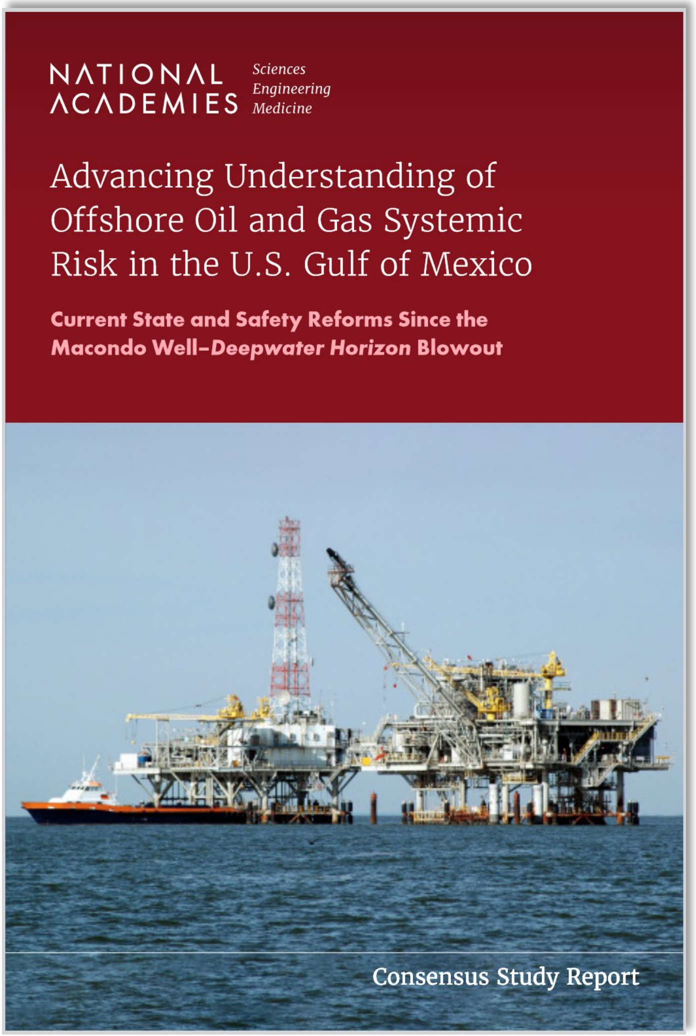
Systemic Risk in Offshore Oil and Gas in the U.S. Gulf of Mexico

