Resilience Abilities in Recent Blowouts in the Petroleum Industry

Siri Andersen
Norwegian University of Science and Technology

Eirik Albrechtsen
SINTEF Technology and Society
Purpose


Source: Transocean

Source: PSA
Offshore drilling is more complex than dentist drilling...
Offshore drilling

- High degree of variability and uncertainty related to events and strain

- “It’s dark down there”
  - Red Adair

- “Things never go according to plan”
- “…changes and unknowns happens constantly”
- “..changes and adjustments happen all the time”
Approach

- Literature reviews on accident investigation reports
- Categorized in tables according to Resilience Engineering abilities: anticipating, monitoring, response, learning

Lessons learned:
- Difficult to separate between the abilities
- Premises for the abilities (underlying qualities) needed to be addressed
The Deepwater Horizon accident

- April 20, 2010 in the Gulf of Mexico
- From a planned exploration well to a production well
- Well control event during late phase of the temporary abandonment procedure
- Hydrocarbons escaped the well and followed the riser up to the drill floor, causing explosion and fire
- 11 workers were killed. Oil leakage for 87 days.
Resilient abilities in the Deepwater Horizon accident – main findings:

- Poor risk assessment and management of change processes
  - Last minute changes not assessed
  - Lack of involvement of experts
  - Parts of the system vs the total system

- Learning and sharing information
  - BP accidents in the 2000s
  - Transocean similar near-miss
  - Cement quality not communicated by Halliburton to BP

- Interpretation of well integrity tests

- 50 minutes of kick signals without any reaction
Interpretation of well integrity

- Ambiguous signals on the quality of the cement job
  - Inadequate risk awareness
- Negative pressure test the only possibility to evaluate the integrity of the cement job
- For 3 hours the test repeatedly showed that the well lacked integrity
- The test was incorrectly declared successful
  - Poor interpretation of data
  - No critical questions asked
  - No involvement of experts
  - “Bladder effect”
- Should have placed extra precaution and awareness for later phases

Chief Counsel’s report (2011)
The Snorre A incident

- November 28, 2004, Norwegian continental shelf
- Old well (1994) known as problematic
- Well control event during preparation for drilling a sidetrack
- Uncontrolled gas blowout on the seabed and through the piping, leading to gas under and on the installation
- The crew who stayed onboard managed to kill the blowout
- Characterized as one of the most serious incidents occurred on the Norwegian shelf

Rosness et al (2010)
Resilient abilities in the Snorre A incident – main findings:

- Poor risk assessment and management of change processes
  - Inadequate assessment of changes
  - Lack of involvement of Snorre A crew and onshore experts
  - Risk review postponed

- Failure to learn from earlier incidents and use knowledge and experience outside the Snorre A organization

- Monitoring during the whole operation
  - Problems interpreting signals, however job is continued
  - Continued mud loss lead to more tests and increased vigilance
  - Gas detected in several modules.
  - Sea “boiling” with gas. Emergency shut down activated
Successful response at Snorre A

Response characterized by adaption, e.g.:
- Rerouting air intake from external to internal in cement rooms
- Inspection rounds to monitor critical rooms that had lost ventilation and overpressure and doors kept open to prevent temperature from getting too high
- Main power switched on after no observation of gas for one hour.
- During the kill operation the crew run out of mud two times and more mud had to be mixed

Ability to monitor and assess the situation a prerequisite for the response

Important qualities:
- Long experience and local knowledge among the personnel
- All-round competency
- Good relationship and internal structures among actors at the platform
- The crew had worked together for a long time
- Trust among crew members
- Incorporated ability to fast, flexible, simple response
- Effective communication

Source: PSA
Comparison of the incidents

- Complex operations and conditions
- Changes were made without proper risk assessment and evaluation of barriers
- Poor communication and sharing of information
- Experience transfer
- Signals of problems not interpreted sufficiently
- Difference: the Snorre A succeeded in preventing an accident
  - At Snorre A established increased vigilance towards what was going on at an earlier stage
  - Basic qualities (time, resources, skills, collaboration) in place to handle the event successfully
How can resilience be engineered to prevent future blowouts?

- The nature of drilling and well operations justify a resilience-based approach to safety management
- Improve resources for monitoring what is going on
- Involve the onshore organisation
- Better systems for information sharing between actors
- Improve methods of operational assessments and management of change
- Improve skills related to responding to unexpected events.
- Development and implementation of new technology and work processes at the shelf can be an enabler