PROJECT INFORMATION

Project Director's Name*	Scott Tannenbaum
Organization*	The Group for Organizational Effectiveness, Inc
Project Title*	Development of an Evidence-Based, Multi-Level Safety Culture Assessment Battery for the Offshore Industry
Reporting Period*	01/01/23-06/30/23

Note to Grantees: In sections 1 to 5, we ask you to highlight your accomplishments (including outputs and outcomes) through this grant award. These sections of the final grant report will be made available to the public.

1. GOALS AND ACCOMPLISHMENTS

1.1 Please restate the goals and objectives of your project.*

The proposed effort will yield an empirically tested set of evidence-based, practical, innovative assessment tools to diagnose, measure, and track safety culture factors at the team and facility levels. These measures will be accompanied by actionable tips and guidance for addressing potential deficiencies.
The project will include five phases: I) Preparation and Ground, II) Design, III) Development, IV) Test and Validation, and V) Production and Documentation.

1.2 Describe the accomplishments of your project. You should include both the anticipated accomplishments that you outlined in your project proposal as well as any *unanticipated* accomplishments that have since occurred. Describe any activities you have conducted, programmatic progress made, or project benchmarks and milestones met.*

As part of an effort to advance safety in the oil and gas industry, we worked with industry experts to develop a set of evidence-based assessment measures to diagnose key factors that influence safety behavior and culture for individuals, teams, and facilities. The intent was to develop measures that were not prone to typical survey social desirability response biases and that could uncover underlying beliefs and assumptions about safety culture on a team, shift, function, or facility.

We began by grounding our work through a review of the relevant research literature (e.g., on safety climate, team effectiveness), examining industry-related documents (e.g., OOC Reports), interviewing offshore subject matter experts (SMEs), and gathering input from a health care safety expert. Based on this, we subsequently focused our research and development efforts on people who are working on offshore manned facilities during production, regardless of level. Two of the greatest safety culture assessment needs that surfaced were related to safety awareness (do people know what to do) and safety emphasis (what do they believe their facility or crew values). There are several existing traditional safety climate behavioral measures, so we chose to focus more on the cognitive and affective components of culture – aspects that are critical but often “difficult to see” or unmeasured.

We developed preliminary specifications for three types of measures and drafted items for each with extensive input from industry, safety, and team effectiveness experts. The three primary assessment measures we developed examined: Safety Emphasis, Safety Awareness, and Team Safety Climate. The Safety Emphasis measure included 15 dual-anchored items that assess what is valued or emphasized at a work facility pertaining to specific safety themes (e.g., handling mistakes, responding to/anticipating problems, use of stop work authority). The items employ an 11-point (0-10) non-linear scale (i.e., higher scores are not always better) which, in theory, should reduce “gaming” the system or providing socially desirable responses. We assembled a separate set of SMEs from across a broad range of companies and facilitated several interactive working sessions with them to establish red (a concern), yellow (caution), and green (target) scoring zones for each item. The SMES also provided insights and tips for improving safety culture, for example, when a score falls in the yellow or red zones.

The Safety Awareness measure included nine items that ask respondents to estimate the percentage of people at their facility (or crew) who know about various safety risks (e.g., signs or indicators of a hazard, what to do about them). A “general safety” sub-scale included five of the items and a “fire safety” sub-scale included four items. Note that this measure did not ask respondents to self-assess their knowledge, as that is prone to leniency bias. Instead, it asked them about the percentage of people at their location who have possess knowledge about safety risks.

The Team Safety Climate measure consisted of 16 behavioral statements, 14 that fall within 7 evidence-based team safety climate factors (e.g., Cooperation, Communication, Cognitions), and 2 overall team safety climate items. All items are assessed with a 5-point Likert-type agreement scale (1=Strongly Disagree; 5=Strongly Agree). This Team Safety Climate measure is a traditional type of survey measure, while the two other scales are innovative measures that involve new assessment formats that had not been previously developed or tested.

We also developed a series of four brief scenarios that describe how a safety-related situation was handled at a facility (Safety Scenarios). Respondents are asked to assess the likelihood that the situation would be handled that way at their facility.

To garner support, maintain relationships, and offer early support to the industry, we provided several briefings about the project, including a presentation to the COS Safety Culture working group and a presentation at the OTC conference. We also conducted and recorded a presentation on the science of teamwork for members of OOC.

