Human Factors in Offshore Drilling and Production

Grand Challenge

Drilling Safety – Human Factors Overview

Research Statement

To conduct focused, applied research that informs a reengineering of the design lifecycle to include Human-Systems Integration and Human-Centered Design.

- Addresses possible Human Factors (HF) issues associated with:
  - *Workplace and interface design*: fatigue, situation awareness, human machine interface design (for both rig & control room operators), decision support, effective procedure design for comprehension/adherence, etc.
  - *Organizational and culture*: leadership, safety culture, training, hiring practices, etc.

Research Plan

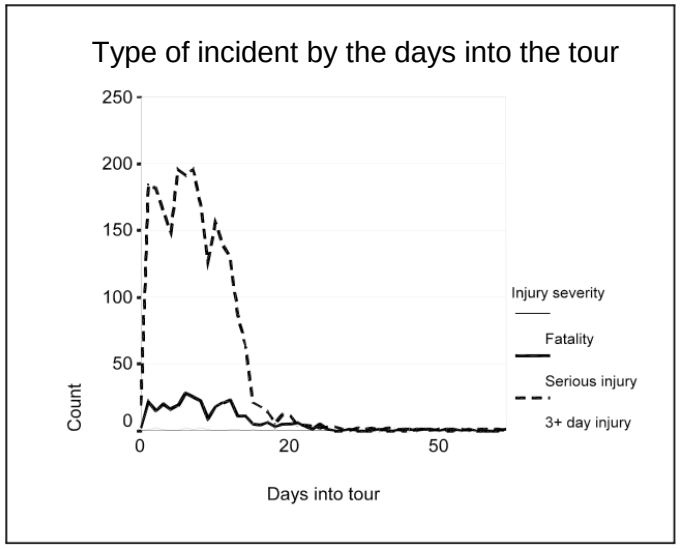
- R&D work will be coordinated between TAMU (S. C. Peres & M.S. Mannan, PIs, 0.5 FTE each) and UT Austin (R. Bias, co-PI, 0.5 FTE), $80K total budget.
- Plan being developed for independent, applied research into possible Human Factors (HF) issues that are associated with increased risks for incidents. Research will be done in collaboration with industry partners to allow for directly applicable findings.

Desired Value to Stakeholders

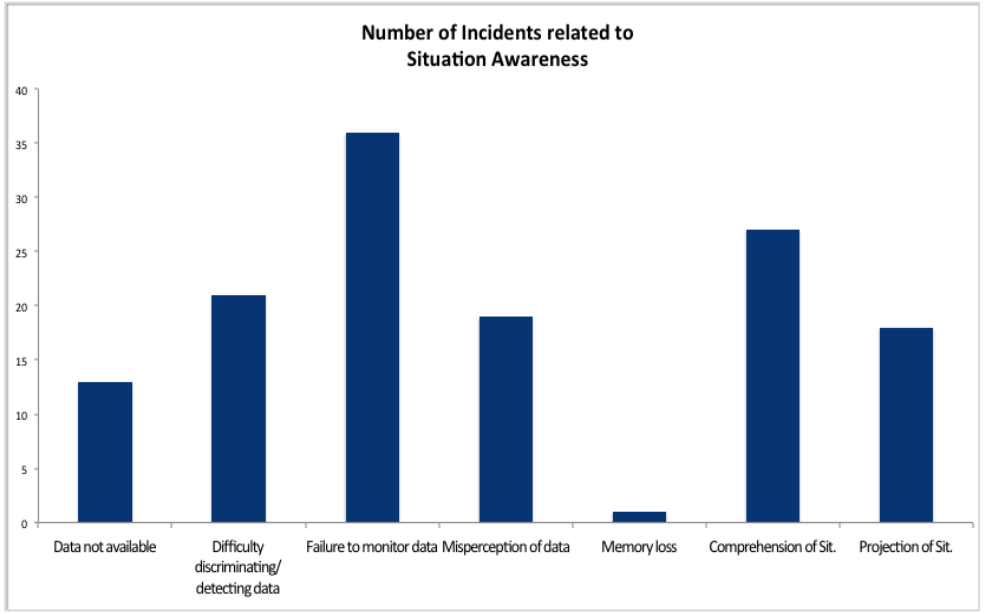
- Estimates indicate that US on & offshore facilities have had a major catastrophic event every ~1.77 years for the last 40 years and that 95%+ of these had direct human involvement in the cause.
- TAMU and UT Austin intend to conduct applied research in conjunction with industry partners to identify what HF findings need to be incorporated into design and leadership practices to mitigate the likelihood of these incidents.

Examples of Human Factors Issues

Issues with procedures are associated with 65% of all industrial incidents. **{left}** Categorization of causes of events for company that involves Upstream, Downstream, Midstream, and Shipping



Situation Awareness is someone's level of awareness of *task* and *environmental* conditions, and judging how these may change in the near future to *predict how the situation will develop*. **{below}** Shows the number of incident related to elements of situation awareness.