S. Camille Peres, Richard A. Sears, Charlie Williams

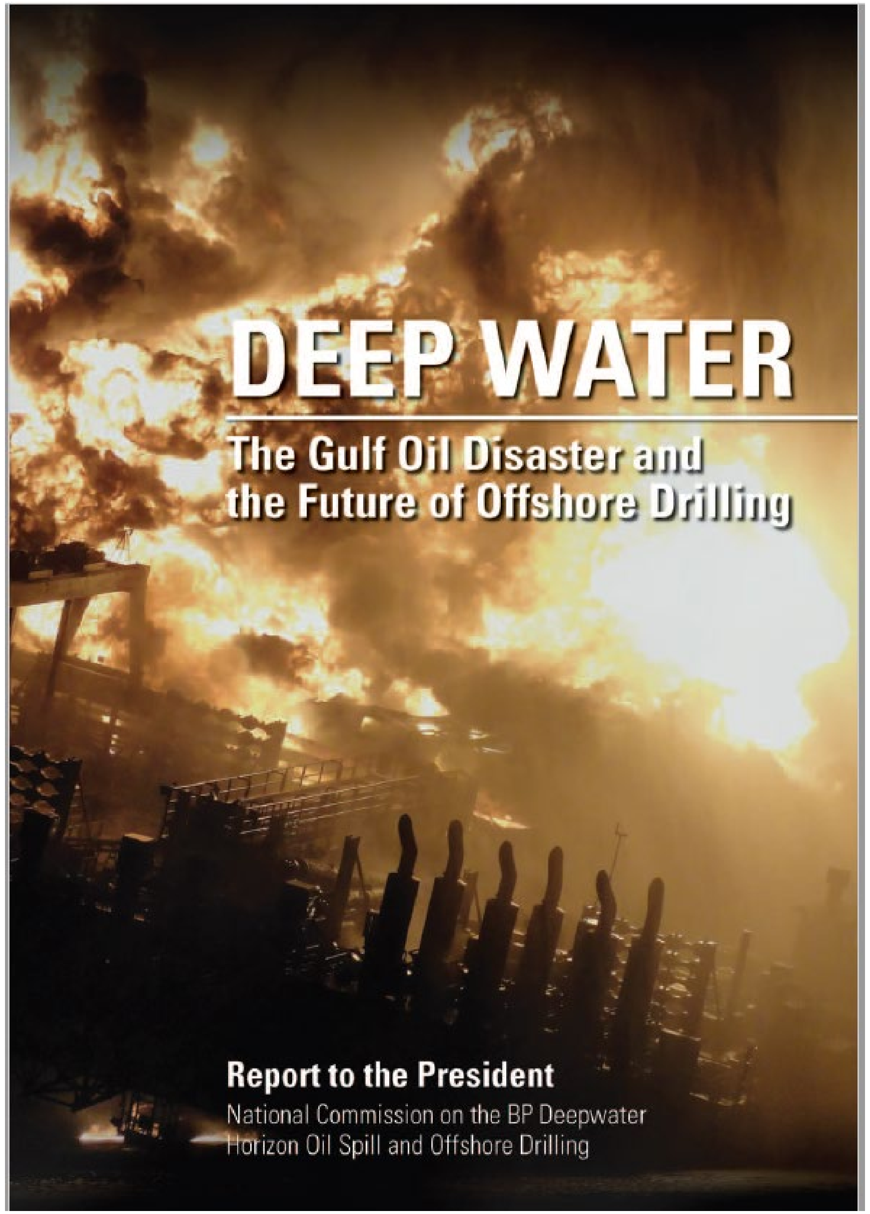


Statement of Task

Provide assessment of risk profile of offshore oil & gas (OOG) operations.

- Define ***current systemic risks profile*** of OOG in GOM related to disasters
- Identify ***critical gaps and prioritize future needs*** for increased understanding, communication, and management of systemic risks related to the OOG industry
- Consider how ***regulatory structure motivates*** technological, environmental, organizational, and process changes that could decrease the systemic risks of OOG operations.
- Assess how ***GRP and other funders have contributed*** to a better understanding and reduction of the systemic risks in offshore oil and gas operations
- Assess how technological, regulatory, environmental, organizational, and process ***changes have contributed to increasing or decreasing these systemic risks since 2012***

The positions described in this paper are those of the authors and do not necessarily represent the views of the GRP, U.S. Nuclear Regulatory Commission, or the U.S. Government.



In 2012

As a result of our investigation, we conclude:

The immediate causes of the Macondo well blowout can be traced to a ***series of identifiable mistakes*** made by BP, Halliburton, and Transocean that reveal such ***systematic failures in risk management*** that they place in doubt the ***safety culture of the entire industry.***