After receiving IRB approval, we conducted a preliminary on-line pilot/usability test with 21 Onshore and 39 Operations/Field Personnel with the intent of confirming or revising wording prior to a more extensive field test and to gather their insights about how to enhance safety culture. Based on the pilot, we made minor changes to a few items to clarify understandability for the target audience. We were able to cluster the 15 safety emphasis items into four logical themes: 1) Anticipate, prevent, understand, improve; 2) Adjust appropriately; 3) Promote psychological safety; and 4) Prioritize safety.

We concluded that the Safety Scenarios measure (four scenarios) would be more useful as a follow up tool to stimulate discussion about safety culture at a facility, rather than as a diagnostic assessment tool, so this measure was not administered during the broader field test. It is now framed as a facilitation tool as described in the Safety Emphasis Scenarios User Guide and is included as an information product from this effort. Each of the four scenarios (safety norms) align with one of the four Safety Emphasis themes, making it easy for an organization to choose which scenarios to discuss based on their survey results. To supplement the measures, we assembled a set of remediation tips for key factors based on prior SME feedback which is included as an information product as well.

To examine the psychometric characteristics and usefulness of the measures, we conducted a field test in which we administered the three revised measures in the form of a voluntary online survey referred to as the “Supporting and Facilitating Effective Teams, Organizations, and People (SAFE-TOP) Survey.” Employees at two organizations representing nineteen different facilities within the oil and gas industry participated. To examine trends over time,

we administered the survey a second time thirteen months later at one of the organizations. After dropping incomplete and inattentive responses, we assembled a data set with survey responses from 179 employees at the first organization and from 1473 employees from the second organization (in total across the two administrations). These were de-identified for purposes of respondent confidentiality and are included as a data product from this effort. Note that when we use the term “unit” below, that refers to people from the same facility, shift/crew, or a particular functional area (e.g., maintenance or construction).

Given the project objectives and industry needs, our research was intended to address the following questions about the newly developed measures: 1) Will respondents acknowledge a deficiency or show unrealistic leniency, and can the measure detect leniency and inattentiveness? 2) Does the measure offer ample diagnosticity across units (i.e., consistent responses within a unit and variability across units)? 3) Can the measure detect changes over time or as the result of an organizational change? 4) What is appropriate level of granularity for interpreting the results (facility, shift/crew, team)? 5) Are the findings perceived as useful and actionable by decision makers?

We analyzed the survey data using statistical software, including an examination of average responses across different units, trends in cross-unit response variability (are there ample differences across units for the measure to be diagnostic), changes over time (can the measure detect changes over time), and within unit agreement (do members of the same facility, crew, or function see things in a similar way). We built an Excel-based reporting tool to help organizations interpret and use company-specific results from the survey. Unit averages from a basic statistical analysis can be entered into the spreadsheet and the tool then provides a series of reports to clarify safety culture strengths and opportunities, for example by showing red, yellow, and green results for the Safety Emphasis measure. This spreadsheet (Gulf Safety Culture Survey Reporting Tool) and an accompanying user guide are provided as an information product.

As anticipated, the traditional Likert-scale Team Safety Climate measure showed fairly strong social desirability bias or leniency, with average item scores for units consistently at 4.3 or above on a 5-point scale. This measure may still be useful when the focus needs to be on teamwork related safety behaviors, but the user should not expect to see a great deal of variability across teams or items. In contrast, the Safety Emphasis and Safety Awareness measures showed ample variability across units, allowing for greater diagnosticity. These measures also offered an additional benefit, as they helped reveal which respondents were exhibiting extreme social desirability or inattentiveness (e.g., high scores on all the Safety Emphasis items when a high score isn’t always better). This allowed us to remove invalid data that only create noise in the results, improving interpretability of the findings. We tried two data cleaning approaches, and a recommended approach is documented in the deliverables.

As part of our psychometric analyses, we examined intraclass correlations and inter-reliability metrics, which showed there was high agreement among respondents within a unit (facility, crew, function). However, crew members

tended to agree among themselves more so than did members clustered on the basis of functional areas. Detailed analyses reveal that the measures are diagnostic for all respondent partitions but are most suitable for use at the crew level of granularity. Facility level analyses can also be revealing, but there is likely to be less value in examining unit differences across functional area. Respondents consistently reported somewhat greater awareness about fire risks and hazards than about general safety risks.

