SPE Summit: Safer Offshore Energy Systems
Summary Report

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Introduction

This document summarizes the purpose, process used, participants, and key outputs of a summit that the Gulf Research Program (GRP) sponsored, and the Society of Petroleum Engineers (SPE) organized. At this "SPE Summit: Safer Offshore Energy Systems," 41 offshore experts participated over 2.5 days from 22 to 24 May 2018.

Several attachments are included as appendices to this summary. The most important document is the full spreadsheet detailing 144 opportunities identified by the Summit participants, ranked by importance, and sorted into "themes". This spreadsheet, a modified version of a spreadsheet used by ExxonMobil to prioritize research opportunities, was the primary deliverable of this Summit. This summary report describes by whom and how the spreadsheet was created.

The spreadsheet will be used by the GRP to identify and prioritize possible research projects, and perhaps by other industry associations to identify and prioritize individual or joint activities.

Purpose

The Summit was conceived to better identify specific and implementable research areas where the involvement of GRP can make offshore development safer. It is anticipated the GRP would use this list to identify and prioritize areas for future funding and research.

The stated purpose of the Summit was to engage a broad set of industry experts **to reach agreement on** areas where GRP or jointly-funded **research** is **needed to minimize and manage risks** for both people and the environment **by minimizing the possibility of a major incident**. The scope of research should include both technical and human performance opportunities.

Potential areas of research could include:

- **Improving collaboration** among industry, regulatory, and academic communities to advance understanding and communication about systemic risk in the offshore environment.
- Outlining fundamental scientific and technological research to **spur innovation aimed at reducing or managing risks** associated with offshore energy systems.
- Exploring how to **create robust and resilient organizations** that minimize major incidents with improved manage change, sim-ops management, decision support, and operational procedures that support safe work.
- **Identifying educational or training programs** to promote a skilled and safety-oriented workforce and to retain that workforce through economic cycles in the oil and gas industry.

The spreadsheet mentioned in the opening paragraph details 144 opportunities to improve safety directed towards these ends.

Process Employed in the Summit

The Society of Petroleum Engineers (SPE) periodically conducts summits to engage the appropriate collection of expertise in a facilitated process with the goal to address an important topic or produce a specific outcome.

Appendix I lists the Summit's Steering Committee which was composed of industry volunteers selected by a set of co-chairpersons (and agreed to by the GRP) to represent a broad experience base, and have links to particular parts of the industry. The Steering Committee met monthly in some ½ day face-to-face and some 1-2 hour virtual meetings from December 2017 through March 2018. In these meetings, the Committee designed the process, and recruited attendees. The Steering Committee was coordinated by the SPE staff.

Appendix II shows the final Summit high-level agenda. The basic idea of Session 1 was to align everyone with presentations summarizing the goals of the GRP, and the state of safety in the Gulf of Mexico from different perspectives - Regulators (BSEE), Operators (OOC), Drilling Contractors (IADC), and the Center for Offshore Safety (COS). These presentations are included in Appendix III.

Sessions 2 to 5 was used to brainstorm and then refine opportunities to make the Gulf safer. As described in Appendix II, each of the sessions had a formal facilitation plan that was created by two Session Managers and reviewed by the Committee as a whole. For the facilitated sessions, participants were divided into four "streams", representing four broad phases of the petroleum development process:

- Pre-drill: Well design, seismic, sub-surface and metocean environment
- Well operations: Drilling, completions and interventions
- Construction: Facility design, construction and installation including production facilities, rigs, subsea infrastructure, and pipelines
- Production: Production operations through the facilities

The goal was not to be dogmatic about what opportunities were in a phase or out of a phase but rather to ensure there were groups looking at the situation from different perspectives.

The results of these sessions are summarized in the referenced spreadsheet. The following is a brief summary of each session.

Session 2 goal was to brainstorm and sort opportunities to improve safety, along with a brief description and a summary of the potential benefits. As mentioned above, the groups identified 144 different opportunities.

Sample of output from Session 2 of Construction/Subsea Group

	Opportunity Name	Opportunity Description	What is the Benefit?
1	Safety Testing Equipment	Establish best practices for Procedure and frequency including to ensure appropriate location/environment for better/safer tests. (examples include: relief valve testing procedure, and SPPE testing frequencies, High pressure equipment)	1) Reducing operation risk during testing 2) unnecessary wear and tear; 3) better assessment of relief valve methods; 4) reduced unnecessary operations and record keeping and manning;
2	Remote Barrier testing methodologies	Be able to measure slow/small leaks in remote well or subsea barriers. Measuring slow/small leaks because of volume involved or avoid the hazards flow line leak upstream of boarding valve.	Increasing confidence in remote barrier from better testing
3	Optimization of field development, project and life cycle risks.	Better manage overall risk of well construction, subsea, production design. Optimized trade off of risks between 'silos'... balance construction, drilling well risk and facility risk.	Lower risk, more efficient field development
4	Developing contracting strategy reduce and manage overall risk	Understanding how various contracting strategies/approaches can effect project safety/execution/Cost/success. Ensuring clarity of R&R and where decisions are made.	Clear/Proper roles and responsibilities, lower total project cost/risks.

Session 3 characterized each opportunity by phase, and who could be potential investigators, and who might currently working on each opportunity.

Sample of output from Session 3 of Construction/Subsea Group

	Opportunity Name	Operational Phase	People	Process	Plant	Information	Potential Investigators	Who Else is Working This Opportunity
1	*Safety Testing Equipment*	Drilling					DNV, ABS, API, Equip Manufacturers	
		Construction		x	x	x		
		Production		x	x	x		
2	*Remote Barrier testing methodologies*	PreDrill Data					API	
		Drilling						
		Construction		x	x			
		Production		x	x			
3	*Optimization of field development, project and life cycle risks.*	PreDrill Data		x		x	IPA	IPA
		Drilling		x		x		
		Construction		x		x		
		Production		x		x		
4	*Developing contracting strategy reduce and manage overall risk*	PreDrill Data		x			IPA	IPA
		Drilling		x				
		Construction		x				
		Production		x				
5	*Leveraging technology for better inspection*	PreDrill Data					DNV, ABS	Lots of Vendors, Univ of Rio, ABS JIPs
		Drilling	x	x	x	x		
		Construction	x	x	x	x		
		Production	x	x	x	x		

Session 4 further described each opportunity by evaluating outstanding questions that remain before starting to pursue the opportunity, and identifying if the opportunity had a research component. Each subgroup also ranked each of their opportunities as high, medium or low (H-M-L) to identify those that the group felt was most promising for making gains in operational safety, whether or not the opportunity was a research opportunity, or if it was suitable for the GRP to pursue.

The subgroups ranked 55 opportunities as "H". The complete spreadsheet includes all the detail from each of the four groups.

Sample of output from Session 4 of Construction/Subsea Group

	Opportunity Name	**Outstanding Questions - What do We Need to Know to move forward**	**Is This a Research Item? (Y/N)**	**CONSTRUCTION VOTE**
1	*Safety Testing Equipment*	**No outstanding issues with this being a good topic**	***Y***	*H*
2	*Remote Barrier testing methodologies*		***Y***	*M*
3	*Optimization of field development, project and life cycle risks.*		***N***	*M*
4	*Developing contracting strategy reduce and manage overall risk*		***N***	*L*
5	*Leveraging technology for better inspection*	**No outstanding issues with this being a good topic**	***Y***	*H*

Prior to Session 5, a subset of the committee sorted each of the opportunities into one of 11 "themes". These themes generally included items from each of the different breakout groups. No attempt was made to consolidate similar or identical ideas from the groups – each opportunity was simply identified by one of these 11 themes (see ranked list below for themes used).

Session 5 was a plenary session where the entire group reviewed the 55 opportunities rated as HIGH by each sub group, sorted by theme. During the review each participant was asked to carefully consider the relative value of the items in each theme for improving safety in the Gulf.

The 37 participants attending Session 5 (GRP participants did not vote) ranked the importance of these opportunities in each theme as follows:

1. Crews (People)
2. Risk analysis/understanding
3. Innovation/evolution/technology
4. Data collection and analytics
5. Automation/remote actions
6. Inspection/testing of equipment/barriers
7. Interface management/systems engineering
8. Regulators, regulations, and laws
9. Standardization/simplification
10. Communication
11. Environmental

A detailed analysis of the rankings by the participants by the total group, each breakout group, and by organization they represented is included in Appendix VI. The analysis shows quite broad agreement among participants from different phases and organization types on the importance of the opportunities in each theme.

Appendix VII is an embedded version of the complete spreadsheet.

During the plenary session, participants also discussed possible further actions in addition to sending the completed spreadsheet of opportunities for use by the GRP. It was agreed by participants that:

- The spreadsheet and this report should be sent out to different industry groups for their use. These groups will include (at least) the Offshore Operators Committee, the Center for Offshore Safety, the International Association of Drilling Contractors, Society of Petroleum Engineers, BSEE and the Coast Guard, and others.
- This work product should be available on the GRP website for access by anyone wishing to use it.
- GRP should solicit from the Summit participants whom might be willing to act as an advisor on each opportunity.
- It would be beneficial for the GRP to periodically reconvene a similar group to revisit the opportunity list.
- Prior to release, the spreadsheet will be sent to participants to collect names with each item – who to talk to, who's interested in further contributions and perhaps specific suggestions on way forward for items that participants would be willing to contribute to in the future.

Participants

Appendix V includes a list of Summit participants, while Appendix IV shows the breakdown of participation by organization type for the Summit, and for each of the breakout teams. Participants were invited by the Committee based on their individual expertise to ensure

- a range of perspectives representing all players in the Gulf of Mexico petroleum production operations
- participation was spread over many organizations
- balanced representation for each of the four broad phases described above.

Participants were specifically instructed to present their professional opinions. They were not invited as representatives of their organization, but as individual engineers and professionals.

While about a dozen of invitees were unable to accept, and about a half a dozen of those that did accept could not attend at the last moment for assorted reasons, each of the breakout group leaders believed they had a representative cross section of quite knowledgeable experts, and those present admirably participated in the process.

Ground Rules

The ground rules for the Summit were discussed in the first session and are listed below.

GROUND RULES

1. **An Engineer, Not an Advocate. Represent yourself NOT your company** – you were selected for your experience and potential as an individual contribution.
2. **If you think of something – contribute**. We are not afraid of different perspectives – we WANT them.
3. **Focus on task at hand - we do have a specific deliverable.** We will keep a parking lot so not to lose any ideas/issues, and will cover them at close of session or close of Summit. But we really do need to get our deliverable completed.
4. **Don't be afraid of 'far out' or 'step change' opportunities.** This is about research and longer term opportunities. We can look at immediate/low hanging opportunities, but now is the time to think way ahead.
5. **Part of the GRP's purpose is to be a catalyst.** So while we want to meet our specific deliverable, if we find other non-GRP opportunities to improve safety – we want capture those too, either in the tool or as a parking lot item.

The National Academies of SCIENCES ENGINEERING MEDICINE
GULF RESEARCH PROGRAM

Society of Petroleum Engineers

Appendix I – Steering Committee

Name	Title	Current Organization	Industry Segment
Ajay Shah	Team Lead GGOM Legislative and Regulatory Advocacy	Chevron	Operator
Alan Quintero (*)	Senior Vice President	Rowan Drilling	Drilling Contractor
Brad Smolen	Director Safety	BP	Operator
Charlie Holt	Senior. Operations Specialist	BP	Operator
Charlie Williams (*) *Co-Chair*	Executive Director	Center for Offshore Safety	Industry Association
Evan Zimmerman	Executive Director	Offshore Operators Committee	Industry Association
Ford Brett *Co-Chair*	CEO	PetroSkills	Education
James McDonald (*)	Manager Reservoir Characterization Operations	Schlumberger	Service Co.
Jeff Moss *Co-Chair*	Drilling Engineer Advisor/New Tech	ExxonMobil	Operator
Ken Arnold *Co-Chair*	Technical Advisor	Worley Parsons, GRP Board	Engineering
Mark Denkowski	VP Accreditation Operations	IADC	Industry Association
Paul Linkin	VP Quality & HSE	Pacific Drilling	Drilling Contractor
Richard Sears (*)	Associate Professor	Stanford, GRP Board	Retired (ex-Operator)
Stanislaus Kaczmarek (*)	SEMS Section Chief	BSEE	Regulator
Steven Nieting	Manager Reservoir Characterization Operations	Schlumberger	Service Co.

Kelly Oskvig, GRP Program Officer participated as an advisor each planning meeting
Gail Smith, SPE, served as the Event Manager.

Some Steering Committee members, while actively participating in Summit's design, were ultimately unable to attend the Summit because of other commitments. Those not attending the Summit are noted by (*).