Forward, page vii

Risk Profile for Offshore Oil and Gas

NASEM 2023, Fig. 4-1, page 99

Risk Profile for Offshore Oil and Gas

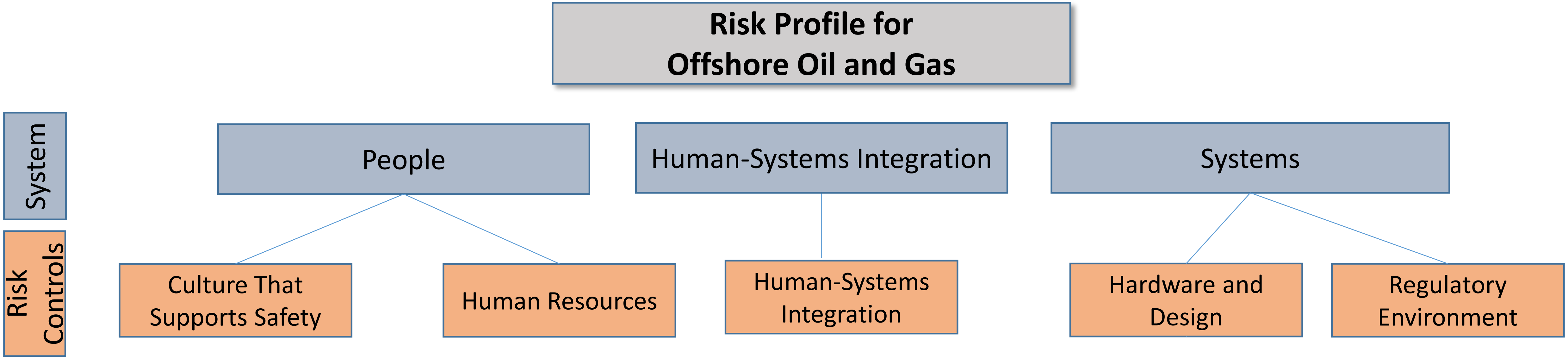
System

People

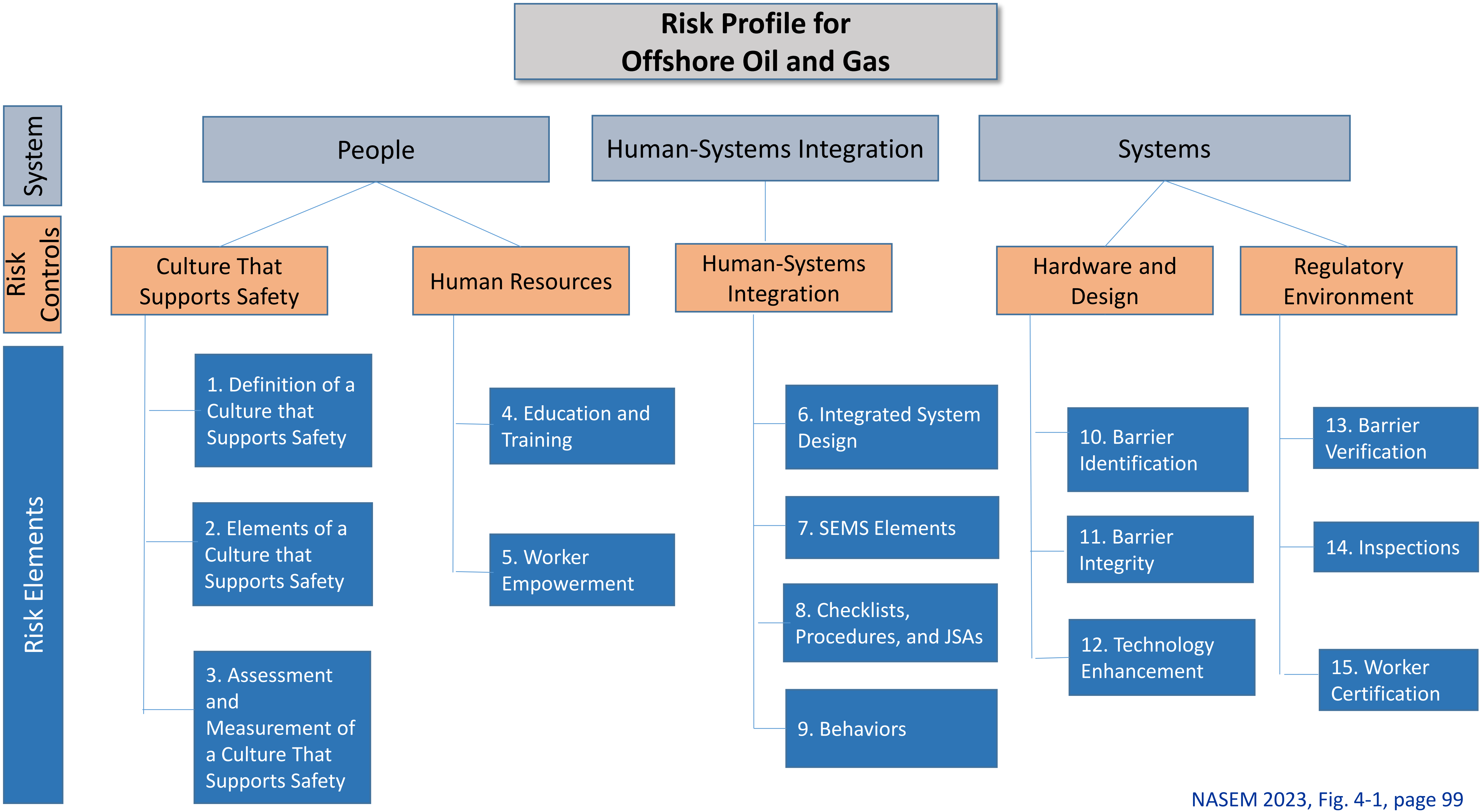
Human-Systems Integration

Systems

NASEM 2023, Fig. 4-1, page 99



NASEM 2023, Fig. 4-1, page 99



NASEM 2023, Fig. 4-1, page 99

Maturity Ratings: Levels 1 - 5

- ***Level 1—Unacceptable***: strong negative statement
  inconsistent management practices; reactionary versus anticipatory; nascent state of systemic risk management.
- ***Level 2—Concerning***: real concerns about safety management
  regular management foundation; work done in silos with minimal incorporation of improvement strategies.
- ***Level 3—Neutral***: not as negative but not positive
  clear processes and work toward consistency and uniform performance; still focused on procedures or compliance with existing rules.
- ***Level 4—Good***: positive statement of clear evidence of consistent efforts towards effective safety management
  existing processes and capabilities regularly used to achieve risk mitigation; variation controlled but some questions about consistency.
- ***Level 5—Mature***: strong positive statement—generally an aspirational goal
  continuous improvement and learning with focus on innovation, sharing, and collecting and analyzing data; participation and shared ownership in outcomes of risk management; particularly reflected in assessments of risk controls of Culture, Human Resources, and Human-Systems Integration.

Human Systems Integration

"To provide equal consideration of the human along with the hardware and software…"

Human Factors Engineering

Comprehensive integration of ***human capabilities*** and ***limitations*** into ***systems design***

Required Human Capabilities

Human ***aptitudes, KSA, and experience levels*** required to ***operate, maintain, and support*** a system at time it is fielded.

Personnel Requirements

Prediction (& cost) of number & mix of ***personnel required*** and available to ***train, operate, maintain, and support*** each system

Training

Instruction & resources required providing personnel with requisite ***KSA*** to properly ***operate, maintain, and support*** a system.

Habitability

Factors of ***living and working conditions*** necessary to sustain the ***safety, health and comfort*** of user population ***effectiveness and mission accomplish***ment.

Survivability

Ability of a system, including its ***operators, maintainers and sustainers*** to withstand the risk of, ***injury, loss of mission capability or destruction***

Safety & Occupational Health

Consideration of design features related to ***hazards***, ***safety***, and ***risk analysis***