The second data administration at one organization allowed us to take advantage of a naturally occurring research opportunity, as some of their workforce had recently participated in a well-designed safety training initiative, while others did not. This training should have boosted safety consciousness, which was confirmed by our Safety Awareness measure. The Safety Emphasis and Safety Awareness measures were also able to detect changing strengths and needs from the first to the second survey administration.

We shared the survey results from each organization with their respective contacts and provided each with a reporting spreadsheet with their company results. Discussions with leaders suggest that they found the results to be interpretable and actionable, for example as a means to assess progress on their safety efforts or identify where further attention may be beneficial. The scenarios and discussion questions were perceived as useful tools for stimulating a discussion about safety.

In summary, we developed three new diagnostic measures (that can be used independently or administered simultaneously), a reporting tool, a set of remediation tips, four scenarios and related discussion questions that can be used to stimulate conversations about safety either after the use of a diagnostic measure or on its own. The new diagnostic measures showed reasonable psychometrics, but the two innovative measures demonstrated better diagnosticity and less response bias than the more traditional format, while helping uncover “hard to see” aspects of safety culture. The usability testing, work with SMEs, and field tests suggest that the measures were understandable, acceptable, and actionable.

2. Outputs

Before the form is completed, you may click "Save & Continue Editing" at the bottom of the page at any time to save your work or "Next" to move onto the next page of this form.

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2. OUTPUTS

Outputs are tangible or measurable deliverables, products, data, or publications produced during the project period.

2.1. Please indicate the number of students (K-12, undergraduate, or graduate), postdoctoral scholars, citizen scientists, or other trainees involved in the project. *

Please enter 0 if none were involved.

K-12 students	0
Undergraduate students	0
Graduate students	2
Postdoctoral scholars	0
Citizen Scientists	0
Other Trainees	0

2.2. Has your project generated any data and/or information products? *

Generation of data includes transformations of existing data sets and generation of data from existing resources (e.g., maps and images). Information products include publications, models, software, code, curricula, and digital resources.

(Check all that apply.)

Responses Selected:

Data
Information Products

2.3. Briefly describe how you fulfilled the approved Data Management Plan and, if applicable, any changes from the approved plan. *

As described in our Data Management Plan, our data for this effort fell into three general categories: 1) Research data (e.g., de-identified survey responses with meta-data that describes the variables; samples, etc.); 2) Summary reports (e.g., summary of results); 3) Information products (e.g., assessments and related tools)

To fulfill the approved data management plan, we took the following actions:

Short-term management: Collection and Processing
a) Stored data (e.g., individual survey responses) on a computer at The Group for Organizational Effectiveness and backed up the data continuously to a secure cloud server; b) Gathered data using an industry-standard web-application; c) Analysed data using a standard analysis package such as SPSS or R; d) De-identified survey data will be made available in a Microsoft Excel file, accompanied by explanatory information; e) Produced reports and research products as electronic documents using Microsoft Word and Microsoft Excel formats; f) Did not include any proprietary data; g) Accomplished quality control by having multiple members of the research team check the data products.

Metadata: Describe the Data, Data Collection, and Data Processing
a) Accompanied research data by metadata that described the variables, methods, and the sample; b) Wrote and submitted research data and metadata to the GRP-GRIIDC data repository in the required formats. Specifically, the research data was submitted as a .csv file and the meta-data was submitted both via the GRP-GRIIDC tool and in the form of a .txt README file.

Data Sharing
a) Made research data, reports, and products publicly available. The research data are available via GRP-GRIIDC; b) Maintained confidentiality by ensuring that no personally identifiable information was shared; c) Received approval of the research protocol by the Rice University IRB with Exempt status; d) Placed no restrictions on the data.

Data Management Budget
Incorporated data management into the time estimates and overall project budget.

If your project has generated data, please download the Excel worksheet entitled GRP Data Management Reporting. Use the "Data Report" tab in the worksheet to create an inventory of data sets that you produced and to verify deposit in a curation facility. Upon completion, please upload the worksheet to your task list. If you need guidance on how to complete the Data Report, please e-mail gulfgrants@nas.edu. A member of GRP's data management staff will reach out to you.