Appendix II – Summit Process and Agenda

	Session GOAL	High Level PROCESS
Tue AM	**Common Grounding**; Perspectives on data-driven safety concerns	• Presentations with Clarification Questions
Tue PM	**Identify Opportunities** for Safer Gulf of Mexico Operations	• Breakout groups **brainstorm** by 'Phase': Pre-drill, Well operations, Construction/Subsea, Production operations • Short plenary with high level report out
Wed AM	**Characterize Opportunities** into Common Themes	• Breakout into the same work groups to further **define / refine opportunities.** • Short Plenary with **high level report out**.
Wed PM	**Clarify the Opportunities**	• Breakout groups find **"Outstanding Questions**" for each opportunity, and identify who might potentially be able to contribute to answering questions. • Short plenary with **high level report out**.
Thurs AM	**Summarize key Opportunities and ID Next Steps**	***Plenary:*** • Review/refine Wed PM results after sleeping on it • **Prioritize Opportunities** • Identify GRP role, and potential next steps if appropriate • Review/discuss any parking lot items as appropriate

Appendix III – Safety Concerns (Presentations on Various Perspectives)

Session 1

GRP Mission Presentation

The Gulf Research Program (GRP)

- Directed to operate in three areas:
  - Oil system safety
  - Human health
  - Environmental resources
- Directed to work via three mechanisms:
  - Research & Development
  - Education & Training
  - Environmental monitoring

Program Initiatives

Reducing risk in offshore oil and gas; improve underlying science

Data & Observations for improved management of coastal resources

Enhancing the health and resilience of coastal communities

Building capacity to address cross-boundary challenges

Photo credits (from top to bottom): iStock/nielsbleikro; NASA image courtesy Norman Kuring, Ocean Color Team; iStock/stretchic Photograph by Kelly M. Darnell

Safer Offshore Energy Systems

Foster minimization and management of risk to make offshore operations safer for both people and the environment"

- Characterize **deepwater processes** and ecosystems to better understand the offshore energy work environment.
- Support **fundamental scientific and technological research** to spur innovation aimed at reducing or managing risks associated with offshore energy systems.
- Develop and implement **educational or training programs** to promote a skilled and safety-oriented workforce
- **Encourage collaboration** among industry, regulatory, and academic communities **to advance understanding and communication about systemic risk in the offshore environment.**

Types of Activities

- Consensus Reports
- Workshops
- Grants
- Invited proposals
- Roundtables
- Standing Committees
- Other (recurring meeting such as this)

Recent Activities

- 2015/2016
  - Grants -Exploring approaches for effective education and training of workers in the offshore oil and gas industry and health professions
  - Grants - Scenario planning to advance safety culture and minimize risk in offshore oil and gas operations

4

Recent Activities continued

- 2017
  - Consensus Study: Advancing Understanding of Gulf of Mexico Loop Current Dynamics
  - Consensus Study: Evaluation of the Use of Chemical Dispersants in Oil Spill Response
  - Consensus Study: Performance-Based Safety Regulation
  - Grants - Research & Development: Understanding systemic risk in the offshore oil and gas environment

Recent Activities

- 2018
  - Workshop: Process Safety and Worker Empowerment
  - Workshop: Safer Gulf Summit!!!
  - Grants / Long-term Project Planning - Understanding Gulf Ocean Systems

The Human Factors of Process Safety and Worker Empowerment in the Offshore Oil and Gas Industry

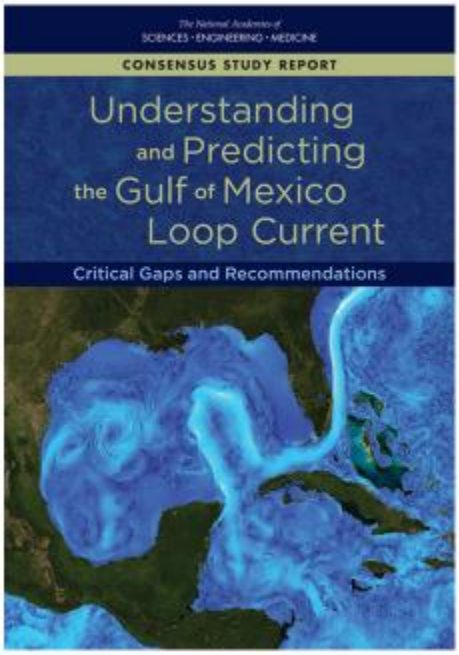
Fit with GRP

- Solid fit with 3 objectives of the Safer Offshore Energy Systems Initiative
- Could inform future GRP work AND
- Of wide community value

Empowerment / Engagement

- Leaders with leadership skills
- Competent technicians
  - Regulated training?
- Learning from the past
  - Past disasters
  - Lessons learned (big and small)
- Training is needed on low-frequency, high-consequence events
- Learn from what we do right

EX:



Goals for the Summit

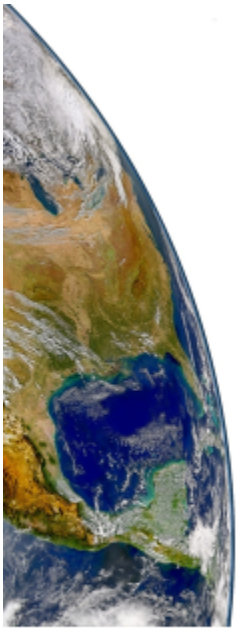
Generally:

- Outcome will inform GRP work and be of wide community value

Specifically:

Ideas for activities that together can build our Safer Offshore Energy Systems Portfolio

- Activities that truly have potential to lead to a safer work environment.
- Theme for long-term cohesive SOES effort
- How can the GRP be a catalyst for change?



Contact Information

Safer Offshore Energy Systems Initiative

Kelly Oskvig, koskvig@nas.edu

Important Links

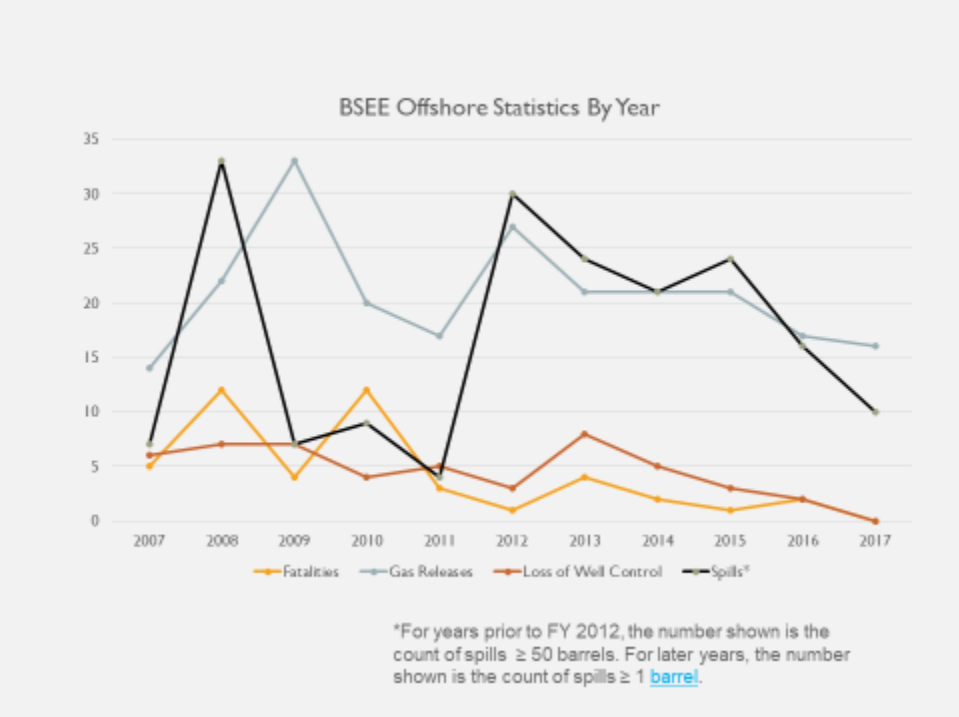
Email updates: http://www.nas.edu/gulf/enews

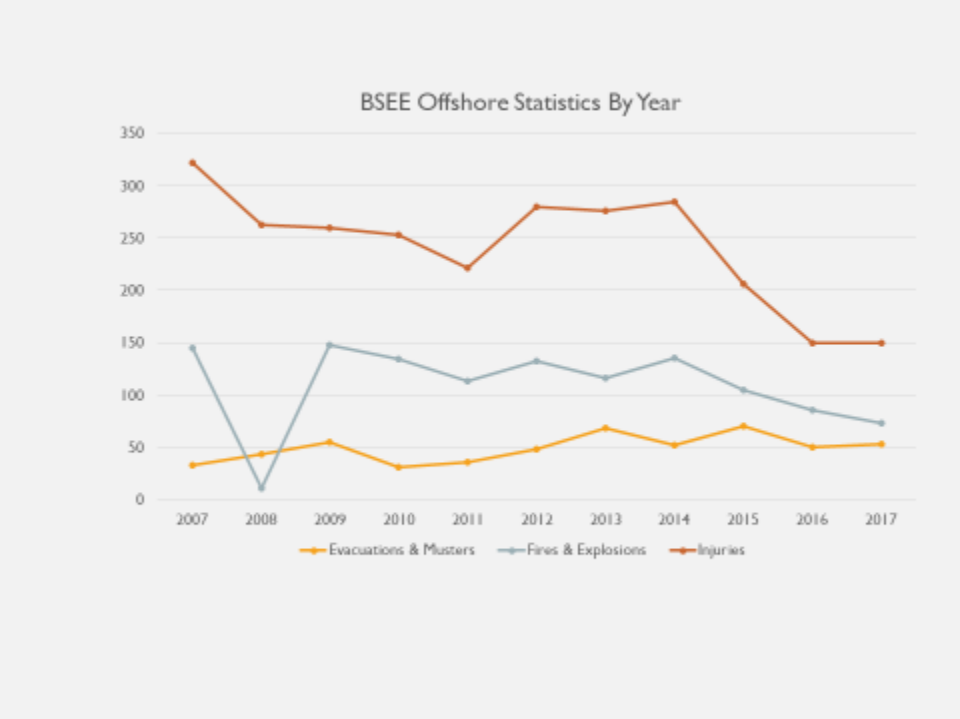
BSEE Perspective

As interpreted by Ken Arnold

From

Conversations with Stan Kaczmarek




BSEE Offshore Statistics By Year
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300
250
200
150
100
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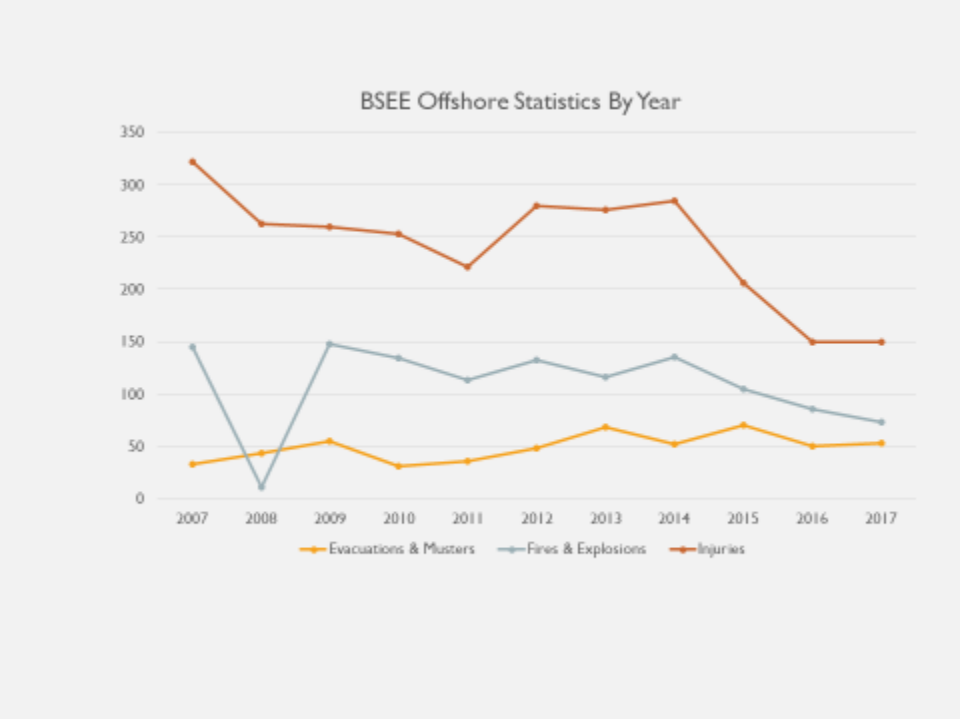
2017
Evacuations & Musters
Fires & Explosions
Injuries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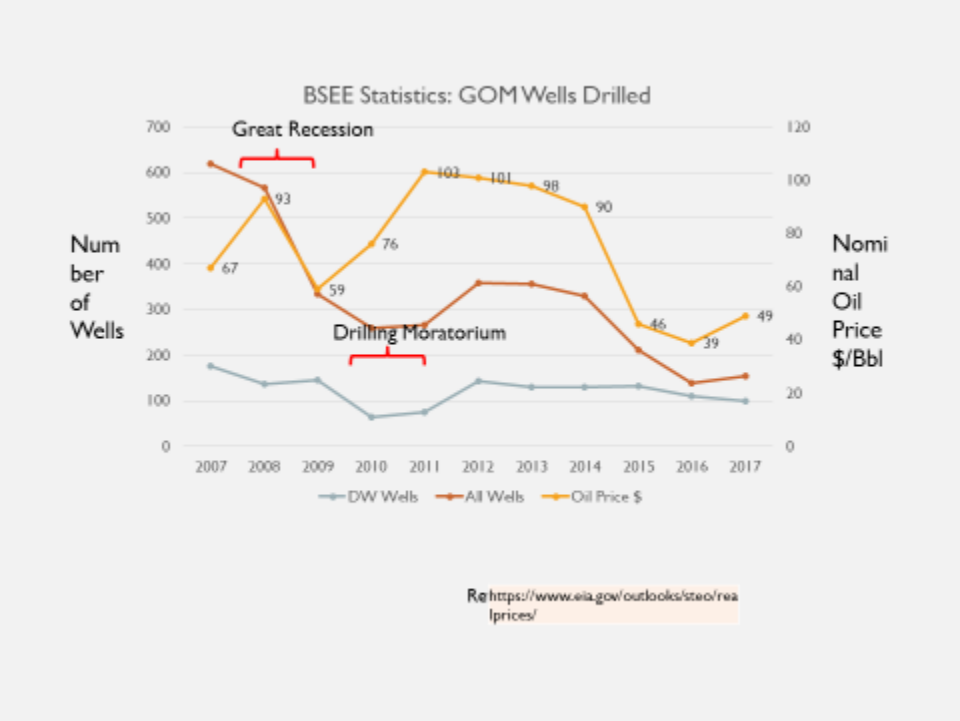
BSEE Statistics: GOM Wells Drilled
Great Recession
Drilling Moratorium
Number of Wells
Nominal Oil Price $/Bbl
700
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120
100
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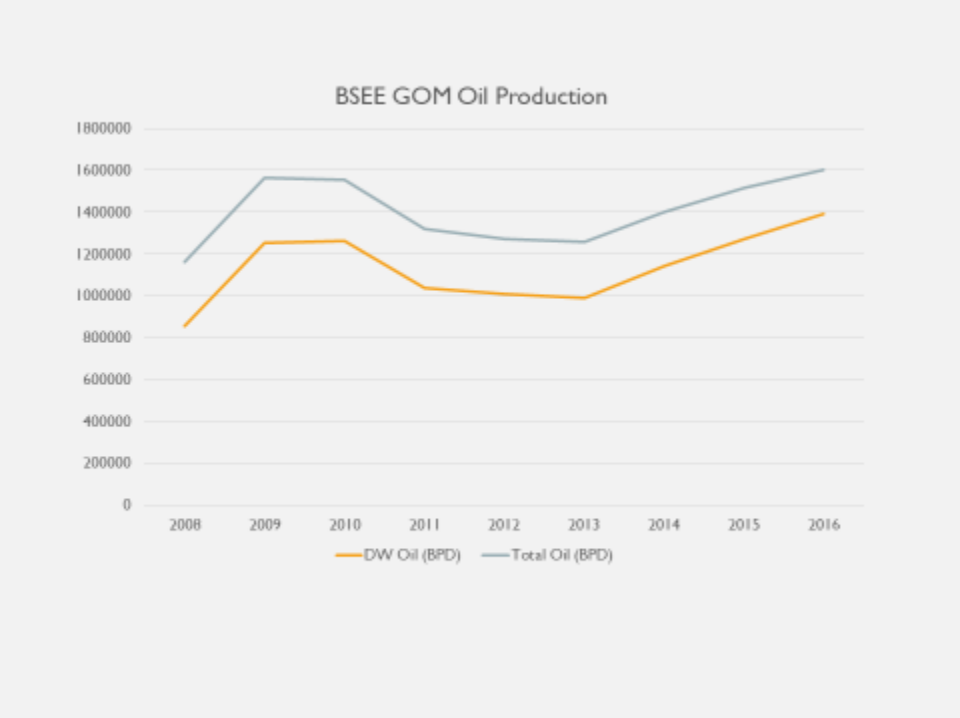
BSEE GOM Oil Production
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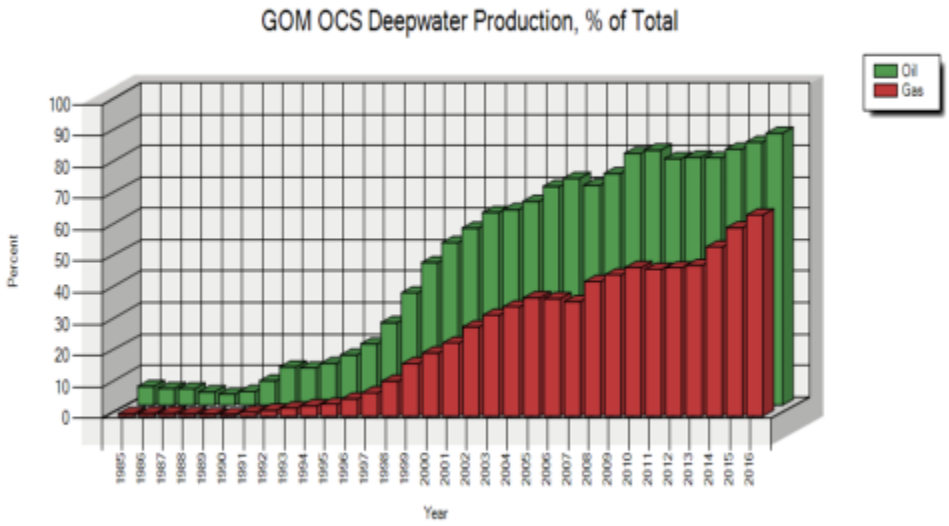
Total Oil (BPD)



