Human Factors in Offshore Drilling and Production

Research Area

Authors

S. Camille Peres, Ph.D.

Randolph Bias, Ph.D.

Noor Quddus, Ph.D.

W. Sloane Hoyle

Lubna Ahmed

Juan Carlos Batarse

M. Sam Mannan, Ph.D.

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Ranjana K. Mehta, Ph.D.

Nafiz Tamim

Changwon Son

Pranav Kannan

Yogesh Koirala

Jim Pettigrew

Dwight Johnson

Valerie Green

Offshore Energy & Human Factors

Research Statement

To conduct focused, applied research that informs an integration of Human Factors and Ergonomics into Offshore Drilling and Production operations.

- 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 associated with increased risks for incidents. Research will be done in collaboration with industry partners to allow for directly applicable findings.

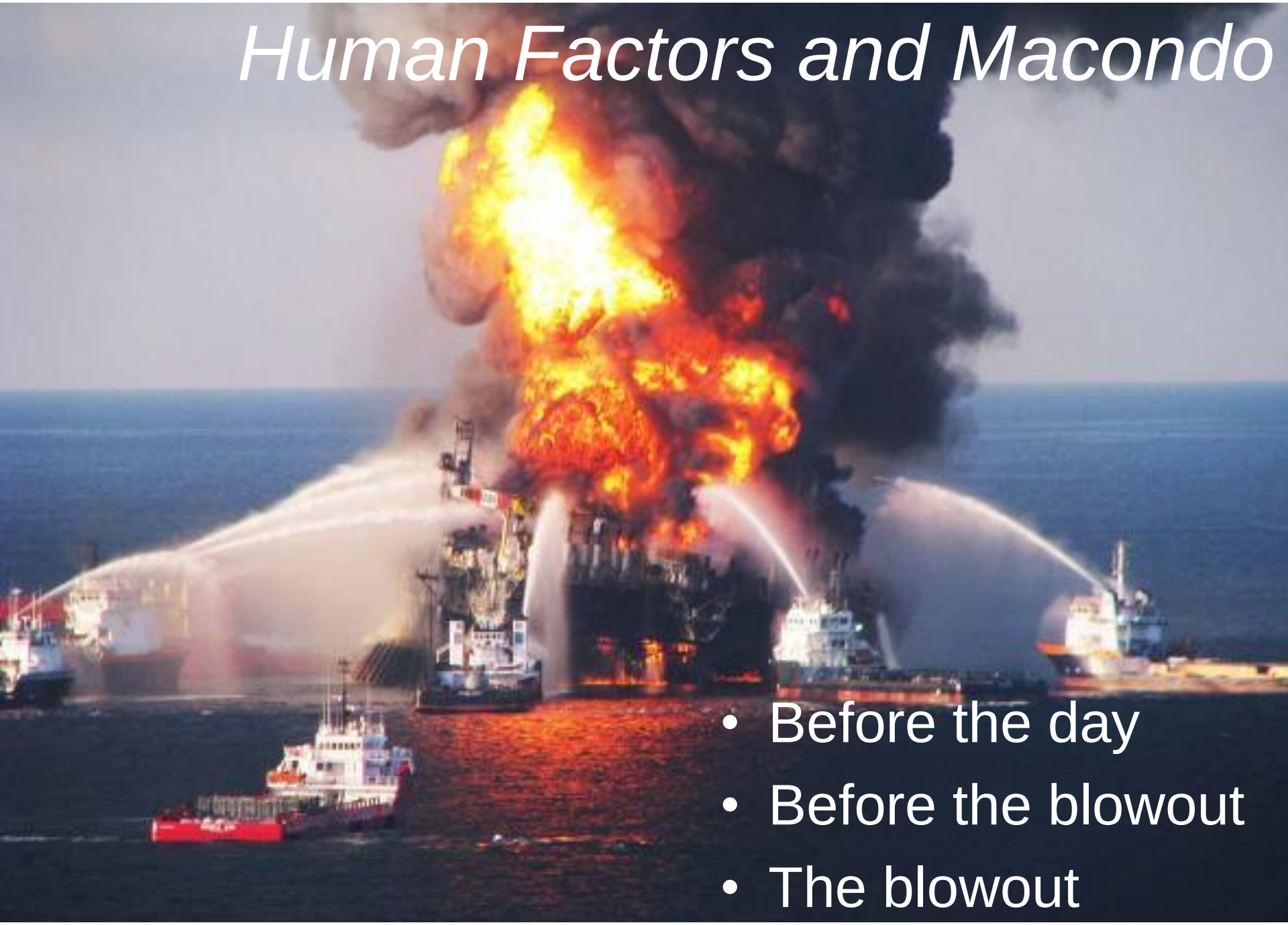
Desired Value to Stakeholders

- 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.

