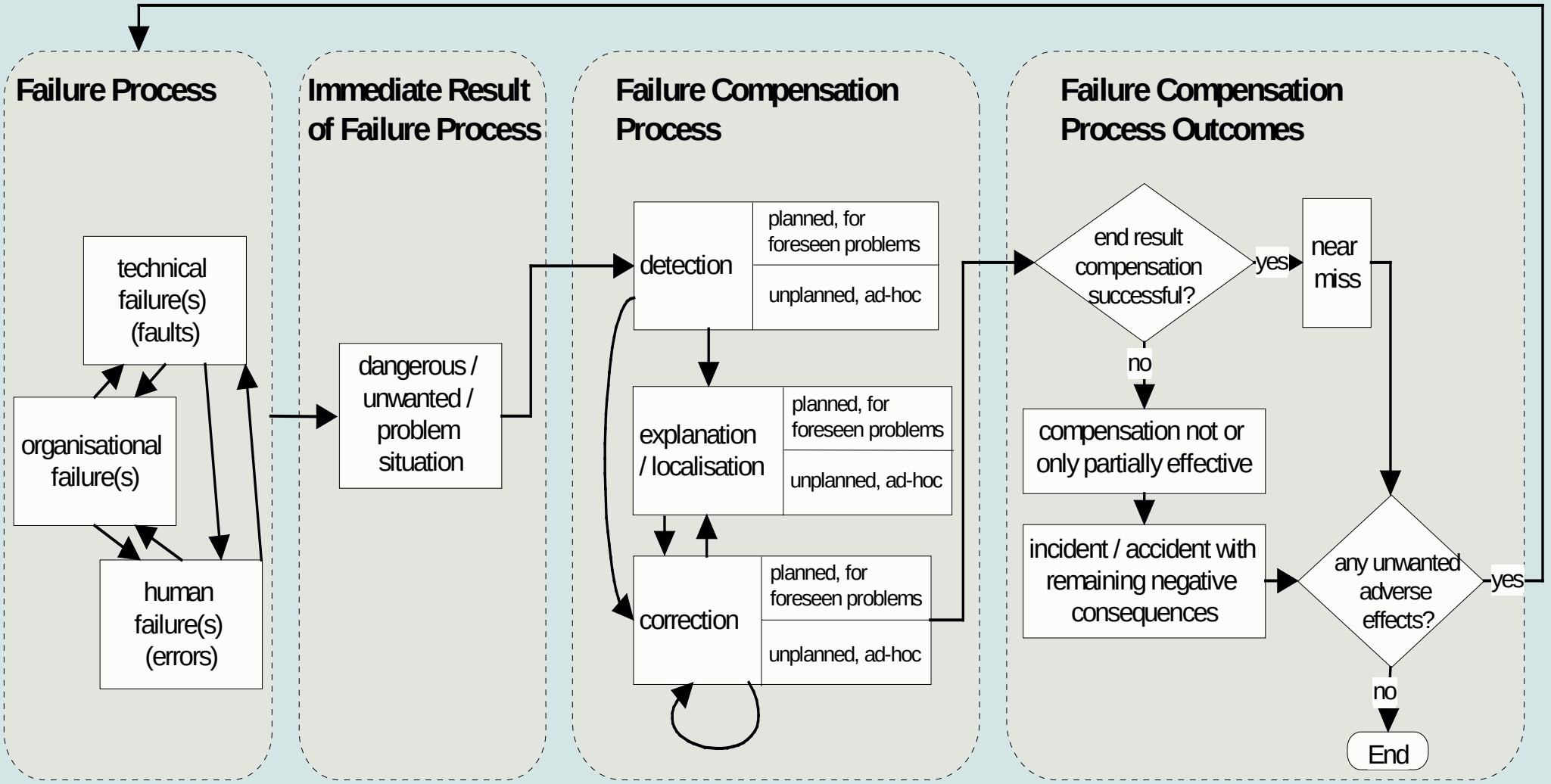


Recovery process phase model

Taking a closer look

- detection
- explanation:
  - definition of problem
  - identification of causes
- countermeasures:
  - stabilization
  - mitigation
  - temporary correction
  - permanent correction

Recovery process in incident causation model



Examples of recovery scenarios

- Simple:

  e.g. case where field operator forgets product sample
  (detection – permanent correction)

- More complex:

  e.g. case with defect in signal transmitter for flow indicator
  (detection – stabilization – definition of problem – investigation of causes – temporary correction – permanent correction)