Success Paths

- Identify what barrier "success requirements" have been found to fail when there are incidents
- Compare that to areas that are typically "inspected."
- Borrow from Argonne Labs ongoing work for BSEE in developing Success Paths for (a) Lifting Operations, (b) Electrical Work, (c) Breaking of Containment, and (d) Coil Tubing Operations.

SEMS Related Failure Points

- Failure points are often "SEMS-related," that is they require operational discipline and common awareness of possible failure mechanisms
- SEMS audit findings have revealed in the past several years the need to focus on the human factors in effective barrier management.

BSEE's Role in Safety Culture

- Ideally the regulator should keep attention of the workforce focused on the main threats to safety and the environment.
- There has been a lot of work done on recognizing the need for there to be significant overlaps in a company's business culture and their safety culture
- BSEE wonders if research can identify what type of regulator oversight culture maximizes the regulator's impact on safety performance.
- BSEE has been exploring this concept with the NEB of Canada but wonder if this group could also look at the role of the regulator when trying to reduce incident severity and incident rates.

BSEE's Ongoing Research Priorities

- Developing a Quality Assurance and Integrity Management Program for offshore pipeline composite repairs
- Developing an Integrity Management Program for unbonded flexible pipes.


CENTER FOR OFFSHORE SAFETY
What Insights Can COS Safety Data Provide for Research Needs?
SPE GRP Summit
San Antonio, Texas
May 22-24, 2018
Brad Smolen, BP
COS Governing Board Chair


CENTER FOR OFFSHORE SAFETY
COS Mission
Promote the highest level of safety for offshore drilling, completions, and operations.
SEMS Audit, Accreditation, and Certification
Data Collection, Analysis and Reporting
Good Practice Development
Sharing Industry Knowledge

COS Members

Operators
- Anadarko
- BHP Billiton
- BP
- Chevron
- ExxonMobil
- Fieldwood
- Hess
- Murphy Oil
- Shell
- Statoil

Rig Contractors
- Ensco
- H&P
- Pacific Drilling
- Rowan
- Seadrill

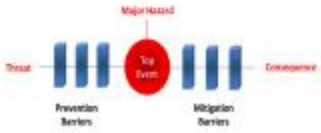
Contractors
- Baker Hughes GE
- Halliburton
- Oceaneering
- Schlumberger
- Subsea7

Affiliates
- ASQ
- IADC
- IMCA
- MSRC
- OMSA
- NOIA
- OOC
- OPITO

Safety Performance Indicators (SPI)

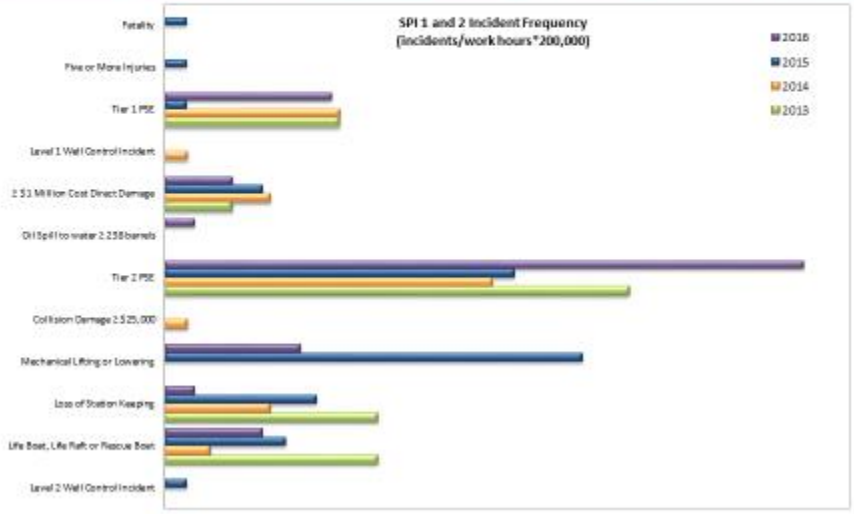
A. Fatality
B. Injury to 5 or more persons in a single incident
C. Tier 1 Process safety event
D. Level 1 well control incident
E. ≥ $1 million direct cost from damage to or loss of facility /vessel / equipment
F. Oil spill to water ≥ or equal to 10,000 gallons

A. Tier 2 Process safety event
B. Collisions that result in property or equipment damage ≥ $25,000
C. Incidents involving mechanical lifting
D. Loss of station keeping resulting in drive off or drift off
E. Life boat, life raft, or rescue boat event
F. Level 2 well control incident



SPI 3: Percentage of SPI 1 and SPI 2 incidents that involved failure of one or more of COS specified equipment as a contributing factor
SPI 4: Crane or personnel/material handling operations
SPI 5: % of critical maintenance, inspections and tests completed on time

Safety Performance (2013-2016)



Safety Performance Indicators

Initial Insights from 2017 Data

- Low, but sustaining frequency of high severity incidents – 1-2 per year is too many – **zero** is the goal
- SPI 2 incident frequency trending up driven by Tier 2 Process Safety Events and lifting incidents
- DART and RIIF trending up in 2017 vs. continual reduction in past three years

2017 data QA/QC and analysis work underway - 2017 COS Annual Performance Report will be available at the COS Safety Forum, Sep 18-19

COS members share incident and event data to enable learning across industry

- SPI 1Incidents
- SPI 2 Incidents
- High Value Learning Events

Areas for Improvement (3 Categories)

- Physical Facilities, Equipment and Processes
- Administrative Processes
- People

Areas for Improvement

- Physical Facilities, Equipment and Processes
  - *Design and Layout*
  - *Specification, Fabrication and Construction*
  - *Process or Equipment Reliability*
  - *Instrument, Analyzer and Controls Reliability*

Areas for Improvement

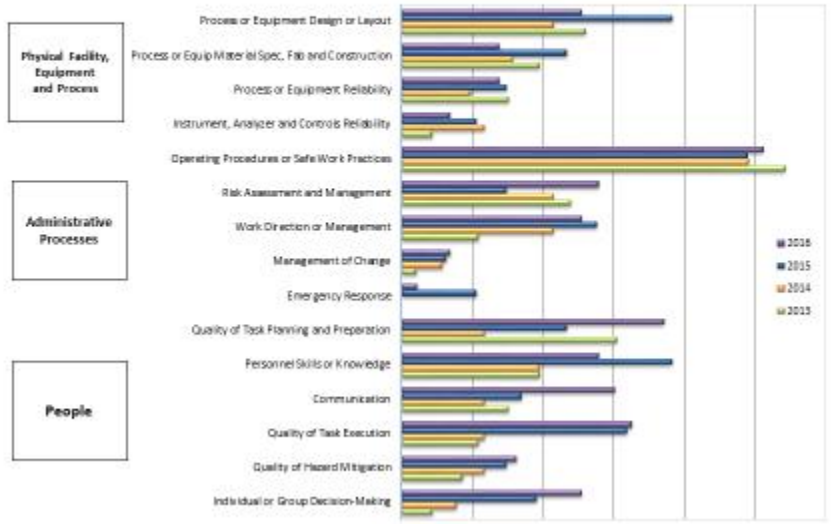
- Administrative Processes
  - *Risk Assessment and Management*
  - *Work Direction and Management*
  - *Operating Procedures and Safe Work Practices*
  - *Management of Change*
  - *Emergency Response*

Areas for Improvement

- People
  - *Quality of Task Planning and Preparation*
  - *Personnel Knowledge and Skills*
  - *Quality of Task Execution*
  - *Individual or Group Decision-Making*
  - *Quality of Hazard Mitigation*
  - *Communication*

- **Physical Facilities, Equipment and Processes**
  - *Design and Layout*
  - *Specification, Fabrication and Construction*
  - *Facility, Equipment or Process Reliability*
  - *Instrument, Analyzer and Controls Reliability*
- **Administrative Processes**
  - *Risk Assessment and Management*
  - *Work Direction and Management*
  - *Operating Procedures and Safe Work Practices*
  - *Management of Change*
  - *Emergency Response*
- **People**
  - *Quality of Task Planning and Preparation*
  - *Personnel Knowledge and Skills*
  - *Quality of Task Execution*
  - *Individual or Group Decision-Making*
  - *Quality of Hazard Mitigation*
  - *Communication*

Learning from incidents and Events (LFI)



Insights

- Its still about Plant, Process and People
- Of greatest need:
  - Procedures Process
  - Quality of Task Planning, Preparation and Execution
  - Knowledge and Skills
  - Plant Design and Layout

Delivered

- Safety and Environmental Management System Auditing
- Leadership Site Engagement
- Knowledge and Skills Management System
- SEMS Maturity Self-Assessment Tool
- Guidelines for a Robust Safety Culture
- Annual Safety Forum and OTC SEMS Session

Coming

- Guidelines for SEMS Auditing
- Guidelines for Assessing SEMS Effectiveness
- Guidelines for Procedure Writing and Management
- Guidelines for Evaluating Barrier Integrity and Effectiveness
- API RP 75 Edition 4 (SEMS)

Need for deeper inquiry (and maybe research):

- What defects can be eliminated during design and construction that can reduce risk of incidents during well and production operations? What role can new technology play?
- What errors can be eliminated by better understanding or implementation of human performance principles– the interaction between individuals and each other, plant and process?
- How can we close gaps between *work as imagined* and *work as done*?
- Whether we call it safety culture, operating culture, safe operations, or operating discipline; how do we raise it to a level that gets us to and sustains zero?
- What role does leadership play?

