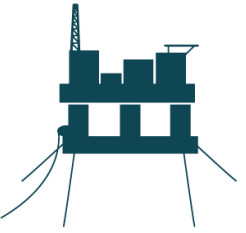


GLOBAL OFFSHORE

B R A Z I L
S U M M I T



FPSO BEST PRACTICES Joint Industry Project (JIP)

Bruce Crager
Executive Vice President
Endeavor Management

Endeavor
Expert Advisory Group



Need for FPSO Best Practices JIP

Alignment

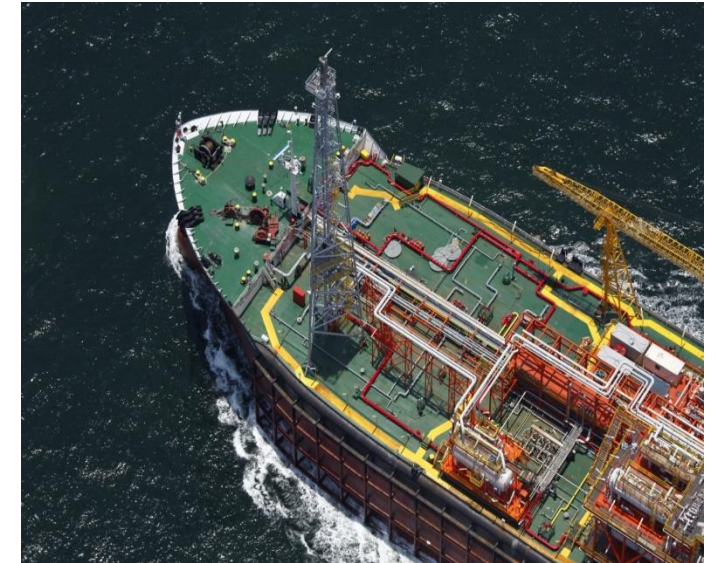
- Collaborative across the industry—including between Operating Partners
- Consider all Stakeholder concerns
- Improve delivery time

Execution

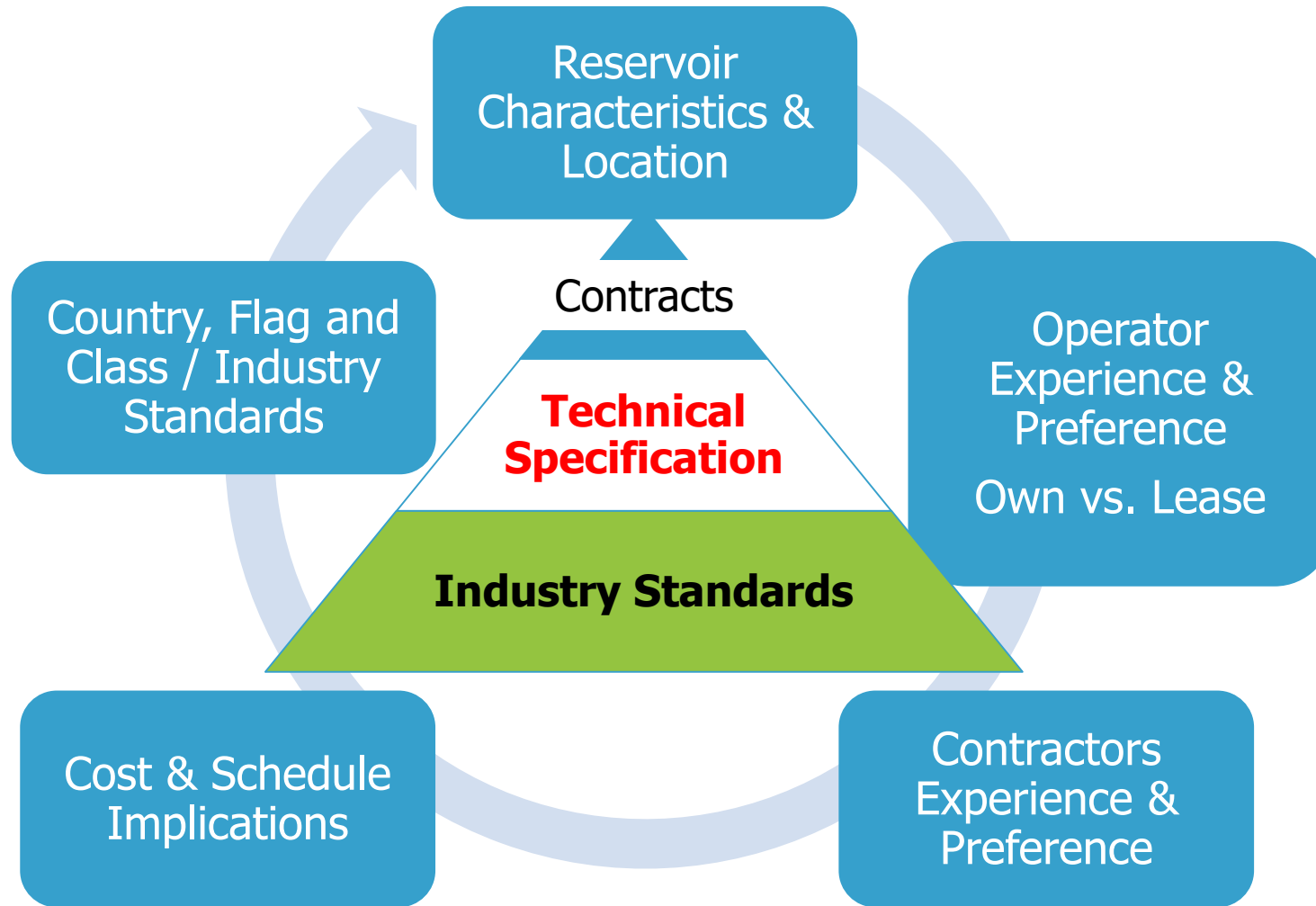
- Reduce costs
- Fit for Purpose solutions
- More reliance on industry standards and specs

