NATIONAL ACADEMIES Sciences Engineering Medicine

GULF RESEARCH PROGRAM

2017: Safer Offshore Energy Systems 3
Final Report

Project Title: Unobtrusive Assessment of Macrocognition Processes in Team Decision Making
Award Amount: $788,301
Awardee: Florida Maxima Corporation
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I. PROJECT SUMMARY (from proposal)

In this proposal, we describe an approach to monitor, track, and correct decrements in decision making processes through the assessment of spontaneous verbal output in real-time communications. We develop and evaluate a lexical analysis tool as a means to assess team decision making processes in an unobtrusive manner, provide feedback, and aid in critical decision making. Specific aims of this project are twofold: (1) develop a methodology to assess cognitive state and decision-making processes "at a distance" through spontaneous verbal output in real-time communications and (2) produce a real-time assessment tool to detect cognitive performance and decision-making deficits in the offshore oil and gas operational setting.

In brief, we will develop a methodology to analyze communication in decision making teams to track the extent to which critical decision-making processes are being engaged. This type of ongoing, unobtrusive measurement of decision-making processes will allow decision making deficits to be identified and corrected to foster optimal decision-making capabilities. The research required includes the elaboration of a model of team decision making processes and sub-processes specific to offshore oil operations, the development of lexical dictionaries reflecting the engagement of these processes, and archival, laboratory, and field research to validate this approach.

Primary tasks for the first year include: (1) the development of a multi-level working model of team decision-making in the offshore oil industry and (2) the generation of a lexicon (in American English) indicative of these constructs. Second and third years of the project will focus on the validation of the lexical methodology through a multi-level empirical research. The primary tasks include: (1) validation via archival analysis of previously collected data, (2) validation studies conducted with representative and analogue populations, and (3) delivery of a transparent system which allows for real-time assessment and graphical display of team decision-making processes drawn from ongoing verbal or textual communications.

The perceived impact of the proposed work will accrue in several areas. First, it develops and evaluates an innovative and non-obtrusive approach to detecting and mitigating critical team decision-making deficits in the offshore oil and gas operational setting. These real-time, unobtrusive indicators of cognitive processes can be used to assess team decision-making without interfering with the process and performance being studied. Second, assessment of team decision-making deficits can identify and pinpoint interventions for improving decision-making processes. Third, the advantages of this approach apply not only to decision-making capabilities in offshore exploration and production work, but to any setting in which it is valuable to dynamically and unobtrusively monitor decision-making processes employed by teams under adverse circumstances. Stakeholders will be engaged from the initiation of this project to ensure that products are directly and immediately applicable to enhancing decision-making in offshore exploration and production work.

II. PROJECT SUMMARY (from final report)

Effective team decision making is essential to reducing risk in the offshore oil and gas environment. This project attempts to develop and test an innovative approach to capturing how decisions are made by teams. We propose a methodology for tracking and monitoring team decision-making processes in an unobtrusive manner through the analysis of ongoing communications. The basic premise of this work is that team members' verbal output provides a natural, valid, and unobtrusive indicator of the basic cognitive processes involved in team decision making. The analysis of the team's communication provides a cognitive footprint of what is occurring, or the processes that are being engaged, at any point during the team's decision-making activities, and can point to deficiencies in the team's decision-making processes.

III. PROJECT RESULTS

Accomplishments

Through our outreach efforts, interviews with industry experts have called attention to the need for more thorough and objective performance assessment in well control simulations, especially for "nontechnical" skills such as decision making. They further noted that, typically, non-technical skills are assessed by instructors' subjective ratings and that more structured, objective assessments would be useful in training. The use of alternative assessment approaches such as team communication analysis and related behavioral markers of effective and ineffective decision-making processes can provide additional insight into team decision-making dynamics.

Team decision making is often conceptualized by what is termed a stage model—that there are sequential stages of team decision making, including situation assessment, problem analysis, solution generation, solution analysis and decision agreement and implementation. At each stage, teams engage in various communication activities serving to enact these processes. Our focus was on identifying lexical or speech markers that reflect activity within these stages. Research was conducted to develop a model of team decision making relevant to offshore oil operations and a methodology for analysis of decision-making processes; conduct empirical research to establish initial validation of this approach; conduct experimental and archival evaluations of this approach; and propose applications of this research to training.