- GOAL: Decrease incidents through incorporation of Human Factors and Ergonomics; Human Systems Integration
- This involves
  - Information gathering regarding existing gaps
  - Identification of existing obstacles
  - Information dissemination efforts

Why we are here

Human Factors and Macondo



- Before the day
- Before the blowout
- The blowout

Before the day

- Decision to abandon well and use cement barrier
  - No standard work instructions or ***procedures*** provided to driller by operator
  - ***Quantitative risk analysis***, ***standards*** have to be appropriately leveraged and adhered to
  - Insufficient communication between operator and contractor—***safety culture*** and ***safety climate*** failures

- Personnel misinterpret test for cement barrier integrity, leading them to erroneously believe that hydrocarbon bearing zone at the bottom of the well had been sealed.
  - This represents probable failures in ***situation awareness, display design*** and ***safety climate***

Before the blowout

- No conversion of available data to information
  - Clear failures of ***display design*** & ***alarm management***
- A lot of different jobs being done on the rig. Some workers on 24 hour shift cycles as well.
  - ***Fatigue***, ***lack of sleep***, ***high workload,*** and ***reduced situation awareness*** could have impacted ability to detect kick

The Blowout

- Gas-in-riser event released oil/gas onto the rig (contents of the riser erupted onto the rig floor 2-3 minutes after hydrocarbons entered it).
  - ***Stress, fatigue, situation awareness, crew performance and HMI design*** all impact how effectively they can manage this
- Crew manually closed the BOP.
  - ***Stress, fatigue, situation awareness, crew performance and HMI design*** again impact the efficiency and effectiveness of this effort.
- Oil/gas gushed onto rig, ignited and exploded
- Explosion should have activated automatic emergency response system to shear drill pipe (BOP) and seal the well, but it was unsuccessful.
  - Elements of the BOP-human interaction were automated. Due to maintenance and other issues, this did not occur and caused the biggest spill in the GOM (***Human-automation interaction)***

Not new topic

- After Piper Alpha, HF elements clearly outlined in that disaster
  (Gordon, 1998)
- Papers continuously at OTC regarding risks of bad HF since then
  (e.g., Thomas, 2002; Miller, 1999)
- Two conferences on HF and offshore drilling and production
  - International workshop on human factors in offshore operations (2000, 2002)

Clearly something's broken

- Topic is not new
- Major failures still occur
- Time to better understand
  - What do we know
  - What do we need to know

What do we know: Method

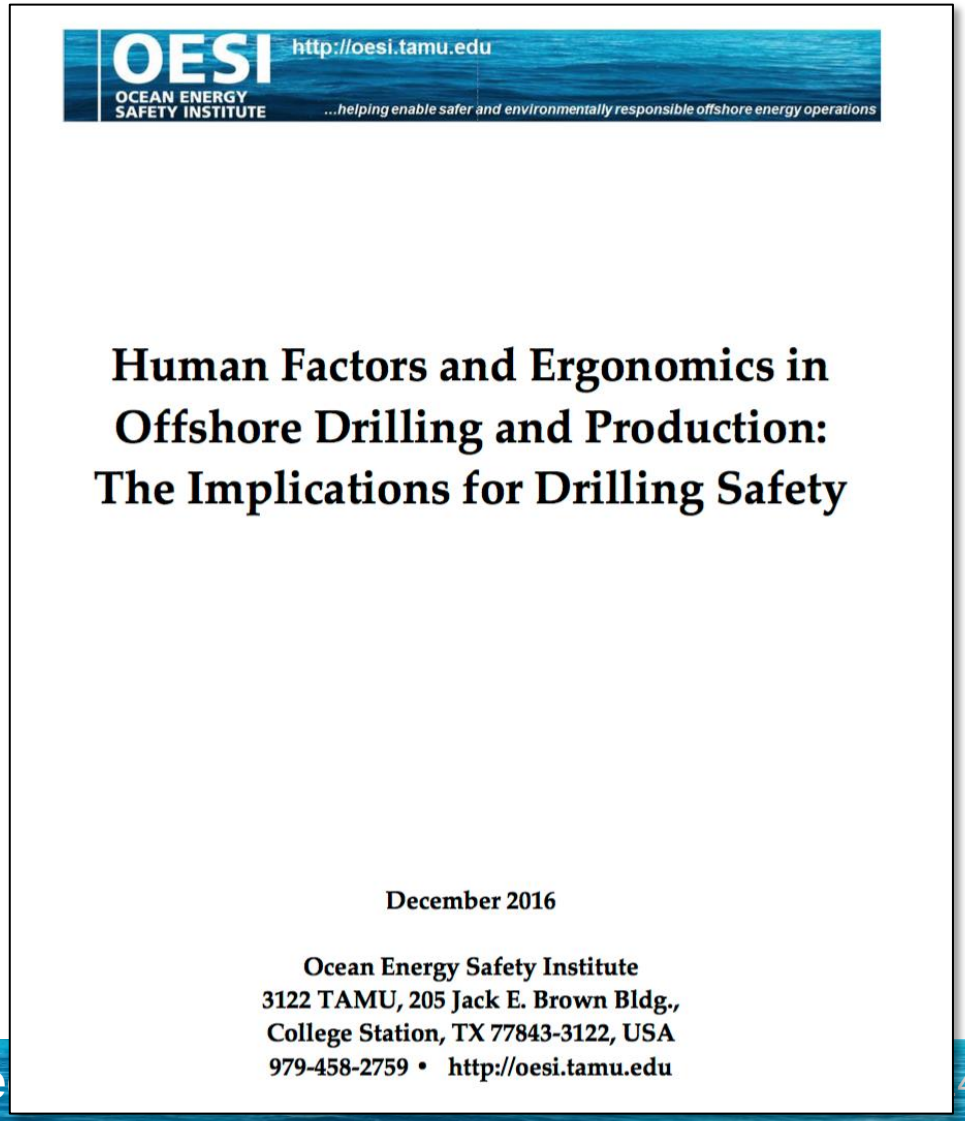
- Search sources
  - Google scholar and web of science
  - Conference proceedings
    - RPSEA, OTC, MKOPSC, IADC, OOGP, SPG, AIChE, COS, and COP.
- Search terms
  - [Human factors or ergonomics] and [offshore] with:
  - [drilling], [production], [fatigue], [cognitive], [oil and gas], [human error offshore], [situation awareness].