Fatigue is the inability to function at the desired level due to incomplete recovery from the demands of prior work, circadian rhythm adjustments, cognitive load, and other waking activities. Acute fatigue can occur when there is inadequate time to rest and recover. Cumulative (chronic) fatigue occurs when there is insufficient recovery from acute fatigue over time. {**left**} Shows effects of *circadian rhythm adjustments* as incidents decrease as the duration of the tour extends over time.

Keywords

Accident Involvement Offshore	Attitudes, and Perception and Other Factors Offshore
Accident Outcome Variables Offshore	Quantitative Risk Analysis Offshore
Accident Rate Offshore	Regulation, Standards, and Guidelines
Crew Resource Management Offshore	Risk Assessment Offshore
Design and Installation Offshore	Risk Management Offshore
Ergonomics Offshore	Risk Perception Offshore
Human Error Offshore	Safety Climate Offshore
Human Factors Offshore Drilling & Production	Safety Offshore
Human Factors in Oil & Gas	Situational Awareness Offshore
Human Machine Interface Offshore	Stress Fatigue Offshore
Human Performance Offshore	

Suggestions for others welcome!

Publication Sources

Source	Frequency
Safety Science	17
Reliability Engineering and System Safety	8
Journal of Loss Prevention in the Process Industries	7
Work & Stress	4
Applied Ergonomics	3
Team Performance Management: An International Journal	2
Process Safety Progress	2
Process Safety and Environmental Protection	2

Authors

Authors	# of Ref	Topics
Flin, R. G.	5	Safety Climate, Risk Perception, Crew Resource Management, Emergency Decision Making
Skogdalen, J.E.	4	Quantitative risk analysis, Safety (Prevention)
Bea, R.G.	4	Risk Analysis, Risk/Safety Assessment, Crisis Prevention, Safety
Mearns, K.	4	Safety Climate, Human Factors (General)
Sneddon, A.	4	Situational Awareness, Stress, Fatigue, Safety
Gordon, R.P.E.	3	Design and Installation, Accident Analysis (contribution HFs)
Parkes, K.R.	3	Stress, Fatigue
Gould, K.S.	2	Design and Installation, Accident Risk Analysis
Rundmo, T.	2	Risk perception, Other attitudes and workloads
Sutherland, K.M.	2	Stress
Chen, W. Q.	2	Occupational Stress
Crichton, M.	2	Stress, Crisis Management
Widdowson, A.	2	Assessment, HFs Integration (offshore and onshore)
McSweeney, K.P.	2	Human Systems Integration, Design and Install (HFs Implementation)

Activity thus far

- Identified and categorized ~ 100 references on HF in offshore drilling

Examples

Training and Human Factors Engineering

- Crew Resource Management (CRM)
  - Evidence suggests that CRM training offshore should help to address non-technical skills which contribute to safe and efficient performance (Rhona, et al. 2002)
- Human Factors Engineering Integration
  - Practical and successful approach for Human Factors Engineering Implementation Program (HFEIP) has been developed and integrated in past designs of offshore installations (McSweeney, de Koker, & Miller, 2008)

Quantitative Risk Analysis

- Human Reliability Analysis used to quantify human error and employed for subsequent error reduction (Kirwan 1987).
  - Case study with HRA represents relative contribution of hardware and human components to risk.
- Limitation of HRA: only considers operator performance, does not consider organizational factors (Skalle et al. 2014)
  - Technical Error and Human Error has been modeled using a hierarchical ontology (Skalle et al. 2014).

Fatigue, Situation Awareness & Stress

- Fatigue and sleep disruption were associated with lower levels of situational awareness (both self-report; Sneddon, Mearns, & Flin, 2013)
- Stress has been found to significantly predict situational awareness such that increased stress was related to less situational awareness (Sneddon, Mearns, & Flin, 2013).
- Recognition of personal limitations in offshore industry is not high (only 34% indicated their performance is affected by stress and fatigue) (Qualitative work assessed attitudes towards stress: Crichton, 2005)
- Job stress and perceived risk are factors that increase workload. Increased workload can lead to increased strain and a decrease in the ability to cope in dangerous situations (Rundmo, 1992).