Safety

- More consistent operational procedures across the industry
- Sharing of best safety practices



Strategic Decisions



KEY STRATEGIC DECISION: Newbuild vs. Conversion

Definition of success

- Early preparation of a comprehensive Statement of Requirements
- Structured basis for conversion hull selection or newbuild design
- Evaluation of conversion candidates: database review, inspections

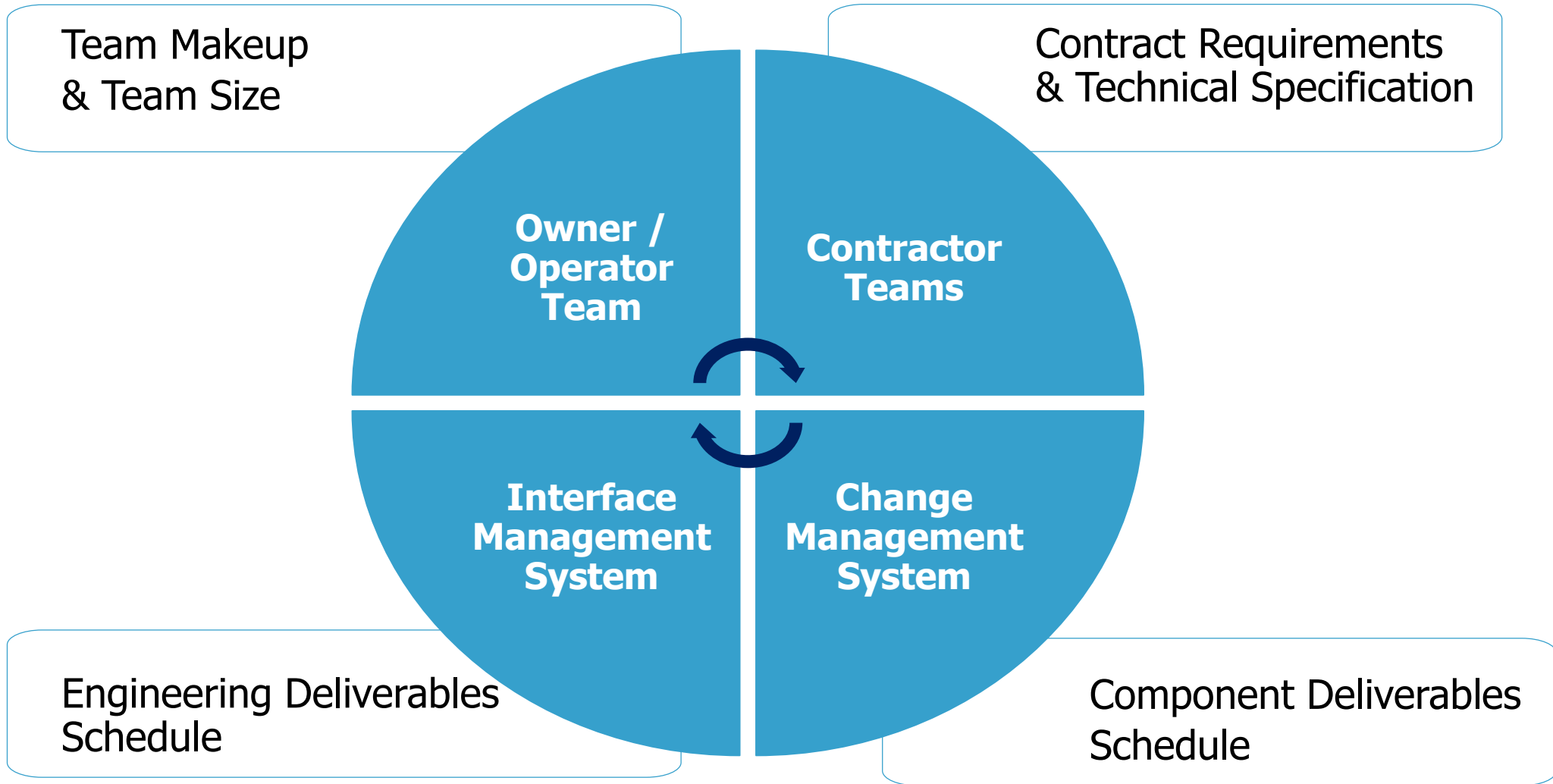
Newbuild

- Inappropriate hull specification for FPSO service
- Longer time to delivery
- Need for propulsion system?