OOC Key Concerns

San Antonio, Texas, USA

22-24 May 2018

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Collaboration is Key

- 99% of the Federal OCS Production
- Offshore Safety is a Critical Mission ("OOC is field focused")
- Research Efforts both Environmental & Technology Focused
- OOC DeepStar™

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OOC Key Concerns

- Operational focus for "safer offshore energy systems" efforts
  - Wide variety of operators & the assets they operate
  - Importance of implementation focus
- Criticality of context with safety data
  - Operators need context to take effective action
  - General safety data trending can be misleading to the public
  - Good data is key & actionable
- Trades work well on focused, well framed areas of concern
  - Shallow water source control, well interventions, life boat loading, etc.

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Well Framed Research is Valuable

- Technology Opportunities
  - Must consider implementation
  - Should understand operational controls in place
  - Must consider context within operations
  - Industry partners can help "field test" concepts
  - Lots of areas not funded
  - Regulations sometimes create barriers
- Human Side
  - Must consider nature of work
  - Should have good working perspective on industry
  - Variety of work tasks & offshore environments
  - Regulations do not always facilitate a safe working environment

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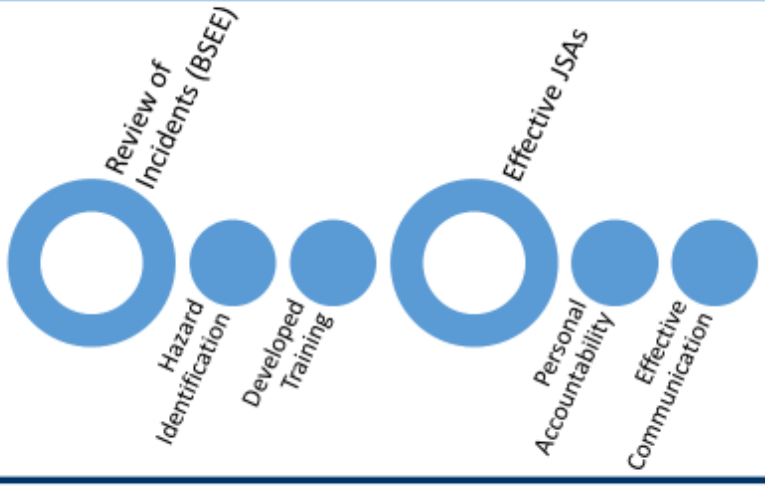
OOC Key Concerns: Action Taken



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OOC Key Concerns: Looking Forward

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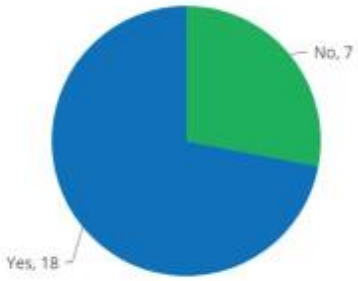
Membership Survey: Safety Data

11. Should several major trades work together and form an offshore related safety data institute?



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Membership Survey: Safety Data

10. Should OOC be a central hub for safety related data (Well Control Rule, Subpart H, etc.), rather than BSEE or BTS?

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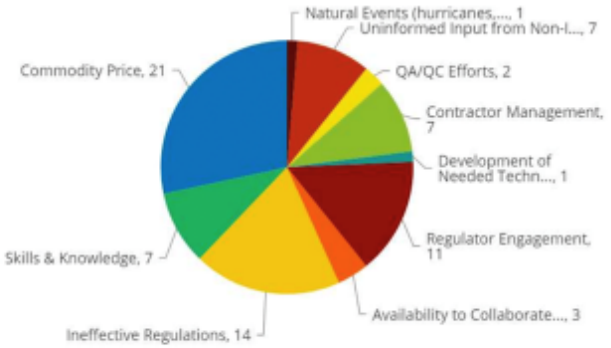
Membership Survey 18-Months Ago

8. The top three areas our industry is currently struggling with are:



- Skills & Knowledge
- Contractor Management
- (Technology Needs)

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OOC Visions of Success

- Lets have good tools in our toolbox
  - *Technology is valuable when it actually fits the application*
- Maximize the value of people's time
  - *We operate in a time & labor intensive environment*
- Focus efforts on things that work
  - *We should spend our time on activities that make a positive impact*
- Healthy safety management systems
  - *Continuous improvement, adapting to our changing world*
- Safe collaborative environment to promote learnings across industry
  - *Dialogue and open sharing around safety can improve any industry*
- Robust mechanisms for knowledge transfer to the next generation
  - *Lets not repeat the mistakes of the past*

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Final Thoughts

1. People, People, People (knowledge, communication, culture)
2. Managing Interfaces Between Entities (handoffs, roles & responsibilities)
3. Context can be the difference between a report & actionable information
4. Criticality of "Field Focused" input in efforts

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U.S. Department of Transportation
Office of the Assistant Secretary for Research and Technology

Safer Offshore Energy Systems Summit

SafeOCS Industry Safety Data (ISD) Program Phase 1 Overview

May 22, 2018

Background

- U.S. Department of the Interior's Bureau of Safety & Environmental Enforcement (BSEE) approached SPE in 2014 regarding potential **collaboration on developing industry-wide near miss framework** to enhance industry's ability to capture and share key learnings from significant near miss events, with objective of identifying and mitigation potential high consequence risks
- Proposed outcome would be SPE summit to **address opportunities and challenges** associated with collaborative near miss reporting framework, including role of SPE in facilitating this process
- Work group formed to explore benefits/mechanism for collaboration, including representatives from **SPE, BSEE, BTS, COS, OESI, IOGP, and ABS**
- **Summit held in April 2016** focused on "Assessing the Tools, Processes, and Value of Sharing & Learning from Offshore E&P Safety-Related Data"
  - Technical Report issued in September 2016
  - Key action item was to pursue volunteer pilot implementation plan to "test" process for aggregating data and to determine if "right data" ae being collected to support risk-based decision-making

2

SafeOCS Program Overview

- Facilitates capture of essential information about accident precursors and potential hazards associated with offshore operations, including risks related to pipeline safety and offshore transport.
  - Managed by U.S. Bureau of Transportation Statistics (BTS)
  - Protects source data, provides confidentiality, and protects data from legal discovery
- Collects and analyzes three categories of reports
  - **Well control equipment** component failure data related to failures of BOP and other well control equipment; currently focuses on mandatory data submissions required by BSEE
  - **Safety and pollution prevention equipment (SPPE)** failure data relates to failures of valves and their associated actuators, safety valve locks, or landing nipples; also currently focuses on mandatory data submissions required by BSEE
  - **Industry safety data (ISD)** reporting related to incidents, near misses, and stop work events that cause (or could have caused) human injury/fatality, damage (loss) of assets, or negative environmental impact; includes mandatory data required by BSEE in addition to voluntary company data that has learning value for industry

3

ISD Program - Phase 1 Planning Team Role

BTS formed a Planning Team consisting of representatives from companies interested in participating as early implementers for the SafeOCS program

- Discuss type of data to be captured for period 2014-2017 to ensure appropriate learning value
- Coordinate with BTS on effectiveness of SafeOCS ISD program design and process
- Review SafeOCS annual report draft and provide feedback prior to release
- Participate in one or more Data Review Teams, as appropriate

4

Desired Outcomes

- Phase I Planning Team agreed that primary objective of pilot effort is to develop "proof of concept" for proposed industry-wide safety data sharing database
  - Team recognized importance of industry input to maximize benefits of end products
  - Results of Phase I to be captured in report that will focus primarily on processes for data transmittal, mapping, and aggregation
  - Aggregated data could then be leveraged to provide more appropriate analysis and avoid redundancies in data collection
- Phase II of effort will then focus on steps to improve data analytics with an objective of increase application of predictive analytics
  - Identify effective leading indicators
  - Promote dialogue on barrier management and precursor analysis

5

Phase II Participation

- Once company decides to voluntarily submit data to SafeOCS ISD Program, first step is to execute company-specific Cooperative Agreement with BTS
  - Identify type of data to be submitted (e.g., incidents, near misses, stop work events)
  - Determine event data ranges for submitted data
  - Explain format of database to be provided to BTS
  - Discuss company's expectations for review/analysis of own data
- Upon execution of Cooperative Agreement, company transmits data via secure FTP site
- BTS data analysts review and aggregate data for further review and analysis by Data Review Teams consisting of BTS and industry SMEs

6

Core Data Fields for Phase I (1 of 2)

Event

- Identifier
- Incident type
- Stop work authority
- Process safety event
- *Proc. safety event tier*
- Description
- Geographic location
- Water depth
- Type of facility
- Operation type
- Activity type
- Event date
- Event time
- Party reporting
- Targeted incident types
- Weather factors
- Impacts

Injury

- Injury/illness classification
- Job title
- Short service employee?
- Experience (years)
- Company
- Day of hitch
- Evacuation?
- Body part
- Body sub-part
- Injury type

Note:
- Italicized items are optional

7

Core Data Fields for Phase I (2 of 2)

Fire

- Type of fuel
- Source of ignition
- Method of extinguish
- Length (minutes)
- Location on facility
- Hazard area class.
- Temporary equip. (y/n)

Property Damaged

- Equipment damaged
- Extent of damage
- Cost

Loss of Primary Containment

- Type
- Material released
- Release type
- Onsite or offsite?
- Contained?
- Reported volume

Dropped Object

- Object dropped
- Object lost overboard?
- Object recovered?
- Drops classification

Investigation

- *Likelihood/frequency*
- Consequence/severity (actual)
- Consequence/severity (potential)
- Causal factors
- Causal factor narrative
- *Corrective actions*

Notes:
- Italicized items are optional
- BTS to define items in red based on data submissions

8

Projected Time Line for Phase I

• Execute Cooperative Agreements	April
• Submit company-specific data to BTS (for 2014-2017)	May
• Conduct initial data review/analysis	June-August
• Initiate discussions on prospective enhancements for Phase II based on aggregated data review	June, then ongoing
• Transmit initial draft of Phase I report to Team	September
• Planning Team review/comment on draft report	October-December
• Release Phase I report to public	January 2019
• Schedule workshops, summits, and other networking opportunities to review data trends, share learnings, and address risk mitigation considerations	Ongoing

9

SafeOCS: www.safeocs.gov

10

Safer Offshore Energy Systems

San Antonio, Texas, USA
22-24 May 2018

Mark Denkowski
IADC

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Equipment

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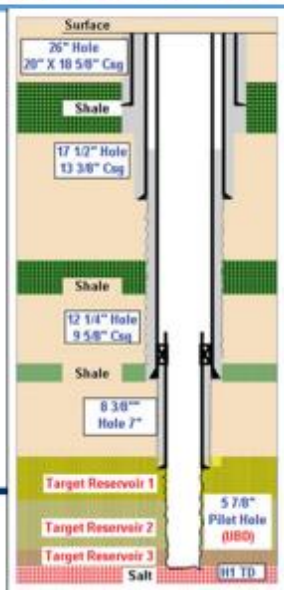
Well Construction



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Process Safety

- Process Safety Management and Process Safety Engineering
- Process Hazard Analysis (PHA), including HAZOP
- Incident Investigation & Root Cause Analysis, including for Near Misses (Close Calls)
- Layer of Protection Analysis (LOPA)
- Safety Instrumented System (SIS), including Safety Instrument Function (SIF) and Safety Integrity Level (SIL)
- Operating Procedures and Documentation
- Human Factors

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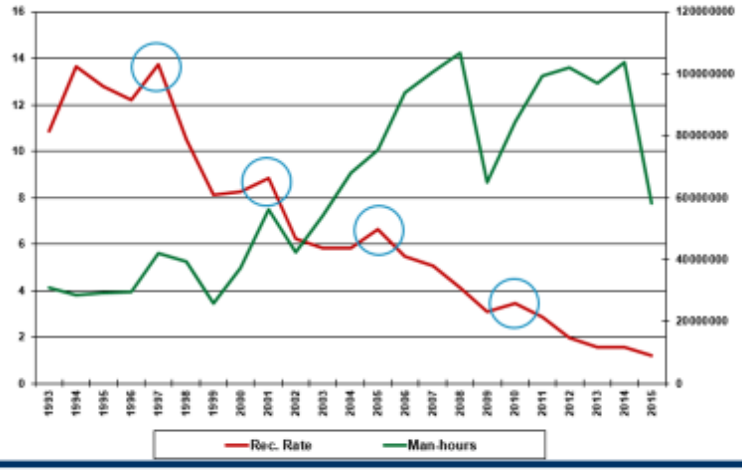
IADC ISP Incident Statistics



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Environment

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Where should we focus?