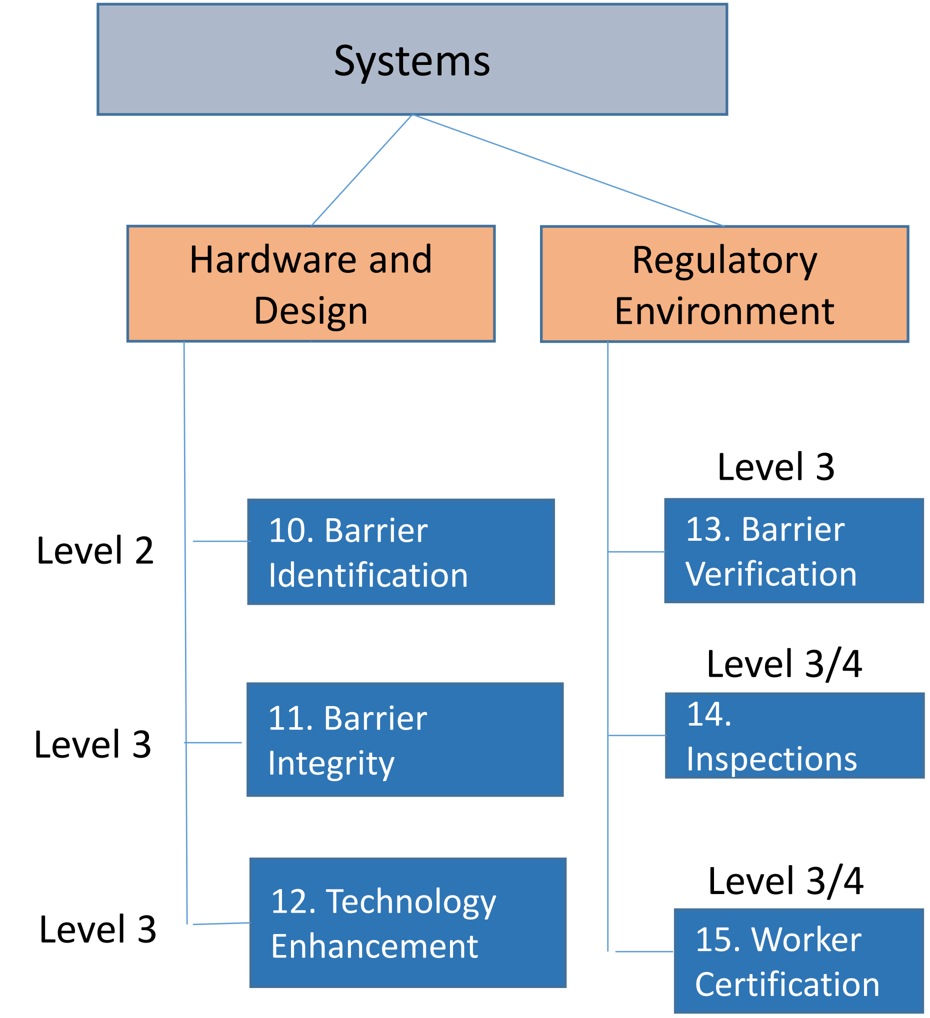
Risk Profile for Offshore Oil and Gas

System

Risk Controls

Risk Elements