These are JUST Examples

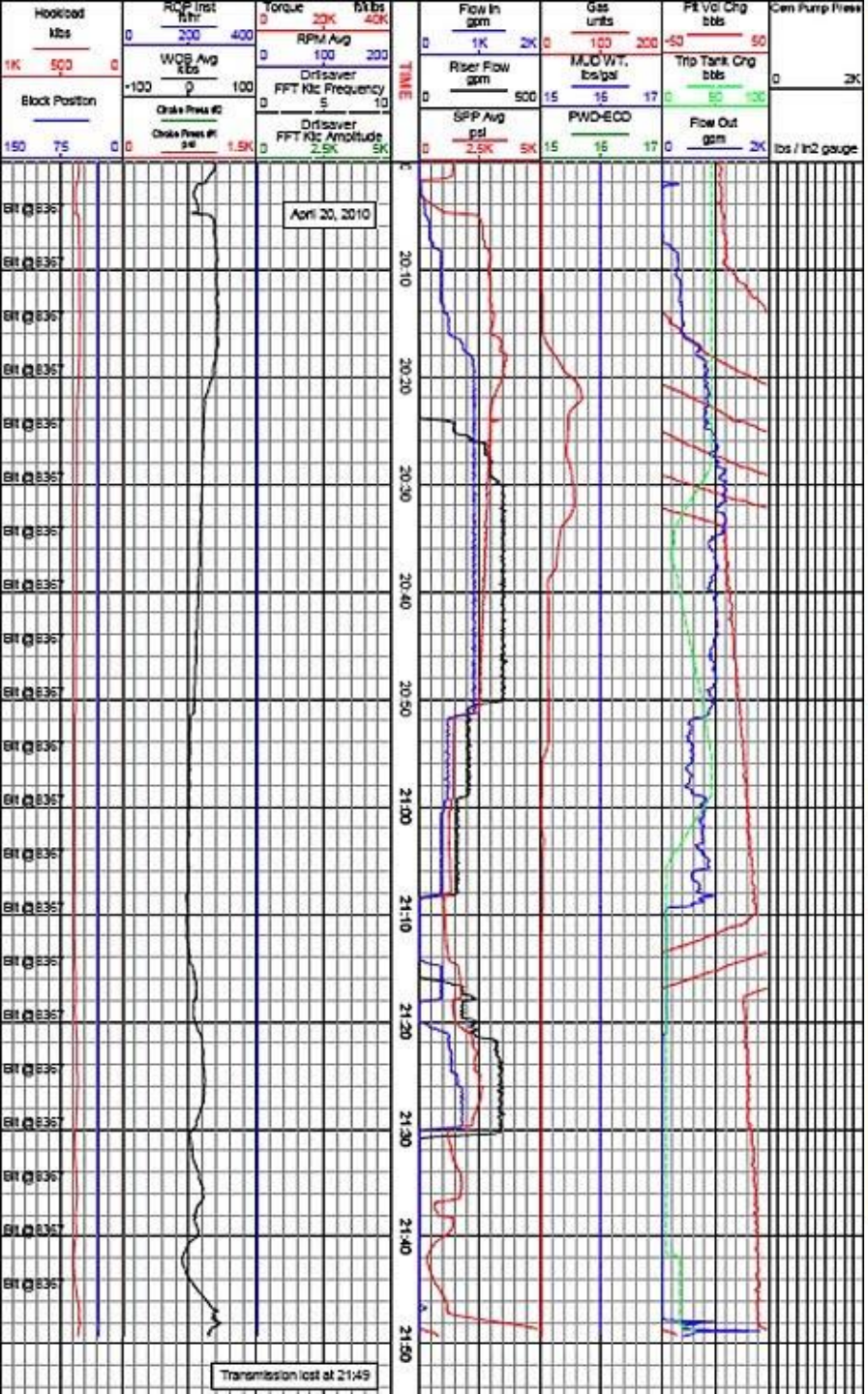
However, they provide insight into how evidence and research on human performance can play a tremendous role in the mitigation of errors and incidents, and thus in the important metrics of safety and ROI.

Next Steps

- Integrate additional keywords and sources as we hear them from you
- Continue to Summarize
  - Current state of the science
  - Biggest risks with HF for offshore drilling and production
- Begin building gap analysis

Gaps beginning to show

- Current research is shallow
  - Very few empirical studies
  - Some not done by current experts in the field
    - e.g. Fatigue
- Very little on human-machine interface
  - Some of the incidents occurring offshore have to do with interface between the humans and machines


Hookload
klbs
Block Position
ROP Inst
ft/hr
WOB Avg
klbs
Torque
ft/lbs
RPM Avg
Drillsaver
FFT Klc Frequency
Drillsaver
FFT Klc Amplitude
Flow In
gpm
Riser Flow
gpm
SPP Avg
psi
Gas
units
M.D.W.T.
lbs/gal
PWD-ECD
Pit Vol Chg
bbls
Trip Tank Chg
bbls
Flow Out
gpm
Cem Pump Press
lbs / in2 gauge
TIME
April 20, 2010
Transmission lost at 21:49


RIG AIR PRESSURE
PRESIÓN DE AIRE DEL EQUIPO DE PERFORACIÓN
MANIFOLD PRESSURE
PRESIÓN DEL MÚLTIPLE
ACC. PRESSURE
PRESIÓN DEL ACUMULADOR
ANNULAR PRESSURE
PRESIÓN DEL ANULAR
Psi
ALARM ACKNOWLEDGE
PUMP RUN
ANNULAR REGULATOR
INCREASE
DECREASE
ALARMS
ALARMA
LOW FLUID LEVEL
LOW ACCU PRESS
LOW RIG AIR PRESS
EMERGENCY POWER ON
UPS FAULT
COMM FAULT
UNIT STATUS
ANNULAR
SYSTEM BYPASS
LOW
HIGH
TOP PIPE RAMS
OPEN
CLOSE
OFF
ON
CONTROL PANEL POWER
MULTIPLE VOLTAGES PRESENT
115VAC & 24VDC
KILL LINE
CHOKE LINE
SPARE 1
BOTTOM PIPE RAMS
PUSH AND HOLD TO OPERATE
DIVERTER PACKER

Questions and Discussion