High Reliability Organisations and Drilling

John Thorogood
Macondo: a non-technical summary

• Failure to pick up on weak signals:
  • Discarding concerns over simulator results
  • Concerns over cement sample tests
  • Inconsistencies in converting the float collar

• Cognitive bias:
  • Acceptance of bladder effect (group think)
  • Pressure anomalies (Confirmation bias)
  • Failure to detect flow (ditto)

• Failure to Manage Change:
  • “Evolution” of programme
  • Lack of rigorous control

SPE 151338: Is there a Place for High Reliability Organisations in Drilling? Thorogood
Characteristics of HROs

Anticipation & Awareness of the Unexpected

• **Preoccupation with Failure**: Chronic unease about safety, analytic errors, unexplained failures

• **Reluctance to simplify interpretations**: technical work is documented, reports are independently checked

• **Sensitivity to Operations**: Everybody is aware of what is happening, what it means and what may happen

Containing the Unexpected

• **Commitment to Resilience**: the organisation is able to improvise and respond competently to surprises

• **Deference to Expertise**: technical decisions are referred to those with the expertise to make them
How Do We Embed the Mindset?

**Leadership Culture**
- Rigorous Process Safety Performance Management
- Chronic Unease around barriers and safety-critical systems
- Leadership that moderates goal conflicts

**Operational Discipline**
- Standardised chain of command and decision-making procedures
- Clear levels of decision-making authority
- Demonstrated competence through immersive training and assessment

**Non-technical Skills**
- Situation Awareness
- Decision-making
- Teamwork
- Communication
- Leadership
- Stress Management
Driver: Performance Management

- Focus reporting on health of barriers to Major Accidental Events
  - Underpins intent of Operator technical policy and standards
  - Previously overlooked, now highly relevant post-Macondo
  - Identify key un-wanted events using Bowtie analysis
  - Identify barriers between threats and consequences
Major Accident Event Performance Measures

• \textbf{Tier 2: “Near-miss” Events}  
  – Influxes contained by barriers  
  – Failures of safety-critical systems

• \textbf{Tier 3: Challenges to Safety Systems}  
  – Double barrier standard compromised,  
  – Anti-collision tolerance line crossed,  
  – Failure of monitoring system

• \textbf{Tier 4: Operational Discipline}  
  – Dispensations, certification of people & kit  
  – MoC, Drills, standard & procedures current
Why aren’t Emerging Incidents Noticed?

Cognitive biases:
• Confirmation Bias
• Group-think
• Tunnel Vision
• Illusion of Knowledge
• Goal Focus
• Framing

How often are such psychological factors addressed in incident reports?

What steps can be taken to address psychological factors?
# Structure of Non-technical Skills

<table>
<thead>
<tr>
<th>Non-technical skills</th>
<th>Description</th>
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<tbody>
<tr>
<td>Situation awareness</td>
<td>Gather information from relevant sources, diagnose the situation and anticipate how the situation might evolve</td>
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<tr>
<td>Decision making</td>
<td>Reach a judgment or choose an option to meet the needs of a given situation</td>
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<tr>
<td>Communication</td>
<td>Exchange appropriate information using a range of techniques and formats to achieve effective interaction</td>
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<tr>
<td>Teamwork</td>
<td>Work effectively and interdependently with two or more people to achieve a common goal</td>
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<tr>
<td>Leadership</td>
<td>Influence and support others by acting as a positive example, providing guidance and direction, and managing workload and resources</td>
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<tr>
<td>Stress management</td>
<td>Recognize, and manage the adverse reaction that self and others have, or may have, to excessive pressure or demands placed upon them</td>
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Training Non-technical Skills

Introduce the psychological theory of biases
  •  Impact of biases on thinking process and decision making

Teach concepts underlying non-technical skills
  •  Demonstrate how they counter the biases

Combine Theory and Practice
  •  Simulator sessions to practise and apply new information

Develop the practice of Threat and Error Management
  •  Ground risk assessment in reality to systematise chronic unease

Check understanding of theory and practice
  •  Directed feedback and debriefing

Continue coaching into the workplace
  •  Supervisors trained in NTS and included in briefings and debriefings

Provide recurrent training and assessment
  •  Continuously reinforced within workplace and working life

SPE 163489: Operational Control & Managing Change, Thorogood & Crichton
How do we know this works?:
A case study

- Deep water rank wildcat well; multi-cultural operational team
- Week-long intervention (pre-spud):
  - executing operations
  - managing change
  - considering impact of non-technical skills
- Decision exercises featuring potential dilemmas
- Guided feedback and reflection

Session 4, Exercise 6 – Tier 1 - “Getting out of a Sticky Problem”
After an Titanic struggle on the previous well in Brazil, the DrillMax was finally released to YPF two months late, in mid-May. The transit down to Comodoro was uneventful and the rig arrived on location and commenced operations on 6th June. However, having missed the weather window, progress has been slow with frequent storms interrupting progress and the severe conditions pushing the limits of the rig’s station-keeping capabilities.

It is now mid-July and the well is three weeks behind schedule. Downtime is running at 30%. The additional time has already forced an over-run of $25 million on the well cost, and on present trends this total is only going to increase further. YPF management are concerned about the costs and lack of progress and are under pressure from the Partners to bring the well to close as soon as possible while minimising compromises in the primary well objectives.