If your project has produced publications, websites or data portals, GIS applications, models or simulations, software packages or digital tools, code, curricula, or other interactive media, please download the Excel worksheet entitled GRP Information Management Reporting. Use the "Information Products Report" tab in the worksheet to create an inventory of these products and to verify deposit in a curation facility. Upon completion, please upload the worksheet to your task list. If you need guidance on how to complete the Information Products Report, please e-mail gulfgrants@nas.edu. A member of GRP's data management staff will reach out to you.

2.4. Aside from data and information products, what other tangible or measurable deliverables or products (e.g., workshops, trainings, and outreach events) were produced during the project period? *

Upon completion of this form, you may upload supplemental material that represent the tangible or measurable deliverables or products to complement this narrative report.

We presented project highlights at 2 OOC general meetings (one in Houston, one in Austin). We also shared information with the Center for Offshore Safety at one of their board meetings.

3. Data Management

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3. DATA MANAGEMENT

In this section, please provide a response to each question to complement the **Data Report** in the GRP Data Reporting Excel worksheet.

3.1 If you listed multiple data sets in the data reporting table, please briefly describe how these data sets relate to one another. *

1 data set

3.2. Please provide a list of additional documentation to describe the data listed in the reporting table (e.g., code books, lab manuals, workflow procedures). Enter none if you did not produce any additional documentation to describe the data. *

We created the Gulf Safety Culture Measures User Guide to describe the measures, and how to clean and analyze the data. A text file was also included on the GRP-GRIIDC site to explain the variables.

3.3. Beyond depositing data and metadata in a repository, what other activities have you undertaken or will undertake to ensure that others (e.g., researchers, decision makers, and the public) can easily discover project data? What other activities have you undertaken to ensure that others can access and re-use these data in the future? *

Data has been uploaded into the Gulf Research Program - GRIIDC. Resources will also be available on the Offshore Operations Committee website.

3.4. Are any data products you produced sensitive, confidential, and/or proprietary? *

No

4. Information Products

Before the form is completed, you may click "Save & Continue Editing" at the bottom of the page at any time to save your work or "Next" to move onto the next page of this form.

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4. INFORMATION PRODUCTS

In this section, please provide a response to each question to complement the **Information Products Report** in the **GRP Information Products Management** Excel worksheet.

4.1. Please select the type(s) of information products that your project produced. *

Responses Selected:

7. Other: excel file, user guides, tipsheet

Curricula for education and training, GIS applications, Models or simulations, Software packages or digital tools, or other interactive media, and Other *

If you produced any additional documentation to describe information products, please provide a list of this documentation (e.g., model or simulation documentation, software manuals, source code annotation).

Gulf Safety Culture Survey Reporting Tool
Gulf Safety Culture Survey Reporting Tool User Guide
Gulf Safety Culture Tips for Safety Emphasis Themes
Gulf Safety Culture Measures User Guide
Gulf Safety Emphasis Scenarios User Guide
Gulf SAFE-TOP Survey - All Measures
Gulf SAFE-TOP Survey - Safety Emphasis Measure
Gulf SAFE-TOP Survey - Safety Awareness Measure
Gulf SAFE-TOP Survey - Team Safety Climate Measure
Gulf Safety Culture Project Briefing - SAFETOP

4.2. Beyond depositing information products in a repository, what other activities have you undertaken or will undertake to ensure that others (e.g., researchers, decision makers, and the public) can easily discover and access the listed information products? *

The information products will be available on the website of the Offshore Operations Center and available to the public. Specific details are available in the information management spreadsheet.

4.3. Are any of the information products you produced confidential, proprietary, or subject to special license agreements? *

No

5. Project Outcomes

Before the form is completed, you may click "Save & Continue Editing" at the bottom of the page at any time to save your work or "Next" to move onto the next page of this form.

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5. PROJECT OUTCOMES

Outcomes refer to the **impact(s), consequence(s), result(s), or effect(s)** that occur from carrying out the activities or outputs of the project. Outcomes may be environmental, behavioral, health-related, or programmatic. Example outcomes include, but are not limited to: increased learning, knowledge, skills, and motivation; policy changes; actions taken by a group as a result of information generated by your project.