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People

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Normalization of Deviance

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People

Challenger Crew

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People

David McCelland – Harvard Psychologist

- traditional achievement and intelligence scores may not be able to predict job success"
- what is required is to profile the exact competencies required to perform a given job effectively and measure them using a variety of tests.
- **the definition of a job competency requires that the person's intent be understood, not merely that the person's behavior be observed.**

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People

- Human Factors
  - CRM
  - HMI
- Knowledge Retention
- Continuous Learning
- Knowledge Gap Closure

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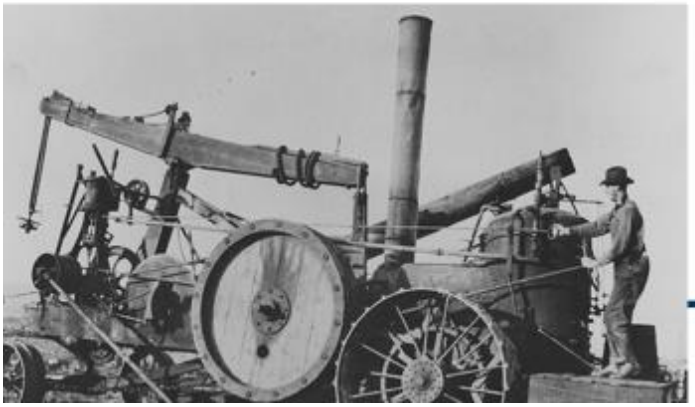
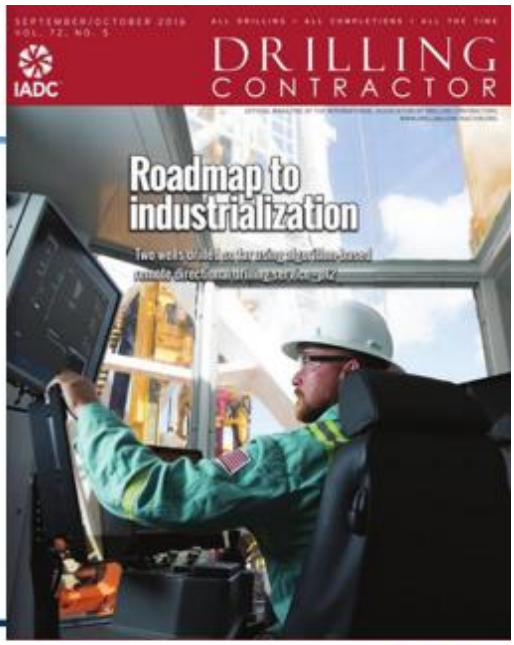
Crew Resource Management (CRM)

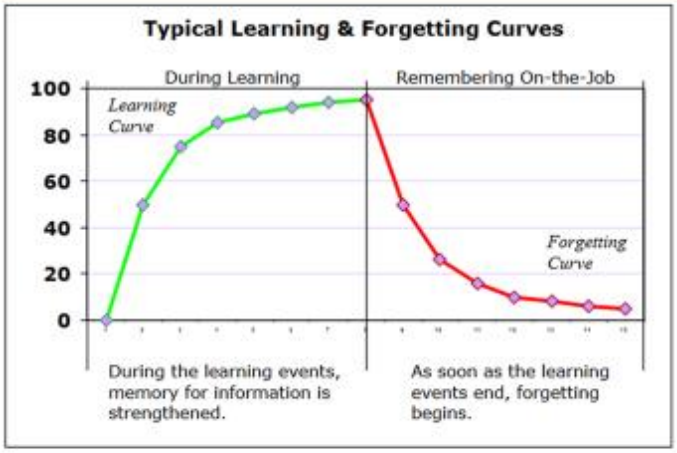
Human-Machine Interface

Then and Now





Knowledge Retention



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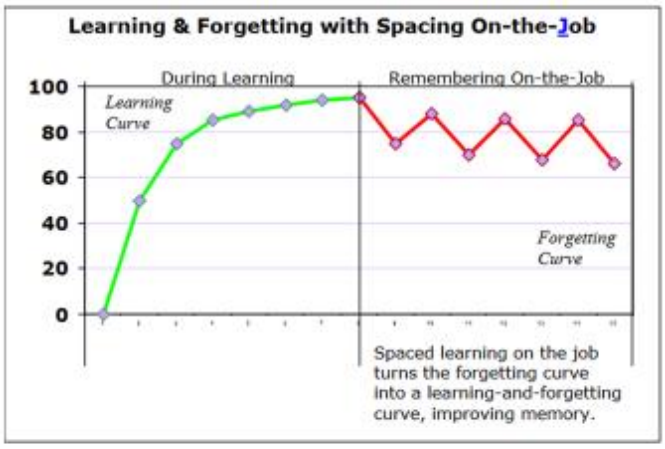
Knowledge Reinforcement



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July 7, 2017– San Francisco

Safer Offshore Energy Systems

San Antonio, Texas, USA

22-24 May 2018

Society of Petroleum Engineers

Session 2: Identify Opportunities for Safer Gulf of Mexico Operations

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Session #2 – Identify Opportunities for Safer Gulf of Mexico Operations

- Objective:
  - Brainstorm potential opportunities, describe activity, and identify benefits
  - Populate Safer Gulf Session Tool and present outcome back to Plenary Group
- Brainstorming Groups:
  1. Pre-Drill; well design, seismic, sub-surface, and meta-ocean (Steven & Jeff)
  2. Drilling; drilling, completions, interventions, abandon (Mark & Paul)
  3. Construction; facility, infrastructure, pipelines, onshore & offshore (Ford & Ken)
  4. Production; hydrocarbons management through facilities (Brad & AJ)
- Questions to Consider:
  - In what way might we improve safety in GoM operations?
  - In what way might we do things differently?
  - What are the barriers to close the gaps for safer well delivery?
  - What does good look like in the future?

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Session #2 - Brainstorming Guidance

- Quantity, not Quality
- Avoid judgment and analysis
- Encourage wild and even 'absurd' ideas
- Capture everyone's ideas
- Narrow ideas

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Breakout Teams and Rooms

- Pre-Drill
- Drill
- Construction
- Production

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Session #3 – Categorize Opportunities into Common themes: People, Plant, Process, and Information

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Session #3 – Categorize Opportunities into Common Themes: People, Plant, Process, and Information

- Objective
  - Categorize brainstormed opportunities into themes: People, Plant, Process, and Information
  - Define: impacted parties, key contributors, and who else is working opportunity
  - Populate Safer Gulf Session Tool & present outcome back to Plenary Group
- Workgroups, same as Brainstorming Groups
  1. Pre-Drill; well design, seismic, sub-surface, and meta-ocean (Steven & Jeff)
  2. Drilling; drilling, completions, interventions, abandon (Mark & Paul)
  3. Construction; facility, infrastructure, pipelines, onshore & offshore (Ford & Ken)
  4. Production; hydrocarbons management through facilities (Brad & AJ)
- Questions to Consider:
  - What are the human attributes and human factors at play?
  - How can facility design improve safety and/or efficiency?
  - What process considerations should be documented to maximize safety?
  - How can the industry, regulatory bodies, professional associations and communities better communicate or collaborate?

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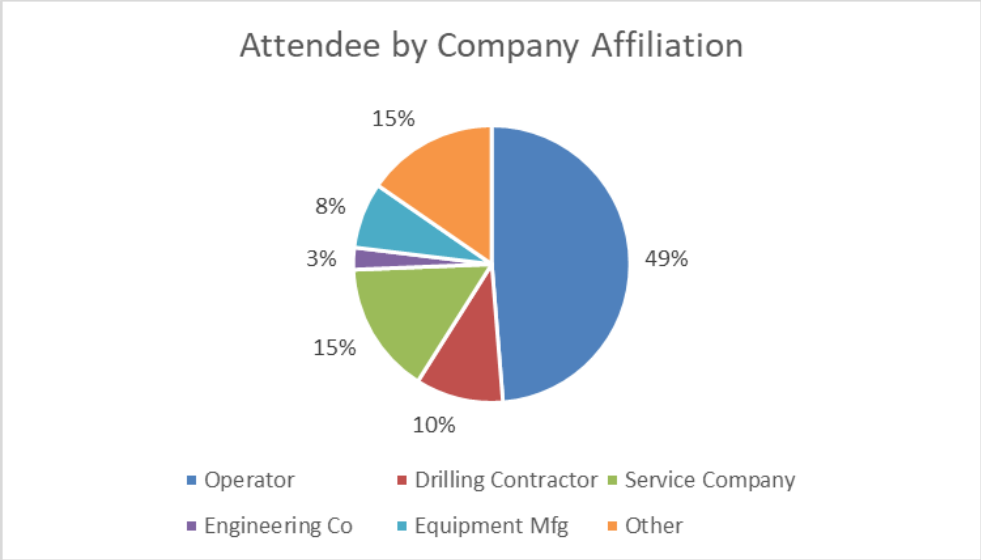
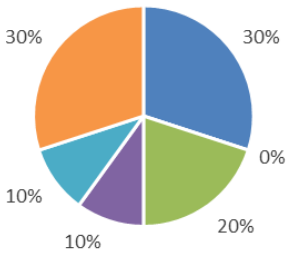
Appendix IV – Attendee Breakdown

Total Participants by breakout group

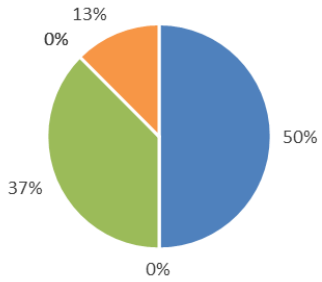
Pre-Drill Data – 8 Drilling - 13 Construction/Subsea- 10 Production Operations - 8



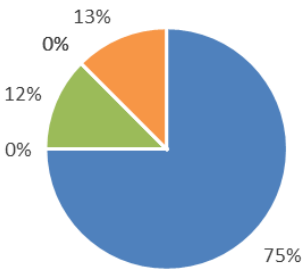
Construction/Subsea Breakout Composition



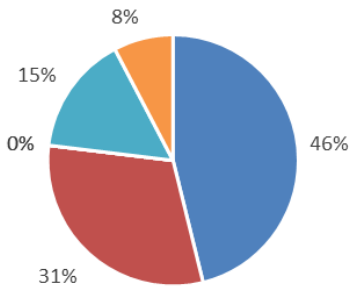
Pre Drill / Data Breakout Composition



Production Operations Breakout Composition



Drilling Breakout Composition



Appendix IV – Attendee List

Ken Arnold
K Arnold Consulting, Inc.
President

Leopoldo Bello
Vryhof Anchors B.V.
Vice President

Ford Brett
PetroSkills
CEO

Stephen Dazet
ExxonMobil Development Co.
Drilling Advisor

Mark Denkowski
IADC
Vice President Accreditation Operations

Mike Dolman
Baker Hughes, a GE company
HSE Leader Global Operations

Cengiz Esmersoy
Schlumberger
Technology Advisor

Steve Frantz
Arena Offshore, LP
Senior Construction Engineer

Jeremy Greenwood
Halliburton Co.
Chief Global Advisor: Drilling Engineering

Phil Grossweiler
M&H Energy Services
Principal Consultant
Director of Corporate Outreach

Roberto Hinojosa
Chevron Corporation
WellSafe Systems Engineer

Charlie Holt
BP America Inc.
Sr. Operations Specialist

Karina Khazmutdinova
The National Academies of Science, Engineering, and Medicine
Associate Program Officer

Andrew Koblenzer
BP America Production Co.
Operations Manager - BP GoM S&OR

Joe Leimkuhler
LLOG Exploration
Vice President - Drilling

Paul Linkin
Pacific Drilling
VP Quality & HSE

Ro Lokken
ExxonMobil Production Co.
Chief Offshore and Infrastructure Engineer

Jennifer Lucas
BP
Senior Geoscientist

Robin Macmillan
National Oilwell Varco
Senior VP

Roland Moreau
Consultant

Jeff Moss
ExxonMobil Development Co.
Drilling Engineering Advisor / New Technology

Gene Narahara
Chevron Corporation
Reservoir Engineer

Steven Nieting
Schlumberger Oilfield Services
Reservoir Characterization Group
Kelly Oskvig
GRP
Program Officer

Kristin Paul
BP America Production Co.
HSE Manager

Will Pecue
Taylor Energy Co.
President
Jim Pettigrew
Ocean Energy Safety Institute (OESI)
Director of Operations

Tom Proehl
ENSCO plc
Senior Technical Advisor, Well Control

Jim Raney
Anadarko Petroleum Corp
Director, Engineering & Technology

Harris Reynolds
Diamond Offshore Drilling Inc.
Direstor R&D

Gregory Rhodes
Subsea 7
Business Development Director

Ken Richardson
ABS Americas
EVP Global Offshore

Ajay Shah
Chevron North America E&P
Team Lead

James Siegfried
ExxonMobil Corporation
Manager, New Operations

Brian Skeels
TechnipFMC
Senior Technology Advisor

Brad Smolen
BP
Director

James Stear
Chevron Corporation
Metocean Lead / Senior Offshore Engineer

Lee Stockwell
Shell Exploration & Production Co.
General Manager, GOM South Assets

Jim Weir
National Oilwell Varco
R&D Development Engineer

Tom Williams
RPSEA
President, RPSEA

Evan Zimmerman
OOC
Executive Director

Appendix V – Opportunities Ranked as "HIGH" by each breakout group, sorted by "Theme"

For a complete list of all opportunities, and details for each, see spreadsheet

Theme	Opportunity Name	Opportunity Description	Industry Area	Priority
Automation and Remote Actions	Customizable automated well control	Understand variables/parameters for customizable automated well control	Drilling	HIGH
Automation and Remote Actions	Reduce lifting offshore	How to reduce the frequency of lifting through the use of drones, lower inventory, etc.	Production	HIGH
Automation and Remote Actions	How to reduce staffing needs and exposure on offshore facilities	Can physical (mechanical) systems be designed so that more tasks can be done by automation/robotics	Production	HIGH
Automation and Remote Actions	What is the appropriate level of automation	Too much automation may lead to higher levels of risk; when is automation too much automation?	Production	HIGH
Automation and Remote Actions	Remote access to expertise	How can we help increase access to expertise without needing physical presence? (such as remote mentoring/coaching, etc.)	Production	HIGH
Crews and People	Crew Resource Management (CRM) for Operational Integrity	Improved implementation of CRM principles extended to include operational integrity situations	Drilling	HIGH