Conversion

- Condition, trading & maintenance history uncertain
- Uncertain remaining hull fatigue life
- Lack of options to meet double side requirements
- Corrosion protection – coatings and CP – need renewal strategy
- Adequacy and condition of cargo handling system

Project Delivery



Mooring and Offloading

Considerations should include

- Site-Specific Environmental / Metocean Conditions
- Need to Disconnect FPSO for Iceberg / Hurricane Events
- Requirement for the Risers/Umbilicals (size, number, pressure rating)
- Type of Export Tanker (DP or Standard Tanker w/ tug assist)
- Capital and Operation Costs
- Perceived Operational Risks

In general, there does not appear to be a single or “standard” mooring / offloading solution for a given operating region.

Process Module Design

Key Considerations

- Crew Safety
- FPSO Operability
- Process Module/Hull Interfaces



Module Design and Placement

- Module Arrangement to reduce Risk to Crew
- High Pressure Equipment Farthest from Crew Quarters
- Module Sizing, Construction & Installation
- Number of Modules
- Interfaces and Integration Considerations
- Independent component installation on hull vs. larger modules
- Operability Issues
- Module Placement
- Equipment placement within Modules

Process/Hull Interface Issues

- Different Design Methodologies between Marine and Process Systems
 - Different FEA Models
 - Different Specifications and Standards
 - Structural and Piping Interface Issues
 - Structural Elements to Attach Process Modules to Hull
 - Piping and Electrical Interfaces
 - Between Process Modules, Accommodations, and Hull Systems
-

Gas Disposition

Preferred method

- Flaring, Venting, re-injection, use as fuel, gas conversion to liquid, or other options.
- What are the benefits/downsides of each?

HSE considerations

- Impact on risk to crew and facilities
- Impact on Greenhouse gas emissions

Operational Considerations

- Reliability and Maintainability
- Required crew competence to safely and effectively operate the system

Opex vs Capex

- What effect does each method have on OPEX and CAPEX?
- What are the tradeoffs?

Interface issues

- What effect does the method selected have on vapor recovery?
- Interface with the rest of the process facilities?.
- Interface with the marine systems?

Vapor and Water Disposal

Vapor recovery

- What effect does vapor recovery have to reduce greenhouse gases?
- Carbon tax considerations?
- What is the state of the art for venting and vapor recovery?
- HSE considerations
- Interface issues with gas disposition system/process and marine systems.
- CAPEX vs OPEX

Water disposal

- What is the state of the art related to new technologies and low-cost technologies?
- HSE considerations.
- Flag State/Coastal State/Class Regulations both current and future.
- System flexibility--Can the system be turned down or up if the injectivity is not as expected?
- Reservoir considerations such as rate, pressure, solids content, fluid compatibility and changing reservoir requirements over time.

Redeployment

Advantages

- Faster track to first oil at new location
- Potential low-cost development
- May be more suitable for EPS or EWT
- Shorter start-up and commissioning period if properly planned
- Crew experienced in operation & maintenance of process system may be able to move with vessel

Threats & Challenges

- Lack of advance strategy and planning for potential future redeployments
- Uncertainty surrounding timing and availability
- Specification gaps could be substantial for meeting new field requirements
- Regulatory/Class permits/approvals not understood
- Excessive topsides modifications may be needed
- Extensive hull life extension work may be required
- Mooring, risers and umbilical issues not understood

Operational Best Practices

The Premise

- Multiple operators and FPSO contractors simultaneously develop their own specific operational procedures
- Most procedures are generally similar from one operator and contractor to another
- Essential functions of an FPSO are the same or similar wherever they are and whatever the design

The Rationale

- Millions of man hours can be saved by establishing common operational procedures
- Improved operational efficiency
- Greater certainty of routine safety practices
- Efficient transfer of crewmember skills between FPSOs

Operational Best Practices

Stage One

- **General review of existing Operating Procedures as developed and used by different Owners and Operators**

Stage Two

- **Compare and contrast results of Stage One**
- **Work with Operators and Owners to agree optimum framework and content of Best Operating Procedures**

Stage Three

- **Develop Guidelines for Operating Procedures for FPSOs (*Examples below*)**

Operating Procedures

Safety Management System

Maintenance Management System

Standardized Training Matrices

Crew Job Descriptions

Crew Management & Training

Regulatory Compliance

Stage Three

- **Identify field specific operational issues**

JIP Information

- **JIP budget based on 10 Participants**
 - **Cost per participant of \$79,000**
 - **Schedule of 5 months to complete JIP**
 - **Endeavor Advisors will:**
 - ✓ **Serve as Lead for each of the 8 scopes**
 - ✓ **Develop initial Best Practices based on Participant Input and Advisor Experience**
 - ✓ **Confirm Best Practices with participating companies as appropriate**
 - ✓ **Draft the Best Practice for each scope for Participant review**
-

Endeavor

THANK YOU

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