Human Factors Engineering



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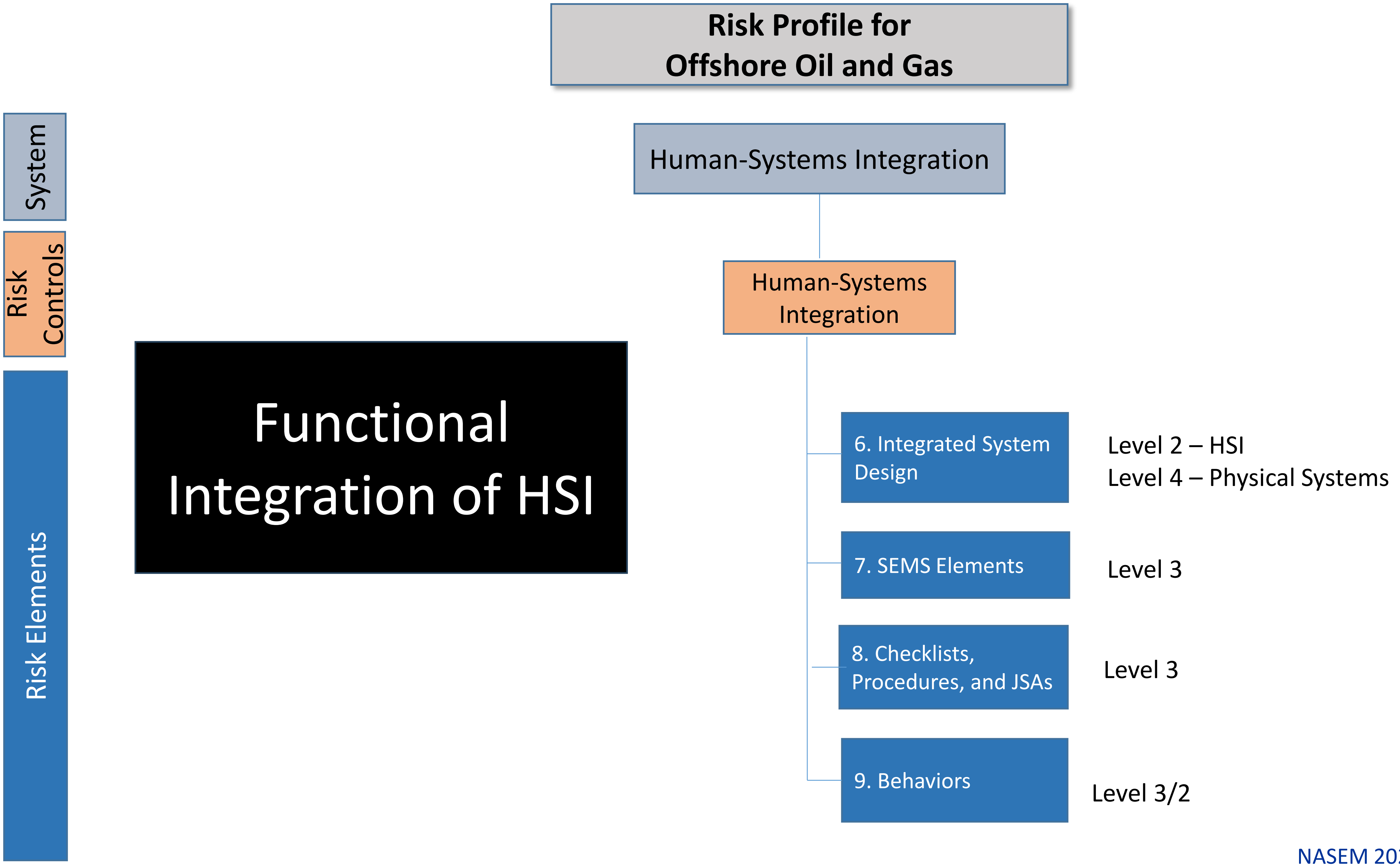