The 13½” casing was set as planned at 1,032m, cemented back to seabed and the BOP stack run and tested. The shoe-track was drilled and a formation integrity test conducted to 11.3 ppg MWE. Drilling of the 12½” hole was slower than expected due to severe drilling vibrations, but continued to the planned TD of 1,442m. At 1,216m an 8m thick sand was drilled that produced high gas readings and bright fluorescence on the cuttings.

After completing the logging at TD the LMRP had to be unlatched in advance of a severe storm. Two weeks later, when the conditions had subsided and the LMRP reconnected, it was found that hole conditions had deteriorated and heavy reaming and a mudweight increase of 0.3ppg was required to get back to bottom. Even then, conditions were not ideal but it was decided to run the 9½” casing anyway.

The casing job is underway and you are in the middle of the morning call when the duty toolpusher barges into the meeting room to announce that the casing is stuck without warning at 1,297m. The forecaster has just told you that the next storm is expected to reach the location in 24 hours time, forcing another disconnect. You’ve quickly finished the morning call having sorted outstanding logistics issues and have agreed to call back on the concall line in 45 minutes time to discuss options and the way forward.

What are you going to do?

Why?
Elements of Operational Control

1. How Drilling Programmes are written
2. Process for generating Written Work Instructions
3. Procedures for monitoring the operation
4. Handling deviations and changes (MoC)
5. Decision-making Protocol (eg.: RAPID®)
6. Operational Discipline
7. Operational doctrine and rules
8. Competency, Training and Assessment
Operational Control of Work

- Geological Prognosis
- Drilling Programme
- Drilling Contractor SOPs
- Company Man Toolpusher
- Daily Drilling Instructions
- Driller Immediate Actions
- Driller
- Operations Monitoring
- Drilling Superintendent
- Drilling Manager
Decision-making Structure

Where

- Office-based
- Office-based; not usually at rig site
- At rig site

Who

- TIER 3 – Gold Drilling Manager
- TIER 2 – Silver Drilling Superintendent
- TIER 1 – Bronze Drilling Supervisor

What

- Decisions relate to Policy, longer term planning and well objectives. Management stakeholders will be engaged if changes to well objectives, scope of the operation or overall well cost are required. Changes may require partner and regulatory approval.

- Decisions may impact well integrity and require programme amendments, or affect well duration or cost within defined limits. Can involve activation of planned contingencies or decision-trees. May necessitate changes to the well design so long as well objectives and cost remain intact.

- Execute plan to achieve well objectives. Decisions have no impact on well integrity or well objectives. Responsible for developing Driller’s Instructions, setting or optimising operating parameters within programmed limits, taking actions following satisfactory completion of programmed operations or tests.
Watching for Deviations

**Tier 1 - Bronze**
- Condition: Nominal
- Decision: Drilling Supervisor

**Operational Limits set in Drilling Programme**

**Rig & OOC Monitoring**
- Data validation
- Cross-check with driller

**Anomaly Validated?**
- No
- Yes
  - Advise Drilling Supervisor “Off Nominal”

**Tier 2 - Silver**
- Condition: Off Nominal
- Decision: Drilling Superintendent

**Drilling Superintendent Confirms Off Nominal Condition**

**Mud Logger & Ops Centre continue Monitoring**

**Condition Exceeds Off-nominal?**
- No
  - Drilling Superintendent Confirms Off Nominal Condition
  - Advise Drilling Supervisor “Abnormal”
  - Resume Planned Operations

- Yes
  - Potential Abnormal Condition?
    - No
      - Condition Resolved?
        - Yes
          - Resume Planned Operations
        - No
          - Drilling Superintendent Confirms Abnormal Condition
          - Advise Drilling Superintendent “Abnormal”
          - Resume Planned Operations
          - Drilling Team, Specialists, OOC assess options & develop solutions, risk assessment & MoC
    - Yes
      - Drilling Manager approves action including MoC

**Tier 3 - Gold**
- Condition: Abnormal
- Decision: Drilling Manager

**Drilling Manager confirms Abnormal Condition**

**Drilling Superintendent Confirms Abnormal Condition**

**Drilling Manager approves action including MoC**

**DM consults stakeholders**

**Condition Resolved?**
- No
  - Drilling Team, Specialists, OOC assess options & develop solutions, risk assessment & MoC

- Yes
  - Resume Planned Operations

**SPE 163489: Operational Control & Managing Change, Thorogood & Crichton**
Drilling Contractor: the “now” state...

• The present interaction
  – Focus on occupational health and safety, not process safety / major accident risk
  – Safety at the expense of performance
  – Traditional master-servant relationship
  – Lack of appreciation of what happens downhole
  – “Machinery operator”
Drilling Contractor HRO: future state...

**Progressively develop HRO Attributes**
- Drive towards high level of Operational Discipline
- Institutionalise chronic unease (Shell)
- Systematically train decision makers in non-technical skills

**Assert due diligence over Operator**
- Interdependent technical relationship, peer to peer
- Review drilling programme against standards and accept (or not!)
- Assess and accept Operator’s supervisors as competent (or not!)

**Implement procedures for:**
- preparing and approving written work instructions,
- monitoring the operation and handling deviations
- Structured decision making

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Conclusions

1. Address human and social aspects to detect weak signals and develop a state of chronic unease
2. Assure competence in non-technical skills to overcome psychological traps
3. Codify procedures for executing and monitoring well operations, making decisions, and managing change within a Standardised Operational Framework.
4. Adopt a high level of operational discipline in the execution of workplace activities
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