Learning about recovery from near misses

- near miss reports lack recovery information
- near miss = failure + recovery
- failure root cause database → preventive measures
- recovery root cause database → recovery promotion

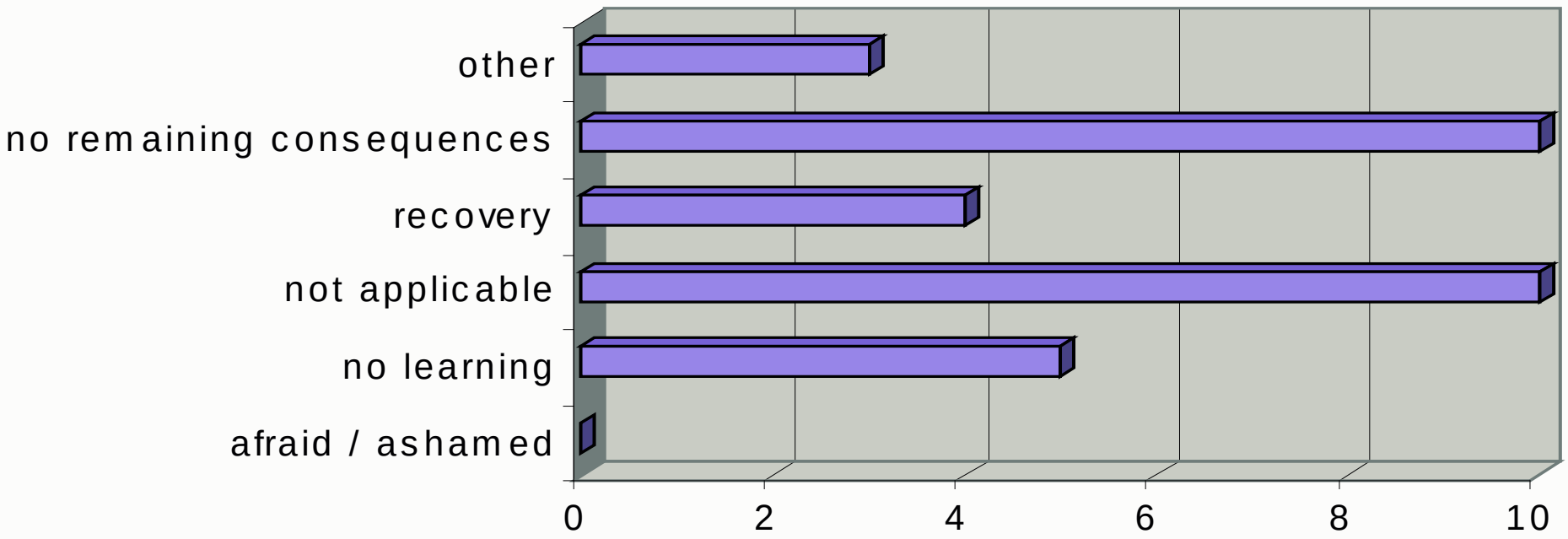
Recovery promotion

- detection: observability
- explanation: traceability
- countermeasures: reversibility

Reporting biases

- Possible reasons?