5.1. Please describe the outcomes achieved during your project and how they were assessed. For this question, we are interested in learning about the immediate short-term outcomes that have already occurred during or as a result of your project. Do not include long-term outcomes you foresee your work contributing to beyond the end of the project. *

In the short-term, two organizations used the measures developed in this effort to assess safety culture in their respective organizations at 19 facilities. They used the results from the measures to identify needs, opportunities, and potential actions for enhancing their safety culture.

5.2. We're interested in hearing not just the results of your project but what are their implications for or contributions to:

- **offshore energy system safety,**
- **environmental protection and stewardship, and/or**
- **health and community resilience**

Please describe what you consider to be the most remarkable accomplishment or finding of your project. What can others learn from your accomplishment and finding? How do you see it fitting in with your greater field of study or community of practice? *

Establishing and maintaining an effective safety culture is critical in all high reliability work settings. It is difficult to build, maintain, and make adjustments to safety culture if you cannot measure it in a meaningful way. There are visible indicators of safety culture (e.g., documented policies and programs; communications; accidents) as well as less visible indicators (e.g., underlying beliefs and perceptions about safety). Naturally it is easier to measure the visible, but employee beliefs and perceptions, such as what they think their organization really values (such as the relative importance of production vs. safety or the importance of reporting concerns), can greatly influence how they act. Beliefs and perceptions may be leading indicators of risk, prior to a problem manifesting as an incident or accident.

The most common way to assess underlying beliefs and assumptions is via survey. We know from work in other domains that surveys based on traditional Likert ratings may be prone to response biases such as leniency (rating everything positively) and social desirability (responding in the way they think the organization wants them to respond).This is what drove us to attempt to develop other innovative ways of assessing safety culture.

The most important takeaways from our research are that: a) we confirmed that a traditional Likert-scale survey measure of team safety climate was prone to response bias; b) we developed and tested two unique survey formats that provide alternative ways of assessing safety culture in a way that can mitigate response bias; and c) the new measures can yield insights that stimulate meaningful discussions and action planning. A key lesson learned for organizations that are interested in promoting a strong safety culture is that measures of safety culture are not an end point (no measure is) but, when properly designed, they can be an important step towards maintaining offshore safety. The primary value of measuring safety culture is to surface potential strengths and needs and to use those insights to guide healthy discussions, explore ways of maintaining strengths and mitigating concerns, and identify appropriate actions prior to a mishap or avoidable accident.

6. Communication

Before the form is completed, you may click "Save & Continue Editing" at the bottom of the page at any time to save your work or "Next" to move onto the next page of this form.

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Note to Grantees: In Section 6, we seek input from you to help us evaluate the Gulf Research Program's funding strategy. This section will not be made available to the public.

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6. Information to Inform GRP Evaluations

6.1. Sharing the difficulties you encountered helps us learn from your experience. Describe any challenges you encountered in your project and how you addressed or overcame them. Challenges are inherent to conducting any complex project. These may include (but are not limited to): unexpected staffing changes, changes in the community you are working in, appearance of a new technology or dataset in the field you are working in, challenges accessing a field site, policy or regulatory changes that affect the issue you are addressing, low recruitment rates, delays in setting up services, or other problems in implementing and conducting your project. *

We have conducted applied field research for three decades, and two recurring themes are 1) finding organizations who are willing to participate and then 2) sustaining their energy and support. Our industry partner was very helpful in identifying organizations to participate (we could not have done this project without them), but recruitment of companies was still a challenge as it often is in field research.

As a project progresses, leaders and sponsors can change, and support may wax and wane. In this effort, the pandemic amplified the typical challenges. It limited our access to sites and required us to complete the work virtually, which fortunately we were able to do. The pandemic however did add stress to the facilities. It made data collection a bit more challenging and probably prevented an organization from participating.

To mitigate the challenges as best as possible, we cast a wide net for potential participants, relied on our industry partner, provided regular briefings and updates, and requested a no cost extension when COVID created limitations. The no cost extension enabled an interested organization to participate in a longitudinal follow up data collection.

