Going from Hindsight to Foresight
Crew Resource Management

PSA, Stavanger, 27 November, 2013

Rhona Flin
Industrial Psychology Research Centre
University of Aberdeen
Safe and Efficient Performance

Latent Conditions

Organisational / Professional Culture

Professional Behaviour

Technical & Non-Tech. Skills

Individual actions

Job Performance
Non-Technical/ CRM Skills

- Leadership
- Team Work
- Communication
- Situation Awareness
- Decision Making
- Personal Limitations – managing stress and fatigue
Crew Resource Management

To address these identified weaknesses in individual and crew performance - new training devised.

“using all the available resources- information, equipment and people- to achieve safe and efficient flight operations.” Lauber, 1977

CRM training provides a set of countermeasures against human error; it is based on the premise that human error is ubiquitous and inevitable.

Helmreich (1996)
Crew Resource Management

- Based and updated on human factors research identified as critical for safe crew performance
- Developed by psychologists and pilots, delivered by pilots
- 2-3 days basic training (inc. videos, role-plays, etc.)
- Annual recurrent training
- Practised with feedback in simulator (LOFT)
- Pilots’ CRM/NTS skills formally assessed (eg NOTECHS)
Tenerife (1977)

Two Boeing 747s crashed into each other on the runway. 583 people killed.

Causes: conflict resolution, lack of assertiveness, communication failures, poor situation awareness, stress – non-technical skills
Closing the NTS/CRM Loop

- Behaviour/Safety Problem
- Task Analysis/Accid. analys
- Identify NTS & conditions
Closing the NTS/CRM Loop

Monitor
Evaluate

Behaviour/Safety Problem

Task Analysis
Accid. analy

NTS/CRM training

Identify NTS & conditions
Identifying Pilots’ Non-Technical Skills

• Task analysis from 1979
  – Flight deck or simulator observations
  – Interviews with pilots
  – Surveys of pilots’ attitudes, experiences
  – Confidential safety reporting systems
  – Accident analysis, especially analysis of cockpit voice recorder
Offshore Installation Black Box?
What would be on your voice recorder?

“........”

“......”
Offshore Installation Black Box?

“My way is much quicker....”

“Did the driller say increase?”

“What’s the mud guy complaining about now.?.”

“No-one ever follows that procedure...”

“I knew that was going to happen...”
**Pilots’ Non-Technical Skills**

NOTECHS system (1998)

Pan-European

Behaviour rating method to assess a pilot’s non-technical (CRM) skills.

Recommended by CAA

Adopted by some airlines, adapted by others.

<table>
<thead>
<tr>
<th>Categories</th>
<th>Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Situation Awareness</td>
<td>Gathering Information</td>
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<tr>
<td></td>
<td>Understanding Information</td>
</tr>
<tr>
<td></td>
<td>Projecting and anticipating future state</td>
</tr>
<tr>
<td>Decision Making</td>
<td>Considering options</td>
</tr>
<tr>
<td></td>
<td>Selecting and communicating option</td>
</tr>
<tr>
<td></td>
<td>Implementing and reviewing decisions</td>
</tr>
<tr>
<td>Communication and Teamwork</td>
<td>Exchanging information</td>
</tr>
<tr>
<td></td>
<td>Establishing a shared understanding</td>
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<tr>
<td></td>
<td>Co-ordinating team</td>
</tr>
<tr>
<td>Leadership</td>
<td>Setting and maintaining standards</td>
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<tr>
<td></td>
<td>Supporting others</td>
</tr>
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<td></td>
<td>Coping with pressure</td>
</tr>
</tbody>
</table>

Yule et al. *Medical Education*
Evidence for CRM effectiveness
(Salas 2006; O’Connor 2008)

• Reactions to training
• Attitude shift
• Learning
• CRM skills (behaviour) measurement
• Organisational indicators eg accident data
• Accounts from pilots

Results - limited empirical evidence but what there is, is positive
CRM training beyond the cockpit

• Nuclear Power Industry
• Air Traffic Control
• Hospital operating theatres
• Fire service
• Systems analysts
• Rail industry
• NASA mission control/ astronauts
• Merchant Navy (Bridge/ Engine Room Resource Management)
• Mining
Linking CRM training to the SMS
CRM: learning from accidents

Air France AF447, Airbus 330
Rio de Janeiro to Paris
1st June 2009
Crashed into Atlantic Ocean
Loss of 228 passengers and crew

The design of training must be such that it generates surprise and startle to teach pilots how to react and work in stressful situations.
Startle Effects

• Distinction: startle/ surprise with fast recovery and startle with associated fear response
• High emotional component from fear disrupts cognition
• Ongoing research into this topic applied to pilots to build into CRM training
Factoring the Human into Safety: Translating Research into Practice

Prof. Rhona Flin, Dr. Kathryn Mearns, Rachael Gordon, Paul O’Connor & Sean Whitaker
Industrial Psychology Group

(1998 - 2000)

Develop a bench-marking study of safety.
Develop Crew Resource Management for offshore teams.
Analyse the human factors causes of offshore accidents.