Reporting biases

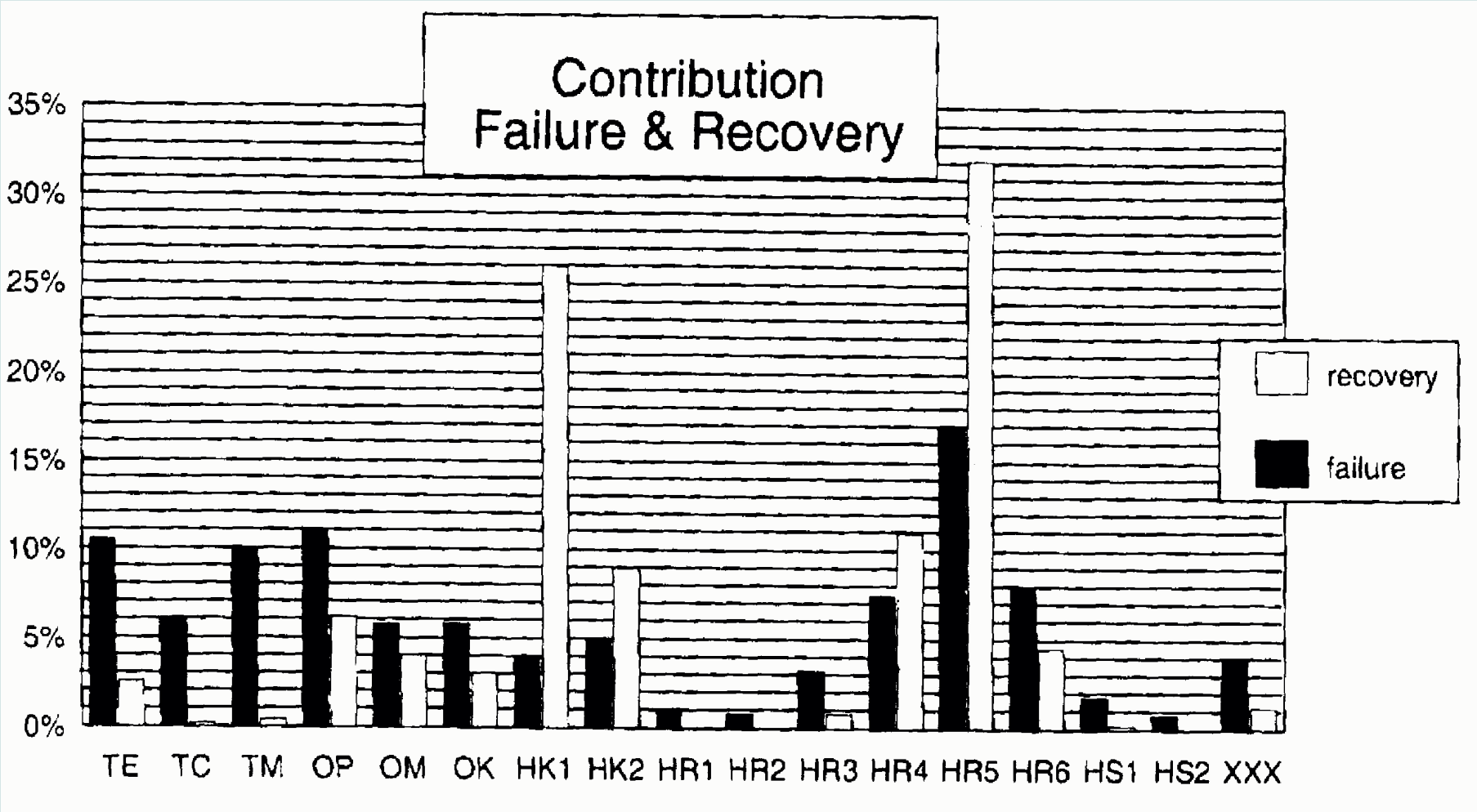


Distribution of 32 reasons given by 21 operators for *not* reporting 25 “diary incidents” to the existing near miss reporting system

Overcoming reporting biases

- management has to convince operators of the value of successful recoveries of all types of errors
- human operators as the strong link in the chain!
- top-down and bottom-up approach to near miss reporting system design

Analysing recovery root causes (1)



Analysing root causes (2)

	planned recovery	unplanned recovery
human	p-H	up-H
technical	p-T	up-T
organisational	p-O	up-O
other		up-X

Further reading

- Kanse, L., & Van der Schaaf, T.W. (2001). Recovery from failures in the chemical process industry. *International Journal of Cognitive Ergonomics, 5*(3), 199-211.
- Van der Schaaf, T.W., & Kanse, L. (in press). Biases in incident reporting databases: An empirical study in the chemical process industry. *Safety Science.*
- Van der Schaaf, T.W. (1992). Near miss reporting in the chemical process industry. PhD thesis, Eindhoven University of Technology.
- Kanse, L. (early 2004). How people recover from failures – theoretical and empirical studies in the chemical process industry. PhD thesis, Eindhoven University of Technology.
- Van der Schaaf, T.W., & Kanse, L. (2000). Errors and error recovery. In P.F. Elzer, R.H. Kluwe & B. Boussoffara (Eds.), *Human Error and System Design and Management* (pp. 27-38). London: Springer Verlag.
- Kanse, L., & Van der Schaaf, T.W. (2001). Factors influencing recovery from failures. In R. Onken (Ed.), *Proceedings CSAPC '01, 8th Conference on Cognitive Science Approaches to Process Control,* September 24-26, 2001, Universitat der Bundeswehr, Neubiberg, Germany.

Conclusions

- Reporting and analysing recovery is valuable
- Recovery promotion can be supported by proper system design
- Lessons for other high-risk domains