Theme	Opportunity Name	Opportunity Description	Industry Area	Priority
Crews and People	Accredited framework for effective leadership and decision making training programs	Develop/implement an accredited framework to optimize effective leadership training programs and decision making for offshore personnel. Such a program should consider things like: - Well site leadership training - Situational awareness training - Understanding risk versus consequence - Focusing human performance in the midst of external distractions - Identifying confirmation bias - Teambuilding prior to crew going to rig - Accelerated/continuing education for critical positions - Improving transition from work force employee to supervisor	Drilling	HIGH
Crews and People	Individual competency on barrier management	Increasing individual fluency in understanding of barriers to better manage barriers	Drilling	HIGH
Crews and People	How do we measure/monitor the culture of safety in an installation or construction team	"KPIs" for safety culture, leading/lagging indicators for safety culture. Common way to identify safety culture and its effects on safer operations over time. Include: Engaging works input, "Hassle avoidance", stop work, following job safety analysis (JSA), "Doing the right thing in the rain and 2AM when no one is looking", etc.…	Construction	HIGH
Crews and People	Increasing team performance	Build more effective teams with personality traits. Can we build a team with profiling? Can we profile people “Match.com” to pair people with the right jobs?	Construction	HIGH
Crews and People	How do you make sure people are not overly reliant on their safety / equipment systems?	How to ensure that there is an appropriate level of balance between relying and trusting the systems without sacrificing human thought and decision-making	Production	HIGH

Theme	Opportunity Name	Opportunity Description	Industry Area	Priority
Crews and People	Better way to drive personal accountability to everybody (primarily "front-line" workers) around their safety responsibility	How to better understand and drive personal accountability to workforce around their safety responsibilities	Production	HIGH
Crews and People	Understanding the future skill set of workforce and what types of analytics will be necessary to identify those skills	How can we identify the skills necessary for the future workforce to work competently and safely with the new technology being deployed (such as real time monitoring, new materials, automation, etc.)?	Production	HIGH
Crews and People	How to make sure training standards are upheld and used	How can companies get an assurance that the training standards are being used and are useful	Production	HIGH
Crews and People	How to maintain progressive competency	How to use tabletop, drills, etc. to better train operators to keep their skills sharp and respond to changes to the facility	Production	HIGH
Crews and People	The effects of prioritization on normalization of deviance / risk nominalization	How does prioritization and work schedule impact culture	Production	HIGH
Data Collection and Analytics	Better Dissemination of Knowledge throughout industry	Central AND USEFUL repository (with appropriate data analytics) of ongoing and past safety related research, JIPs, etc.; including lessons learned from incidents, design efficiencies, and around designs that works, and why (e.g. Piper)	Construction	HIGH
Data Collection and Analytics	Better utilization of incidents to increase lifting safety	Better capture, characterization and analysis of lifting incidents such that actionable lessons can be learned; such as use detailed bow ties and data to provide context around Lift safety data; more focused actions based on real (operational/field) data. Include dynamic lifts.	Construction	HIGH

Theme	Opportunity Name	Opportunity Description	Industry Area	Priority
Data Collection and Analytics	Better leading indicators	How to build predictive indicators	Production	HIGH
Data Collection and Analytics	How to better data mine and understand existing data (company and industry)	Use existing data that is already collected and reported to identify signals of potential problems earlier	Production	HIGH
Data Collection and Analytics	Sharing of equipment reliability data	How to better share and use reliability data around specific equipment and components	Production	HIGH
Environmental Impact	Mechanical Dispersion	Integration of mechanical dispersion methods (in contrast to chemical dispersion methods) into Emergency Response processes.	Drilling	HIGH
Innovation, Evolution, and Technology	Better pre drill prediction of pore pressure and fracturing gradient	Increasing the certainty and reliability of pore pressure prediction and fracturing gradient. Specify the accuracy tolerance that will lead to a step change in forecasting accuracy of pore pressure and fracturing gradient including principal stresses.	Pre-Drill	HIGH
Innovation, Evolution, and Technology	Real time validation of seismic prediction	Validating velocity assumptions and depth conversions utilizing LWD data prior to drilling hazard interval	Pre-Drill	HIGH
Innovation, Evolution, and Technology	Shallow Hazard management and mitigation	Novel and / or improved methodologies for hazard assessment and kick detection during riserless drilling	Pre-Drill	HIGH
Innovation, Evolution, and Technology	Technology development to operate under a closed system (continuous circulation).	Eliminate diverter in favor of riser gas handling Move to closed loop as a default in lieu of open loop Automated management of bottom hole pressure	Drilling	HIGH

Theme	Opportunity Name	Opportunity Description	Industry Area	Priority
Innovation, Evolution, and Technology	Improved detection of potential kicks	Seismic ahead of the bit Downhole gas influx detection	Drilling	HIGH
Innovation, Evolution, and Technology	Better well bore integrity characterization	Annular pressure buildup mitigation techniques Identification of pressure in multiple annuluses	Drilling	HIGH
Innovation, Evolution, and Technology	Better BOPs (such as better systems, controls, corrosion, instrumentation, etc.)	Better BOP control systems Better measurement of BOP systems How do we take advantage of differential pressure for improved BOP performance Corrosion proof sealable surfaces in BOPs	Drilling	HIGH
Innovation, Evolution, and Technology	Human-machine zone management/worker position detection	Better ways to track and manage worker positions relative to machines, equipment, and other hazards on rig floor	Drilling	HIGH
Innovation, Evolution, and Technology	Improved gas detection and sensor capabilities	Better sensor and detection capabilities may lead to better ways to manage gas exposure situations	Drilling	HIGH
Innovation, Evolution, and Technology	Real time pore pressure	Application of real time pore pressure prediction, monitoring and related decision making	Drilling	HIGH
Innovation, Evolution, and Technology	Leveraging technologies to augment safe work practices with dynamic engagement	Utilize apps, sensors, and other tools to enable taking JSAs, Op Procedures, Safer work practices, etc. dynamically to the job.	Construction	HIGH
Innovation, Evolution, and Technology	How can we create equipment that needs less maintenance?	Create equipment that requires inherently less maintenance	Production	HIGH

Theme	Opportunity Name	Opportunity Description	Industry Area	Priority
Innovation, Evolution, and Technology	Higher usage of thermocomposite pipe on facilities	How to make thermocomposite pipe more useful (i.e. sizing) and economically feasible	Production	HIGH
Innovation, Evolution, and Technology	What will future production look like?	What will figure greenfield production look like with all of the new technology, new designs, new materials, etc. being introduced? How will the way tasks and activities are completed need to change?	Production	HIGH
Inspection and Testing	Safety Testing Equipment	Establish best practices for procedure and frequency including to ensure appropriate location/environment for better/safer tests. Examples include relief valve testing procedure, and safety and pollution prevention equipment (SPPE) testing frequencies, high pressure equipment.	Construction	HIGH
Inspection and Testing	Leveraging technology for better inspection	Drones, etc. confined spaces, fluid testing. Better ways of inspecting risers, mooring systems, structures (fixed and floating). Novel usages of augmented reality to improve construction and inspection. (Digital twin) and better measurement of accumulated effects of time history, and cycles/strain/corrosion.	Construction	HIGH
Inspection and Testing	How to assure the reliability of Maintenance, Inspection, and Testing programs on offshore facilities throughout the lifecycle of the facility	How to assure that the maintenance, Inspection, and testing activities are being done in a way that supports reliable operations throughout the lifecycle of the facility	Production	HIGH
Inspection and Testing	Utilizing smart technology for existing inspection and maintenance activities, especially in brownfields	What technology will allow better monitoring of physical condition of equipment that handles inconsistent / multi-phase fluids	Production	HIGH

Theme	Opportunity Name	Opportunity Description	Industry Area	Priority
Interface Management and Systems Engineering	How to better write and manage procedures	What are the key characteristics that lead to effective procedure writing, management, and communication, including a better understanding of how humans understand and receive information	Production	HIGH
Interface Management and Systems Engineering	Early warning signs for procedural drift	How to better write/manage procedures to identify procedural drift and deviations or abnormal responses earlier - how to know when you've gone off procedure	Production	HIGH
Risk Analysis and Understanding	Loop current / eddies - Improve prediction and extend further out in time (3+ months target)	1. Cheaper ways to monitor loop / eddies over large areas 2. Monitor further upstream - i.e. Caribbean inflow 3. Advanced statistical forecast methods	Pre-Drill	HIGH
Risk Analysis and Understanding	Probabilistic Risk Assessment for Critical Equipment	Develop guidelines for probabilistic risk assessment for critical equipment	Drilling	HIGH
Risk Analysis and Understanding	Offshore Cybersecurity	Improved mechanisms to optimize cyber safety/security	Drilling	HIGH
Risk Analysis and Understanding	Using AI to better identify scenarios for risk analysis.	Find better ways to identify scenarios that create Low likelihood/severe consequence events. Can Use AI on past events? What about using AI on P&IDs?	Construction	HIGH
Risk Analysis and Understanding	How to respond to upset conditions	How to better characterize and respond to upset/abnormal conditions	Production	HIGH
Risk Analysis and Understanding	What aspect of risk management should companies focus on to improve?	What are the most value-adding ways to improve risk management in offshore industry? For example, is the most value added by focusing on risk elimination, risk reduction, risk identification, risk tolerance, etc.?	Production	HIGH
Standardization and Simplification	What is the "basic minimum" of process safety?	How to characterize the minimum process safety requirements and characteristics applicable to all O&G industry	Production	HIGH

Appendix VI – Ranking of Theme Importance by Participants

Ranking of importance each **theme by all participants** (37 Respondents)

ALL PARTICIPANT RANKING	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th
Crews (People)	16	7	4	2	4	0	3	0	0	0	1
Risk Analysis/Understanding	4	10	6	5	2	3	4	1	1	1	0
Innovation / Evolution / Technology	9	3	5	6	4	2	3	1	2	2	0
Data collection & analytics	3	4	5	8	5	4	3	3	1	1	0
Automation / Remote Actions	1	4	4	2	6	7	4	4	2	1	2
Inspection/Testing of Equipment/Barriers	1	0	4	3	6	4	4	5	3	2	1
Interface Management / Systems Enginee	1	4	1	4	2	3	6	7	5	2	2
Regulators / Regulations / Laws	1	1	3	4	1	5	5	3	2	5	7
Standardization / Simplification	0	1	3	1	4	3	2	6	6	10	1
Communication	0	3	1	1	1	1	1	5	6	4	14
Environmental	1	0	1	0	1	4	2	2	8	9	9

Ranking of importance each **theme by Pre-drill/Data Breakout** group members (7 respondents)

PREDRILL / DATA BREAKOUT	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th
Crews (People)	2	1	2	0	2	0	0	0	0	0	0
Risk Analysis/Understanding	0	4	1	1	0	0	1	0	0	0	0
Innovation / Evolution / Technology	3	0	0	0	3	1	0	0	0	0	0
Data collection & analytics	0	2	0	4	0	0	1	0	0	0	0
Automation / Remote Actions	1	0	1	0	1	2	1	0	1	0	0
Inspection/Testing of Equipment/Barriers	0	0	1	1	0	1	0	2	1	1	0
Interface Management / Systems Engineer	0	0	0	0	0	0	1	1	2	2	1
Regulators / Regulations / Laws	0	0	1	1	0	1	0	2	0	0	2
Standardization / Simplification	0	0	1	0	1	1	0	1	1	2	0
Communication	0	0	0	0	0	0	1	1	2	1	2
Environmental	1	0	0	0	0	1	2	0	0	1	2

Ranking of importance each **theme by Well Operations Breakout** group members (13 respondents)

WELLS BREAKOUT	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th
Crews (People)	8	1	1	0	1	0	1	0	0	0	1
Risk Analysis/Understanding	1	4	5	0	0	1	2	0	0	0	0
Innovation / Evolution / Technology	3	2	0	3	1	0	1	1	1	1	0
Data collection & analytics	0	1	1	3	3	2	0	2	0	1	0
Automation / Remote Actions	0	1	1	2	2	1	1	2	1	0	2
Inspection/Testing of Equipment/Barriers	0	0	0	1	3	4	1	2	1	0	1
Interface Management / Systems Enginee	1	1	1	1	0	1	3	4	1	0	0
Regulators / Regulations / Laws	0	1	1	1	0	1	4	1	0	3	1
Standardization / Simplification	0	0	1	1	1	1	0	0	4	4	1
Communication	0	2	1	1	1	0	0	0	1	1	6
Environmental	0	0	1	0	1	2	0	1	4	3	1

Ranking of importance each **theme by Construction/Subsea Breakout** group members (8 respondents)

CONSTRUCTION BREAKOUT	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th
Crews (People)	3	3	0	0	1	0	1	0	0	0	0
Risk Analysis/Understanding	1	1	0	2	1	0	1	0	1	1	0
Innovation / Evolution / Technology	1	1	3	2	0	0	0	0	1	0	0
Data collection & analytics	2	1	1	1	1	1	1	0	0	0	0
Automation / Remote Actions	0	1	0	0	1	2	1	2	0	1	0
Inspection/Testing of Equipment/Barrier	0	0	1	0	1	0	1	1	0	0	0
Interface Management / Systems Engine	0	0	0	0	1	2	1	1	2	0	1
Regulators / Regulations / Laws	1	0	1	2	0	2	1	0	0	0	1
Standardization / Simplification	0	0	0	0	2	0	0	1	1	4	0
Communication	0	1	0	0	0	1	0	2	0	1	3
Environmental	0	0	0	0	0	0	0	1	3	1	3

Ranking of importance each **theme by Production Operations Breakout** group members (9 respondents)

PRODUCTION OPS BREAKOUT	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th
Crews (People)	3	2	1	2	0	0	1	0	0	0	0
Risk Analysis/Understanding	2	1	0	2	1	2	0	1	0	0	0
Innovation / Evolution / Technology	2	0	2	1	0	1	2	0	0	1	0
Data collection & analytics	1	0	3	0	1	1	1	1	1	0	0
Automation / Remote Actions	0	2	2	0	2	2	1	0	0	0	0
Inspection/Testing of Equipment/Barriers	1	0	0	1	3	0	1	0	2	1	0
Interface Management / Systems Engineeri	0	3	0	3	1	0	1	1	0	0	0
Regulators / Regulations / Laws	0	0	0	0	1	1	0	0	2	2	3
Standardization / Simplification	0	1	1	0	0	1	2	4	0	0	0
Communication	0	0	0	0	0	0	0	2	3	1	3
Environmental	0	0	0	0	0	1	0	0	1	4	3