Sponsored by: Agip, AMEC, AOC/Brown & Root, BP/Amoco, Coflexip Stena, Conoco, Elf, Health & Safety Executive (OSD), Oryx, Salamis, Sedco Forex, Shell, Texaco, Total.

University of Aberdeen
Summary of US (Outer Continental Shelf) causes of Incident 1995-96.
Analysis of cause of incident of a major Offshore Oil Operator in 1997 (n=276)

- Equipment/technical failure: 28%
- Error/omission: 28%
- Violations: 33%
- Design failure: 12%
Drilling rig accident analysis: Main causes

- Technical
- Technical
- Technical
- Technical
- Other
Deepwater Horizon – cognitive skills?

• Situation awareness – of level of risk/time, understanding of the well, meaning of signals, anticipation?

• Decision making – for the well, for the emergency response, between beach and rig?

• Risk calibration of leaders?
Deepwater Horizon – team skills?

• Team - coordination, communication; shared ‘mental model’, speaking up?
• Leadership – supervisors, managers on rig and on the beach?

• Companies’ culture/ rig safety culture.
Montara Commission

• ‘Failure of sensible oilfield practice 101’
• Aspects of standards ambiguous and open to different interpretations
• Deficiencies in decision making
• Systemic failure of communication
• Lack of competence
• Risks not recognised
• Judgements to ‘push on’
Crew Resource Management for Wells personnel

• OGP (Oil and Gas Producers) commissioned project at Aberdeen University (Flin, Wilkinson & Agnew) to outline a basic non-technical (CRM) skills syllabus for drill crews and other wells personnel.

• Detailed syllabus in preparation.
  – WOCRM Syllabus (OGP Report, in prep, 2014)
Method for WOCRM study

- Identify the key categories of non-technical skills required by wells personnel, in order to develop guidance for a generic training syllabus.
- Literature review – human factors in wells operations
- Interviews 33 wells personnel in 17 wells roles
Categories & Roles for WOCRM

**Machine Operator**
- Driller / Operator
- Assistant Driller / Operator

**Supervisors**
- Toolpusher
- Rig Manager (office)
- Company Man
- Drilling Supervisor
- Superintendent (office)
- Well Service Supervisor
- Well Test Supervisor
- Coil Tubing Supervisor
- Slickline Supervisor
- Completions Supervisor
- E-Line Supervisor
- OIM
- Senior Drilling Engineer
- Drilling Engineer
- Senior Completions Engineer
- Completions Engineer
- Well Engineering Manager

**Support**
- Roughneck
- Derrickman
- Mud Logger
- Drilling Fluids Engineer
- Cementer
- Directional Driller
- MWD/LWD Engineer
- Subsea Engineer
- BOP/LMRP Engineer
- Well Integrity Engineer
- Production Supervisor
- Petroleum Engineer
- Operations Geologist
- Development Geologist
- Reservoir Engineer
- Sub Surface Lead/Manager

**Notes:**
1. “Roughneck”, ‘Directional Driller’ & ‘MWD/LWD Engineer’ are the only role added to the OSPRAG / Oil & Gas UK list.
2. **Bold** indicates top priority for each category.
3. Roles in *italics* are not required for CRM analysis at this stage, therefore no interviews were conducted as part of Abz Uni work.
4. Role names can vary across industry and between different companies.
Figure 1: Percentage of data related to NTS categories

- Teamwork: 28%
- Situation Awareness: 23%
- Communication: 18%
- Supervision & Leadership: 12%
- Decision Making: 10%
- Personal Resources: 9%
WOCRM: Skills required

Table 4: Proposed skill categories by wells role group from interview data

<table>
<thead>
<tr>
<th>CRM SKILLS</th>
<th>DRILLERS</th>
<th>SUPERVISORS</th>
<th>SUPPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Situation Awareness</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Decision Making</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
</tr>
<tr>
<td>Communication</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Teamwork</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Leadership</td>
<td>✓</td>
<td>✓</td>
<td>n/a</td>
</tr>
<tr>
<td>Stress &amp; Fatigue</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Suggested WOCRM syllabus
(Flin et al., 2013, OGP Report No 501)

- Situation awareness
- Decision making
- Communication
- Team work
- Leadership
- Personal resources

DAY ONE

DAY TWO

PLUS PRACTICE SESSIONS
  e.g. in simulator
OGP Recommendations (Report 501)

- CRM training to a wide range of wells op roles
- Integrate with tech training
- Technical and behavioural science instructors
- Three days with practical exercises and feedback
- Refresher training
- Generic CRM for a wells team
Is the culture reinforcing or toxic for safe behaviours/NTS?
Training CRM (NTS) skills - UK operating theatre teams

- Investigators noted that “considerable cultural resistance to adoption was encountered, particularly among medical staff”.

Further information

- r.flin@abdn.ac.uk
- www.abdn.ac.uk/iprc
  - safety research projects, papers and reports