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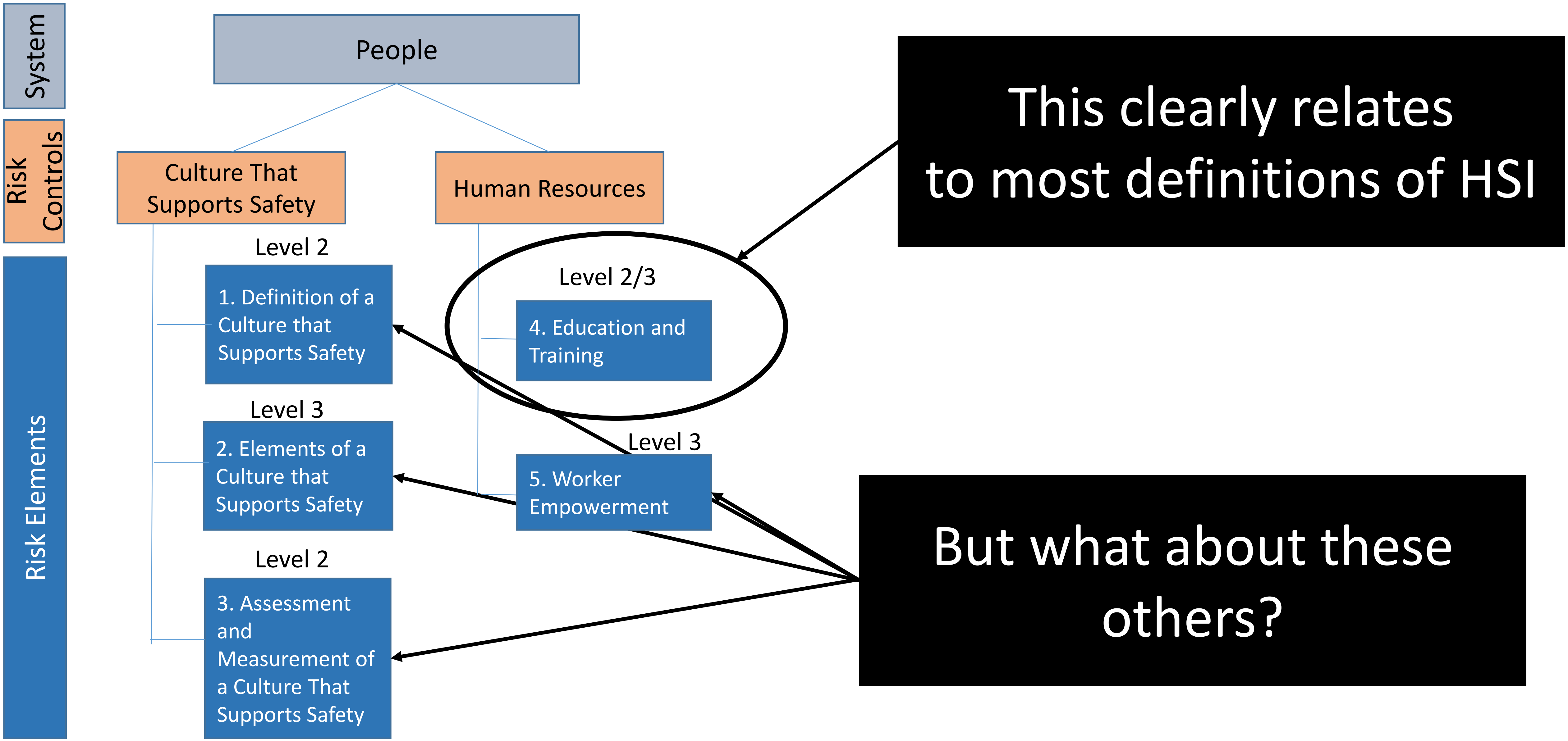
Risk Profile for Offshore Oil and Gas



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Safety & Occupational Health

Consideration of design features related to ***hazards***, ***safety***, and ***risk analysis***

Culture Supporting Safety

Culture that effectively integrates ***communications, management, and behaviors*** that support safety for the ***workers, operations, and environment***

Human Systems Integration

"To provide equal consideration of the human along with the hardware and software…"

Human Factors Engineering	Comprehensive integration of ***human capabilities*** and ***limitations*** into ***systems design***	Habitability	Factors of ***living and working conditions*** necessary to sustain the ***safety, health and comfort*** of user population ***effectiveness and mission accomplish***ment.
Required Human Capabilities	Human ***aptitudes, KSA, and experience levels*** required to ***operate, maintain, and support*** a system at time it is fielded.	Survivability	Ability of a system, including its ***operators, maintainers and sustainers*** to withstand the risk of, ***injury, loss of mission capability or destruction***
Personnel Requirements	***Prediction (& cost)*** of number & mix of ***personnel required*** and available to ***train, operate, maintain, and support*** each system	Safety & Occupational Health	Consideration of design features related to ***hazards***, ***safety***, and ***risk analysis***
Training	***Instruction & resources*** required providing personnel with requisite ***KSA*** to properly ***operate, maintain, and support*** a system.	Culture Supporting Safety	Culture that effectively integrates ***communications, management, and behaviors*** that support safety for the ***workers, operations, and environment***