Ranking of importance each **theme by participants from Operators** (15 Respondents)

Operator Ranking	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th
Crews (People)	8	3	2	0	1	0	1	0	0	0	0
Risk Analysis/Understanding	0	4	4	3	1	1	0	1	0	1	0
Innovation / Evolution / Technology	4	1	4	2	1	0	1	1	0	1	0
Data collection & analytics	2	0	0	4	3	3	1	1	1	0	0
Automation / Remote Actions	0	2	3	1	2	3	0	2	1	0	1
Inspection/Testing of Equipment/Barriers	1	0	0	1	2	3	3	2	2	1	0
Interface Management / Systems Engineering	0	2	0	3	2	0	3	1	3	1	0
Regulators / Regulations / Laws	0	0	1	1	0	1	2	1	1	3	5
Standardization / Simplification	0	1	1	0	3	1	2	2	2	3	0
Communication	0	2	0	0	0	0	1	3	2	1	6
Environmental	0	0	0	0	0	3	1	1	3	4	3

Ranking of importance **each theme by participants from Drilling Contractors** (4 Respondents)

Drilling Contractor Ranking	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th
Crews (People)	2	0	1	0	1	0	0	0	0	0	0
Risk Analysis/Understanding	0	2	1	0	0	0	1	0	0	0	0
Innovation / Evolution / Technology	1	1	0	0	1	0	0	0	1	0	0
Data collection & analytics	0	0	0	2	0	1	0	0	0	1	0
Automation / Remote Actions	0	0	0	0	1	1	1	0	0	0	1
Inspection/Testing of Equipment/Barriers	0	0	0	0	0	0	0	0	0	0	0
Interface Management / Systems Enginee	1	0	0	0	0	1	0	2	0	0	0
Regulators / Regulations / Laws	0	1	1	0	0	0	1	1	0	0	0
Standardization / Simplification	0	0	0	0	0	0	0	0	1	2	1
Communication	0	0	1	1	0	0	0	0	0	0	2
Environmental	0	0	0	0	1	1	0	0	1	1	0

Ranking of importance each **theme by participants from Service Companies** (6 Respondents)

Service Companies Ranking	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th
Crews (People)	1	2	1	0	1	0	1	0	0	0	0
Risk Analysis/Understanding	0	2	1	1	0	0	1	0	1	0	0
Innovation / Evolution / Technology	2	0	0	1	1	1	0	0	1	0	0
Data collection & analytics	0	1	1	1	1	0	2	0	0	0	0
Automation / Remote Actions	1	1	0	0	2	1	0	0	0	1	0
Inspection/Testing of Equipment/Barrie	0	0	2	2	0	0	0	1	0	1	0
Interface Management / Systems Engine	0	0	0	0	0	1	1	1	2	0	1
Regulators / Regulations / Laws	1	0	0	1	0	2	0	1	0	0	1
Standardization / Simplification	0	0	1	0	1	1	0	1	0	2	0
Communication	0	0	0	0	0	0	0	1	2	1	2
Environmental	1	0	0	0	0	0	1	1	0	1	2

Ranking of importance each **theme by participants from Equipment Manufacturers** (4 Respondents)

Equipment Manfacturers Ranking	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th
Crews (People)	1	1	0	0	1	0	1	0	0	0	0
Risk Analysis/Understanding	2	0	0	0	0	0	2	0	0	0	0
Innovation / Evolution / Technology	0	0	1	2	0	0	0	0	0	1	0
Data collection & analytics	1	1	0	0	1	0	0	1	0	0	0
Automation / Remote Actions	0	0	0	0	1	1	0	2	0	0	0
Inspection/Testing of Equipment/Barriers	0	0	1	0	0	1	0	0	0	0	1
Interface Management / Systems Engineering	0	1	1	0	0	0	0	1	0	0	1
Regulators / Regulations / Laws	0	0	0	2	0	0	1	0	0	1	0
Standardization / Simplification	0	0	1	0	0	1	0	0	0	2	0
Communication	0	1	0	0	0	1	0	0	0	0	2
Environmental	0	0	0	0	0	0	0	0	4	0	0

Ranking of importance each **theme by participants from Other Organization** types (6 Respondents)

Other Organizations Ranking	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th
Crews (People)	4	0	0	1	0	0	0	0	0	0	1
Risk Analysis/Understanding	1	2	0	1	1	1	0	0	0	0	0
Innovation / Evolution / Technology	1	1	0	1	1	1	1	0	0	0	0
Data collection & analytics	0	2	2	1	0	0	0	1	0	0	0
Automation / Remote Actions	0	0	1	1	0	0	3	0	1	0	0
Inspection/Testing of Equipment/Barriers	0	0	1	0	2	1	0	1	1	0	0
Interface Management / Systems Engineeri	0	1	0	0	0	1	1	2	0	1	0
Regulators / Regulations / Laws	0	0	1	0	1	2	1	0	0	0	1
Standardization / Simplification	0	0	0	1	0	0	0	1	3	1	0
Communication	0	0	0	0	1	0	0	1	1	2	1
Environmental	0	0	1	0	0	0	0	0	0	2	3

Appendix VII – Spreadsheet Detailing the List of Opportunities from Each Breakout Group

Opportunity Name	Opportunity Description	Industry Area	Priority
Customizable automated well control	Understand variables/parameters for customizable automated well control	Drilling	HIGH
Reduce lifting offshore	How to reduce the frequency of lifting through the use of drones, lower inventory, etc.	Production	HIGH
How to reduce staffing needs and exposure on offshore facilities	Can physical (mechanical) systems be designed so that more tasks can be done by automation/robotics	Production	HIGH
What is the appropriate level of automation	Too much automation may lead to higher levels of risk; when is automation too much automation?	Production	HIGH
Remote access to expertise	How can we help increase access to expertise without needing physical presence (i.e. remote mentoring/coaching, etc?)	Production	HIGH
Drone usage for delivery	Improved delivery of supplies offshore using drones	Drilling	MED
Use technology to reduce or eliminate manning	Utilizing technology (more reliable equipment, sensors, digitalization, etc.) to improving human/machine offshore interface.	Construction	MED
Alternative ways to conduct surveillances / operator rounds	Better ways to assess physical conditions through use of automation to remove personnel from exposure	Production	MED
Self-diagnosing / self-correcting instruments, including flow sensors	Can we design and deploy better instrumentation that has self-diagnosis / self-correcting including flow sensors	Drilling	LOW
Employee-less rig floors	Implement technology for employee less rig floors	Drilling	LOW
Reduce dependence on maintenance staff (such as I&E techs)	Create systems and methods to simplify maintenance such that less physical human inspections and activities are needed	Production	LOW
Safety risks as a result of divestures and acquisitions	What are effects of mergers and acquisition (M&A) on safety?	Production	MED
Faster lessons learning	Improved mechanisms for sharing lessons learned	Drilling	LOW

Opportunity Name	Opportunity Description	Industry Area	Priority
How to better communicate data to right people at the right time	What are the best methods to communicate in a timely way to the appropriate people in a way that is understandable	Production	LOW
How do organizations communicate better vertically	How to better communicate throughout the organization to assure that the messages are being relayed timely and accurately	Production	LOW
Fragmented nature of industry response to specific technical issues	Should industry act in a collaborative way to upcoming and ongoing technical issues (i.e. oxygen scavenging)	Production	LOW
Crew Resource Management (CRM) for Operational Integrity	Improved implementation of CRM principles extended to include operational integrity situations	Drilling	HIGH
Accredited framework for effective leadership and decision making training programs	Develop/implement an accredited framework to optimize effective leadership training programs and decision making for offshore personnel. Such a program should consider things like: - Well site leadership training - Situational awareness training - Understanding risk vs consequence - Focusing human performance in the midst of external distractions - Identifying confirmation bias - Teambuilding prior to crew going to rig - Accelerated/continuing education for critical positions - Improving transition from work force employee to supervisor	Drilling	HIGH
Individual competency on barrier management	Increasing individual fluency in understanding of barriers to better manage barriers	Drilling	HIGH
How do we measure/monitor the culture of safety in an installation or construction team	"KPIs" for safety culture, leading/lagging indicators for safety culture. Common way to identify safety culture and its effects on safer operations over time. Include: Engaging works input, "Hassle avoidance", stop work, following JSAs, "Doing the right thing in the rain and 2AM when no one is looking", etc.	Construction	HIGH

Opportunity Name	Opportunity Description	Industry Area	Priority
Increasing team performance	Build more effective teams with personality traits Can we build a team with profiling? Can we profile people “Match.com” to pair people with the right jobs?	Construction	HIGH
How do you make sure people are not overly reliant on their safety / equipment systems?	How to ensure that there is an appropriate level of balance between relying and trusting the systems without sacrificing human thought and decision-making	Production	HIGH
Better way to drive personal accountability to everybody (primarily "front-line" workers) around their safety responsibility	How to better understand and drive personal accountability to workforce around their safety responsibilities	Production	HIGH
Understanding the future skill set of workforce and what types of analytics will be necessary to identify those skills	How can we identify the skills necessary for the future workforce to work competently and safely with the new technology being deployed (such as real time monitoring, new materials, automation, etc.)?	Production	HIGH
How to make sure training standards are upheld and used	How can companies get an assurance that the training standards are being used and are useful	Production	HIGH
How to maintain progressive competency	How to use tabletop, drills, etc. to better train operators to keep their skills sharp and respond to changes to the facility	Production	HIGH
The effects of prioritization on normalization of deviance / risk nominalization	How does prioritization and work schedule impact culture	Production	HIGH
Improved or new ways to hire and promote people	Improved criteria for hiring and promoting people	Drilling	MED
Personal fatigue limits	Improved analysis of fatigue limits by job classification	Drilling	MED
Improved methodology to evaluate safety culture	How to evaluate a safety culture, incorporating HRO principles	Drilling	MED
Improving Assurance of Fitness for duty - mental and physical	Reliable and workable ways for teams to check that all members are in a “safe mental place” – not tired, not worried, and knowledgeable. Improved understanding the mental and physical status.	Construction	MED
Practical and pragmatic understanding of how team dynamics can be improved	What are the practical ways to assess and understand team dynamics at a facility	Production	MED

Opportunity Name	Opportunity Description	Industry Area	Priority
What is the appropriate time in position for various personnel	Understanding what the "right" time in position is to allow for safe operations without sacrificing ability to manage org	Production	MED
Emotional / mental effects of working offshore	What are the psychological, emotional, and mental effects of working offshore, especially working offshore over a longer period of time	Production	MED
Competency assurance for individuals involved in design and interpretation phase	Removal of company or personal bias that leads to unsafe or inefficient designs for a well / project.	Pre-Drill	LOW
Operating and construction staff competencies	Establishing, developing and assuring the competencies and knowledge of operating and construction staff (Getting the right "know how")	Construction	LOW
What modifications of equipment will be necessary to accommodate future workforce	How does equipment need to modified to accommodate future workforce	Production	LOW
Practical implementation of existing research in personnel fatigue	How to leverage existing research on personnel fatigue into practical and pragmatic solutions	Production	LOW
Operator training standard	What does good training for a production operator look like?	Production	LOW
Effects of overall societal health on fitness for duty	What are the effects of changing overall societal health conditions (i.e. increased instances of obesity, etc.) on safety planning and risk?	Production	LOW
Better dissemination of knowledge throughout industry	Central AND USEFUL repository (with appropriate data analytics) of ongoing and past safety related research, JIPs, etc.; including lessons learned from incidents, design efficiencies, and around designs that works, and why (such as Piper)	Construction	HIGH
Better utilization of incidents to increase lifting safety	Better capture, characterization and analysis of lifting incidents such that actionable lessons can be learned. E.g. use detailed bow ties and data to provide context around Lift safety data; more focused actions based on real (operational/field) data. Include dynamic lifts.	Construction	HIGH
Better leading indicators	How to build predictive indicators	Production	HIGH

Opportunity Name	Opportunity Description	Industry Area	Priority
How to better data mine and understand existing data (company and industry)	Use existing data that is already collected and reported to identify signals of potential problems earlier	Production	HIGH
Sharing of equipment reliability data	How to better share and use reliability data around specific equipment and components	Production	HIGH
Instrumented riser and improved riser analysis	Improved riser system failure analysis/characterization	Drilling	MED
Interpretation of data for predictive failure prevention.	Application of high reliability concepts on well site performance leading to a better understanding failure mode analysis, including how to process big data and determining leading indicators.	Drilling	MED
Better integration of operational knowledge into design process.	Giving 'designers' practical knowledge and feedback to better inform design; Perhaps includes Training and field exposure of technical staff. Including knowledge of past learnings.	Construction	MED
Better understanding of the things that would impact the safe handling of fluids	Includes things like reservoirs characteristics, intervention chemical characteristics and behaviors, etc.	Production	MED
Improved procedures around shallow water/open hole sections	Better characterization of near mud line geo-hazards	Drilling	LOW
Better information collection systems	What is the data that we actually need to drive improvements in operations, Maintenance, Inspection, and Testing, etc.	Production	LOW
How to understand how facilities will and have reacted to storm events	Is there a way to use existing and new technology to understand the current state of facility to react to a storm event and after a storm event	Production	LOW
Mechanical dispersion	Integration of mechanical dispersion methods (in contrast to chemical dispersion methods) into emergency response processes.	Drilling	HIGH
Alternative contingency systems for Spill Response	Alternative contingency systems for source control responses.	Drilling	MED
Alternatives to use of diesel fuel	Improvement of air quality through implementation of alternatives to diesel fuel for all OCS vessels	Drilling	MED