6.2. We like to hear about what you learned from your work and how you feel it affects future work or the work of others. Think back on your project strategies, methods, and activities, what worked and what did not? Is there anything you would do differently in the future? If so, tell us what and why. *

This project reinforced for us the value and importance of establishing strong partnerships with the researchers (who were from different disciplines and institutions), industry partners (OOC), and participating organizations. We had a good team that could work well together, which was very important in this effort. We did discover that more can be accomplished remotely than we would have anticipated, and in future research we'll be strategic about what needs to be done in person and what can be handled remotely.

6.3. What are the next steps for this work, either for you and your project team or other researchers? Has this project led to other opportunities to work in this area? *

The measures and tools we developed are being maintained by an industry association, OOC, who will make them available for use by any organization in the industry.

6.4. Have you developed new collaborations or partnerships (formal or informal) as a result of this work? If yes, please describe the new collaborations or partnerships. *

We partnered with OOC for the first time during this project and would readily partner with them on future work. The same is true for our health care expert who we are now partnering with on a new NIH grant. So this effort helped us build a couple of meaningful relationships.

6.5. What, if any, positive changes in policy or practice do you foresee as a result of your work? *

Too often, companies default to focusing on those things that are readily measured. Underlying beliefs and assumptions are hard to see, and often overlooked, so having meaningful ways to assess them is important. Organizations that adopt the new measures/tools will be better able to assess the underlying beliefs of its workforce with regard to safety culture, identifying risks before they manifest as mishaps or accidents.

6.6. If you could make one recommendation to the Gulf Research Program for how best to build on the work you conducted in this project, what would it be? *

Be sure that the industry knows that the resources are publicly available and how best to access them.

7. Communication and Dissemination

Before the form is completed, you may click "Save & Continue Editing" at the bottom of the page at any time to save your work or "Next" to move onto the next page of this form.

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Note to Grantees: In Section 7, we ask you to help us communicate the importance, progress, and accomplishments of your work. Information provided in this section will be used by the Gulf Research Program to highlight its funded projects in print and electronic informational and promotional materials. The intended audience for the information provided in this section is different and should be thought of as a general audience. When you return to the dashboard, you may upload images that represent and illustrate the work of your project.

7.1. Please describe the most exciting or surprising thing you have learned while working on this project in a way that is understandable by a general audience. *

Organizations that perform potentially dangerous work must establish and maintain an effective safety culture, but it is difficult to build, maintain, and make adjustments to safety culture if you cannot measure it in a meaningful way. There are some visible indicators of safety culture (e.g., tangible policies and programs; communications; accidents) and some less visible ones (e.g., underlying beliefs and perceptions about safety). Naturally it is easier to measure the visible, but employee beliefs and perceptions, such as what they think their organization really values, can greatly influence how they act. The most common way to assess these important underlying beliefs and assumptions is via a classic Likert-scale (1 to 5) survey. Unfortunately, surveys based on traditional Likert scales may be prone to response biases such as leniency (rating everything positively) and social desirability (responding in the way they think the organization wants them to respond). This is what drove us to attempt to develop other innovative ways of assessing safety culture.

The most important takeaways from our research are that: a) we confirmed that a traditional measure of safety climate is prone to response bias; b) we developed and tested two unique survey formats that provide alternative ways of assessing safety culture in a way that overcomes response bias; and c) the new measures can yield insights that stimulate meaningful discussions and action planning. The primary value of measuring safety culture is to surface potential strengths and needs and use those insights to guide healthy discussions, explore ways of maintaining strengths and mitigating concerns, and identify appropriate actions prior to there being a mishap or avoidable accident.

7.2. Do you have any stories that capture the impact of this project? (optional)

If so, please share one or two. Examples of what we are interested in include stories of people/communities that the project has helped; lives that have changed; work that led to policy change, such as legislation or regulation; and research breakthroughs.

(No response)

7.3. Have any communications, outreach, or dissemination activities occurred in relation to your project?*

Please describe:

- Any press releases issued (other than that issued by the National Academies of Sciences, Engineering, and Medicine) about the project.
- Any media coverage or news stories about the project.
- Any social media accounts, websites, listservs, or other communication vehicles used to communicate information about this project. Please include relevant web addresses if available.

We provided a presentation to the Center for Offshore Safety Culture working group, a presentation at the OTC conference, and two presentations to the OOC membership.