Implications

Communication is the primary means by which decision making is carried out. The analysis of the team's communication provides a cognitive footprint of what is occurring, or the processes that are being engaged, at any point during the team's decision-making activities, and can point to deficiencies in the team's decision-making processes. Industry experts have called attention to the need for more thorough performance assessment in well control simulations, especially for non-technical skills such as team decision making. Lexical measures can be utilized to examine the topography of team decision-making processes by tracking communications over the course of decision making, and by providing evidence or markers of effective and ineffective team decision-making processes at any point in time. The current approach to team decision-making assessment proposed in this research can be implemented through high technology or low technology approaches. Advanced technological approaches to assessing communication content in team performance utilizes near-real time voice recognition to track and diagnose team processes. Lower technology approaches include the use of behavioral markers and behavior checklists to assist the trainer in assessing team decision-making processes. Lower technology approaches include the use of behavioral markers and behavior checklists to assist the trainer in assessing team decision-making processes. This approach identifies specific behavioral markers, as reflected in the team's communications, that reveal the extent to which the team engages in optimal decision-making processes. Behavior checklists provide the trainer with a tool to capture these observations.

Education and Training

Number of students, postdoctoral scholars, or educational components involved in the project:

- K-12 students: 0
- Undergraduate students: 4
- Graduate students: 5
- Postdoctoral scholars: 0
- Citizen Scientists: 0
- Other Trainees: 0

IV. DATA AND INFORMATION PRODUCTS

This project produced data and information products of the following types:

- Information Products
- Scholarly publications, reports or monographs, workshop summaries or conference proceedings

DATA

Data Management Report:

All data collection, processing, and reporting have been conducted in accordance with our Data Management Plan and all accepted federal and discipline (American Psychological Association) standards.

Relationships Between Data Sets:

N/A

Additional Documentation Produced to Describe Data:
N/A

Other Activities to Make Data Discoverable:
N/A

Sensitive, Confidential, or Proprietary Data:
N/A

INFORMATION PRODUCTS

Information Products Report:
N/A

Citations for Project Publications, Reports and Monographs, and Workshop and Conference Proceedings:
Project summary publications are in preparation and will be forwarded upon completion and publication.

Additional Documentation Produced to Describe Information Products:
N/A

Other Activities to Make Information Products Accessible and Discoverable:
Project results will be disseminated in scholarly publications and meeting presentations.

Confidential, Proprietary, Specially Licensed Information Products:
N/A

V. PUBLIC INTEREST AND COMMUNICATIONS

Most Exciting or Surprising Thing Learned During the Project
Effective team decision making is essential to reducing risk in the offshore oil and gas environment. Multiple interviews with industry personnel called attention to the need for more thorough performance assessment in well control simulations, especially for non-technical skills such as team decision making. This project developed and tested an innovative approach to capturing how decisions are made by teams. We proposed a methodology for tracking and monitoring team decision making processes in an unobtrusive manner through the analysis of ongoing communications. In brief, we analyze team communications to monitor and track critical decision-making processes. The products of this research include both scientific outcomes and a trainer's guide to implement this approach.

Outcomes Achieved During the Project
Effective team decision making is essential to reducing risk in the offshore oil and gas environment. This project attempts to develop and test an innovative approach to capturing how decisions are made by

teams. We propose a methodology for tracking and monitoring team decision-making processes in an unobtrusive manner through the analysis of ongoing communications. The basic premise of this work is that team members' verbal output provides a natural, valid, and unobtrusive indicator of the basic cognitive processes involved in team decision making. The analysis of the team's communication provides a cognitive footprint of what is occurring, or the processes that are being engaged, at any point during the team's decision-making activities, and can point to deficiencies in the team's decision-making processes. Research outcomes include the development of a model of team decision making relevant to offshore oil operations and a methodology for analysis of decision-making processes; empirical research to establish initial validation of this approach; experimental and archival evaluations of this approach; and proposed applications of this research to training.

Near-term products include a Trainer's Guide: Team Decision Making for Emergency Operations. The purpose of this guide is to familiarize the trainer with principles of team decision making in emergency situations and to provide guidance on how to identify effective decision-making processes. The guide is intended to be used as a tool to support training in well control simulation and tactical decision-games settings.

Communications, Outreach, and Dissemination Activities of Project

No press releases or media coverage.