Opportunity Name	Opportunity Description	Industry Area	Priority
How to better monitor fugitive and actual emissions	Are there better ways to measure fugitive and actual emissions to better measure impact to environment and safety, especially on aging facilities?	Production	MED
Better characterization of natural surface seapage	Improved characterization of natural surface seepage	Drilling	LOW
Improved effectiveness of deployment of secondary well control	View of the future - deployment of secondary well control ends the problem	Drilling	LOW
Science based rules for better overall environmental result from offshore facility/infrastructure decommissioning.	Clear assessment criteria and protocols for 'rigs to reef'/offshore infrastructure to deliver best Safety & Environmental benefit.	Construction	LOW
Better pre drill prediction of pore pressure and fracturing gradient	Increasing the certainty and reliability of pore pressure prediction and fracturing gradient. Specify the accuracy tolerance that will lead to a step change in forecasting accuracy of pore pressure and fracturing gradient including principal stresses.	Pre-Drill	HIGH
Real time validation of seismic prediction	Validating velocity assumptions and depth conversions utilizing LWD data prior to drilling hazard interval	Pre-Drill	HIGH
Shallow Hazard management and mitigation	Novel and / or improved methodologies for hazard assessment and kick detection during riserless drilling	Pre-Drill	HIGH
Technology development to operate under a closed system (continuous circulation).	Eliminate diverter in favor of riser gas handling Move to closed loop as a default in lieu of open loop Automated management of bottom hole pressure	Drilling	HIGH
Improved detection of potential kicks	Seismic ahead of the bit Downhole gas influx detection	Drilling	HIGH

Opportunity Name	Opportunity Description	Industry Area	Priority
Better well bore integrity characterization	Annular pressure buildup mitigation techniques Identification of pressure in multiple annuluses	Drilling	HIGH
Better BOPs (better systems, controls, corrosion, instrumentation, etc.)	Better BOP control systems Better measurement of BOP systems How do we take advantage of differential pressure for improved BOP performance Corrosion proof sealable surfaces in BOPs	Drilling	HIGH
Human-machine zone management/worker position detection	Better ways to track and manage worker positions relative to machines, equipment, and other hazards on rig floor	Drilling	HIGH
Improved gas detection and sensor capabilities	Better sensor and detection capabilities may lead to better ways to manage gas exposure situations	Drilling	HIGH
Real time pore pressure	Application of real time pore pressure prediction, monitoring and related decision making	Drilling	HIGH
Leveraging technologies to augment safe work practices with dynamic engagement.	Utilize apps, sensors, and other tools to enable taking JSAs, Op Procedures, Safer work practices, etc. dynamically to the job.	Construction	HIGH
How can we create equipment that needs less maintenance?	Create equipment that requires inherently less maintenance	Production	HIGH
Higher usage of thermocomposite pipe on facilities	How to make thermocomposite pipe more useful (such as sizing) and economically feasible	Production	HIGH
What will future production look like?	What will figure greenfield production look like with all of the new technology, new designs, new materials, etc. being introduced? How will the way tasks and activities are completed need to change?	Production	HIGH
Topographic Rossby Wave forecasting	Improved numerical modeling for TRW phenomenon	Pre-Drill	MED
Novel measurement techniques that improve characterization in front of the bit	Physics research and development of tools and techniques to gather more data in front and ahead of the bit	Pre-Drill	MED

Opportunity Name	Opportunity Description	Industry Area	Priority
Drilling through salt interface	Techniques or technologies for determining formation stability, strength, fluid and rock type and pressure at salt interfacies.	Pre-Drill	MED
Improve cementing	Better zonal isolation barrier to minimize potential impacts on operations. Research historical solutions for solidification of drill mud to cement for current applicability	Drilling	MED
Drilling equipment integrity and reliability	How can drilling equipment reliability and integrity be improved?	Drilling	MED
Onshore Phase Separation	Move phase separation onshore to simply offshore operations	Production	MED
Subsurface separation	Doing 3-phase separation subsurface, then reinject or release fluid	Production	MED
Everlasting paint	Paint that does need to be replaced	Production	MED
Visual indicators of stressed equipment (piping, vessels, etc.)	Visual indicators that alert personnel to the local stress/pressure on the underlying equipment (e.g. pressure-reactive paint, piezo electric piping)	Production	MED
Visual tools to allow for easier identification of human factors	Wearable technology that would allow for easier identification of human factors at work (such as stress, fatigue, etc.)	Production	MED
Better connectivity in an offshore environment	How to use current/future technology to better connect to remote / offshore facilities in an economically feasible way; how to get higher bandwidth	Production	MED
Formation strengthening plan	Can near well bore stresses be altered without adverse effects to widen the drilling window between PP and fracturing gradient	Pre-Drill	LOW
High speed downhole telemetry	Improved high speed downhole telemetry	Drilling	LOW
Improved data transmission to/from shore to remote sites	Improve data transmission to/from shore to remote sites to enable availability of information to offshore personnel	Drilling	LOW
How to shorten lifecycle and adoption times for new products	Improved process for new product development and implementation	Drilling	LOW

Opportunity Name	Opportunity Description	Industry Area	Priority
Improved / More Efficient Leak detection from pipelines.	Ideas: Fiber optics, and/or barriers to getting access to government satellite imagery for leak detection.	Construction	LOW
Identifying and remediating asphaltenes in flow lines	Tools and processes to identify that there will be an asphaltene problem in wells and/or flowline, and how to remediate the same. Predictive tools are inadequate, deposits may defeat/compromise safety barriers, remediation chemicals are dangerous, and intervention activities create hazards.	Construction	LOW
Leveraging nano-tech in initial design	Incorporating nano-tech in the design and monitoring of the fluids and equipment	Production	LOW
How to better transport people	How to better transfer personnel in a less risky way	Production	LOW
Safety Testing Equipment	Establish best practices for Procedure and frequency including to ensure appropriate location/environment for better/safer tests. Examples include relief valve testing procedure, and safety and pollution prevention equipment (SPPE) testing frequencies, high pressure equipment	Construction	HIGH
Leveraging technology for better inspection	Drones, etc. confined spaces, fluid testing. Better ways of inspecting risers, mooring systems, structures (fixed and floating). Novel usages of augmented reality to improve construction and inspection. (Digital twin) and better measurement of accumulated effects of time history, and cycles/strain/corrosion.	Construction	HIGH
How to assure the reliability of maintenance, inspection, and testing programs on offshore facilities throughout the lifecycle of the facility	How to assure that the maintenance, Inspection, and Testing activities are being done in a way that supports reliable operations throughout the lifecycle of the facility	Production	HIGH
Utilizing smart technology for existing inspection and maintenance activities, especially in brownfields	What technology will allow better monitoring of physical condition of equipment that handles inconsistent / multi-phase fluids	Production	HIGH

Opportunity Name	Opportunity Description	Industry Area	Priority
Remote Barrier testing methodologies	Be able to measure slow/small leaks in remote well or subsea barriers. Measuring slow/small leaks because of volume involved or avoid the hazards flow line leak upstream of boarding valve.	Construction	MED
How to better write and manage procedures	What are the key characteristics that lead to effective procedure writing, management, and communication, including a better understanding of how humans understand and receive information	Production	HIGH
Early warning signs for procedural drift	How to better write/manage procedures to identify procedural drift and deviations or abnormal responses earlier - how to know when you've gone off procedure	Production	HIGH
How to better characterize software interactions when multiple software is in use	What is a good way to characterize and assess the software interactions between multiple software applications, including when changes are made	Production	MED
What are the effects of over designing?	Better understanding of how to design, and not overdesign, to allow for safer operations of facility	Production	MED
Alarm response	How should industry design, develop, and execute alarm response to act in concert with human capacity to react appropriately?	Production	MED
Effects of various joint operatorship / level of interface between different entities on same facility	What are the effects of various interfaces on safety	Production	MED
What is the effect on safety of sharing logistical support?	Does increased sharing of logistical support (i.e. transport, etc.) have an impact on safety and environmental performance?	Production	MED
Cross discipline well design efficiencies (SCRUM Agile)	Risk reduction and process efficiency via a cross discipline interface design process for the lifecycle of a well	Pre-Drill	LOW
Time bound decision making	How to introduce into the design process a timeline or hard stop to allow for sufficient time to plan and execute	Pre-Drill	LOW
Sharing of data and knowledge of risk across the industry	Study the value of sharing the data (proof of concept)and what will give maximum return on safety with minimum impact on competition	Pre-Drill	MED

Opportunity Name	Opportunity Description	Industry Area	Priority
Improved regulatory action to protect staff, employees, companies from punitive consequences resulting from safety data reporting.	Mandatory common reporting and follow up system for reporting Minimum time from regulatory submission to industry receipt for learning events	Drilling	MED
Operator regulatory performance	Develop criteria for evaluating operator regulatory performance	Drilling	MED
Transform the relationship between the regulators and the regulated	Reset relationship between regulator and regulated to encourage cooperation rather than punishment. Create aligned goals around of improving safety. May include: Better training of regulators – in operations design, risk assessment, behaviors. Benchmark regulators from industry/regulators to see what they say about doing impact on industry.	Construction	MED
Jones act interpretation for construction activities.	Clear legal differentiation from transportation and construction activities so that we can use safer equipment on heavy lift operations. (Jones Act issues)	Construction	MED
Establish minimum standards methodologies for PP / fracturing gradient prediction in GOM	Consider revising / updating DEA 119 as potential standard for pore pressure / fracture gradient solutions	Pre-Drill	LOW
Define the common standards around the definition of significant sands to be used in WCA / WCST (Well Containment Analysis) (Well Containment Screening Tool)	How can we optimize and standardize the risks and weighting for definition of a risk (significant sands with regard to HC and H2O bearing sands)	Pre-Drill	LOW
3-year term rig commitment	3 year term rig commitment for activation in OCS waters	Drilling	LOW
Regulatory standardization across operating environments	Industry driven standardize rig acceptance criteria regulatory harmonization across countries	Drilling	LOW

Opportunity Name	Opportunity Description	Industry Area	Priority
Loop current / eddies - Improve prediction and extend further out in time (3+ months target)	1. Cheaper ways to monitor loop / eddies over large areas 2. Monitor further upstream – such as Caribbean inflow 3. Advanced statistical forecast methods	Pre-Drill	HIGH
Probabilistic Risk Assessment for Critical Equipment	Develop guidelines for probabilistic risk assessment for critical equipment	Drilling	HIGH
Offshore Cybersecurity	Improved mechanisms to optimize cyber safety/security	Drilling	HIGH
Using AI to better identify scenarios for risk analysis.	Find better ways to identify scenarios that create Low likelihood/severe consequence events. Can Use AI on past events? What about using AI on P&IDs?	Construction	HIGH
How to respond to upset conditions	How to better characterize and respond to upset/abnormal conditions	Production	HIGH
What aspect of risk management should companies focus on to improve?	What are the most value-adding ways to improve risk management in offshore industry? For example, is the most value added by focusing on risk elimination, risk reduction, risk identification, risk tolerance, etc.?	Production	HIGH
Improved Hurricane evacuation decision making	1. Demonstrate accuracy and reliability of hurricane ensemble forecast modeling 2. Evaluating evacuation risk model	Pre-Drill	MED
Improve competency assurance for low frequency / high consequence incidents	Qualified individual designation for company corporate officers for operational events Centralized critical response team Include more realistic drills	Drilling	MED
Optimization of field development, project and life cycle risks.	Better manage overall risk of well construction, subsea, production design. Optimized trade off of risks between 'silos'… balance construction, drilling well risk and facility risk.	Construction	MED

Opportunity Name	Opportunity Description	Industry Area	Priority
Better understanding of risks associated with 'brownfield' developments	Improving documentation, working knowledge etc. to make better informed decisions on brownfield developments. Perhaps diagnostic tools to understand the current state.	Construction	MED
Study effects on safety due to the cyclic nature of O&G industry	To understand with the effects of cyclical nature O&G business on safety performance over time	Production	MED
Do different operating environments (i.e. deepwater vs shelf, brownfield vs greenfield) require different solutions?	Is industry focused too much on universal good practices - "one-size-fits-all" may not be most effective in improving safety	Production	MED
Well plan assurance with additional industry input	Peer review of well plans taking into account probability versus frequency - "UL listed"	Pre-Drill	LOW
Developing contracting strategy reduce and manage overall risk	Understanding how various contracting strategies and approaches can effect project safety, execution, cost, and success. Ensuring clarity of roles and responsibilities and where decisions are made.	Construction	LOW
How to better evacuate an offshore facility	Better understanding of how to more safely and more effectively evacuate a facility	Production	LOW
How to better react to storm events	Can existing and new technology be used more effectively to react to hurricanes and limit their impacts to human and equipment	Production	LOW
Effects of various ownership structure on safety	What are the effects of various ownership structures on safety	Production	LOW
What are cybersecurity risks specifically to production and process control?	What are the cybersecurity risks and how best to combat them specific to production, process control, and automation	Production	LOW
What is the "basic minimum" of process safety?	How to characterize the minimum process safety requirements and characteristics applicable to all O&G industry	Production	HIGH

Opportunity Name	Opportunity Description	Industry Area	Priority
Standardizing lifting and material handling	Standardize lifting for onshore and offshore applications (i.e. standardized lifting weight limits, standardized lifting standards, standardized connections, etc.)	Production	HIGH
Standardization of construction processes or aids	Evaluate where standardization of construction aids, processes and practices could improve safety. For example, scaffolding, tagging, rigging, factors of safety.	Construction	LOW