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 cannot 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**

- ** BEGIN **
  - problem situation arises as a result of one or more failures

- ** D **
  - detection of problem situation

- ** E **
  - explanation of problem and causes

- ** C **
  - counter-measures against problem at stake

- ** END **
  - of recovery process

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

- **Failure Process**
  - technical failure(s) (faults)
  - organisational failure(s)
  - human failure(s) (errors)

- **Immediate Result of Failure Process**
  - dangerous / unwanted / problem situation

- **Failure Compensation Process**
  - detection
    - planned, for unforeseen problems
    - unplanned, ad-hoc
  - explanation / localisation
    - planned, for unforeseen problems
    - unplanned, ad-hoc
  - correction
    - planned, for unforeseen problems
    - unplanned, ad-hoc

- **Failure Compensation Process Outcomes**
  - end result compensation successful?
    - yes
    - near miss
      - any unwanted adverse effects?
        - yes
        - End
        - no
      - compensation not or only partially effective
        - incident / accident with remaining negative consequences
          - yes
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)

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<thead>
<tr>
<th>Category</th>
<th>Planned recovery</th>
<th>Unplanned recovery</th>
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<tbody>
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<td>Other</td>
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Further reading


Conclusions

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