Topics & Papers Per Topic

Topic	Original	Removed	Added	Final
Alarm Management	-	-	7	7
Automation	-	-	9	9
Crew Resource Management	7	3	9	13
Design & Installation	15	2	-	13
Fatigue	4	-	6	10
Human-Machine Interaction	1		9	10
HF/E Standards & Regulations	10	3	8	15
Interface Design	-	-	13	13
Overview of HF/E in O&G	8	2	7	13
Procedures	-	-	9	9
Quantitative Risk Analysis	28	7	13	34
Risk Perception	3	-	1	4
Safety Culture/Climate	16	6	1	11
Situation Awareness	9	3	5	11
Stress	11	2	10	19
Total	112	28	107	191

White Paper

Summarizes methods, findings, gaps, & next steps



Major findings (What we know)

- Much of the science is in the UK
  - Likely due to regulations after Piper Alpha
  - Little research in GOM
- Groups have generated solutions
  - Little available on efficacy of the solutions
- Standards are not comprehensive or informed by evidence
- Risk analyses not effectively leveraging human performance parameters
- Effects of working in offshore environment on performance not well understood
  - Thus difficult to support performance and mitigate risks

Next steps

- Publish peer-reviewed papers
- Partner with Human Factors and Ergonomics Society to move the science and its application forward

What we need to know

- Human factors is good business for offshore drilling: ROI, KPIs, and Standards
- Human factors solutions for operations: Immediate and long-term solutions
- Quantitative risk analysis and risk mitigation: How human factors can help
- Automation and offshore drilling: Our incorrect assumptions
- Human factors and cyber security: What we know and what we need to be worried about

Good Business

- Human factors is good business for offshore drilling
  - Lots of ROI analysis for other domains. Need to do it for offshore O&G
  - Industry needs clear KPIs to guide programs and track performance
  - Standards need to be more comprehensive, better informed, and more easily accessible
    - Human Factors is not only Safety Culture

Operations

- Human factors solutions for operations: Immediate and long-term solutions
  - Situation awareness (SA)
  - Crew Resource Management (CRM)
  - Alarm management
  - Procedures
  - Safety Culture
  - Interface design
  - Human Machine Interaction
  - Risk Perception
  - Fatigue
  - Stress

QRA

- Quantitative risk analysis and risk mitigation: How human factors can help
  - Many current QRA models may not effectively use human performance data
  - There are models being leveraged by military, aviation, etc. that do
  - More importantly, risks identified by QRA need to be ***mitigated.*** HF methods and principles can help.

Automation

- Automation and offshore drilling: Our incorrect assumptions
  - Automating some tasks can reduce risks and improve performance—clearly
  - Doing this incorrectly—without considering the human—can REMARKABLY increase risks
    - Automation tables have not proven sufficient
  - Research in aviation, military, and automatic cars is clearly showing this

Cyber security

- Human factors and cyber security: What we know and what we need to be worried about
  - Human Factors scientists and professionals are already engaged in this work in other domains (e.g., military, voting, computing)
  - How can this translate to O&G

Moving Forward

- Academic/Industry research partnerships:
  - Needed for collaborative, empirical research.
- Reengineering the design lifecycle to include HFE:
  - Will require systematic adoption of HF into education and training of engineers.
- HFE Standards more accessible:
  - Multidisciplinary effort with industry, regulatory, academia, and professional associations members could establish and maintain an accessible source of HFE standards.

Why we are here

Questions? Comments?