Where Culture is Not Enough

- HSI must be considered early in the design and development of a system
  - At the end it is too expensive and insufficient to address operator needs
- You can't fix bad design with training or culture
  - Problems will keep happening
  - Good design reduces training and manpower requirements
  - Training is only part of the solution
- Need to involve qualified HSI Experts
  - Determining Requirements
  - Design & Development of Systems
  - Operational Policies & Procedures
  - Manpower & Training
- Organizations should have a senior VP level officer in charge of Safety and Human Factors
  - Oversee HSI requirements, activities, and personnel, and serves as an HSI advocate and point-of-contact within the organization.
  - Ensure that human factors considerations don't get ignored or traded off with risk—increasing shortcuts

Thanks!

- Richard A. Sears (Chair)
- Norman A. Abrahamson
- Paul G. Bradley
- Manson K. Brown
- Paul S. Fischbeck
- Dwight Johnston
- Ulku G. Oktem
- S. Camille Peres
- Kathy A. Seabrook
- Charles R. Williams II

Questions or Comments

HSI Resources

- Best Practice
  - Pew, R. W., & Mavor, A. S. (Eds.). (2007). Human system integration in the system development process: A new look. Washington, DC: National Academic Press.
  - Boehm-Davis, D. A., Durso, F. T., & Lee, J. D. (Eds.). (2015). APA handbook of human system integration. Washington, DC: American Psychological Association
- Industry Standards
  - SAE International. (2019). SAE 6906 Standard Practice for Human Systems Integration Warrendale, PA: Author.
  - International Standards Organization. Ergonomics of Human System Interaction (ISO 9241).
  - Human Factors and Ergonomics Society. (2021). Human Readiness Level Scale in the System Development Process ANSI/HFES 400-2021. Washington, DC: Human Factors and Ergonomics Society.
  - Ahlstrom, V., & Longo, K. (2003). Human Factors Design Standard (HF-STD-001) Atlantic City International Airport, NJ: Federal Aviation Administration William J. Hughes Technical Center.
  - Department of Defense. (2012). MIL-STD-1472G Design Criteria Standard: Human Engineering Washington, DC: Author.

Does HSI Make a Difference?

- From the U.S. Coast Guard:
  - 80% of environmental problems result from decisions made during acquisition
  - After initial operational capability, 80% of Life Cycle Costs are HSI-related
    - 40 – 60% of Life Cycle Costs relate to matching human capacity with design, personnel required, and training.
  - Studies on the effectiveness of HSI application show
    - 25% reduction in human error
- Return on Investment:
  - Costs for HSI programs show typical ROI of 17- 900%

Select Conclusions

- Significant historic improvements in occupational safety.
- Process safety management lags offshore technology development and the industry lags other safety-critical industries in key areas.
- The operator-contractor interface remains of particular importance in managing systemic risk.
- Education and training standards lack requirements for demonstrating competence in safety critical positions.
- Some limited data for assessing offshore risk is now being captured though industry commitment varies.
- Industry has evolved significantly since Macondo. The energy transition will add new pressures.
- The model for disaggregating systemic risk into systems, risk controls, and risk elements provides a framework for understanding systemic risk and for catalyzing actionable statements and discussion. Issues with human are prominent in the model.

Human Systems Integration

- **Human System Integration (HSI) is often overlooked or delayed too long during system development**
  - **Human error created by inadequate system design accounts for 60-90% of accidents and incidents**
    - **Often due to failure to consider the human user when the system is developed**
  - **Training, operations and maintenance costs are significantly higher when system not designed to support human use**
    - **Account for 35-70% of a systems life-cycle costs**

      Largely determined by the design of the system
  - **Cost of changing system design 60-100% higher once system design completed**

Human systems design issues must be considered early during system design