1. Deepwater drilling began long before we had production capability
2. Time and depth gap between drilling and production is closing
3. 10,000’ has been the water depth threshold for almost 10 years
Issues Driving Use of Mobile Offshore Production Systems (MOPS):

- Water Depth
- Gas or Oil Production (Primary Function)
- Geographical Location
- Oil Export Options
- Gas Usage / Export Options
- Fabrication
- Wellhead Location (Surface, Subsea or both)
Mobile Offshore Production Systems: Principal Types

- **SUBSEA WELLHEADS**
  - SEMI-SUBMERSIBLE FPS
  - MONOHULL FPSO

- **SURFACE WELLHEADS**
  - JACKUP JPU
  - TLP
  - SPAR
## Wellhead / Tree Location: Surface vs. Subsea

<table>
<thead>
<tr>
<th></th>
<th><strong>Advantages</strong></th>
<th><strong>Disadvantages</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subsea Completions</strong></td>
<td>Lesser or no need for on-site surface support</td>
<td>Complex / costly to access for intervention</td>
</tr>
<tr>
<td></td>
<td>Enables wide areal distribution of wells</td>
<td>Requires remote control system</td>
</tr>
<tr>
<td></td>
<td>Can reduce project capex</td>
<td>May increase opex</td>
</tr>
<tr>
<td><strong>Surface Completion</strong></td>
<td>Simpler / cheaper to access for intervention</td>
<td>Requires supporting platform</td>
</tr>
<tr>
<td></td>
<td>May reduce drilling cost Low opex</td>
<td>Restricted areal coverage, directional wells</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Requires heave compensation on floater</td>
</tr>
</tbody>
</table>
Three System Groups:

1. **Dry Tree Systems** – Fixed Platform, Production Jackup, Compliant Tower, TLP, Spar

2. **Wet Tree Systems** – New Gen. TLPs, Conventional TLPs, FPSOs, Cell Spar, Control Buoy, SS Tiebacks, Semi-FPS

3. **Mixed Dry / Wet Tree Systems** – Fixed Platforms, New Gen. TLP, Conventional TLP, Spar
Jackup Production Unit (JPU)

Operating: 40

First: 1971, Gulftide, Ekofisk

Deepest: Harding, UK, 400 ft

Depth Range: 43 ft – 400 ft

Construction: 2

Locations: Worldwide
FPS - Semi Submersible

Operating: 39

Stacked: 4

First: 1975, Argyll, Hamilton

Deepest: 7,920 ft, MC920 Independence Hub

Construction: 6

Locations: Worldwide
FPSO

Operating: 182

Stacked: 13

First: 1977, Castellon, Shell

Deepest: 8,300 ft, Cascade Chinook

Construction: 29

Locations: Worldwide
TLP

Operating: 24

First: 1984, Hutton, Conoco

Deepest: 4,674 ft, Magnolia
          GB783/84

Construction: 1

Locations: North Sea, Angola,
           Gulf of Mexico,
           Indonesia and
           Equatorial Guinea
SPAR

Operating: 18

First: 1996, Neptune, VK 826

Deepest: Perdido 8,008 ft
Alaminos Canyon 857

Construction: 0

Locations: Gulf of Mexico, Malaysia
Optimum Application Ranges

Source: FloaTEC
Worldwide Forecast Floating Activity by Year 2010-2014e

Units to Award 2010-2014: 129
Units to Start-up 2010-2014: 85

Source: Quest Offshore Resources, Inc.
Worldwide Forecast Floating Activity by Year 2010-2014e
Base Mean and High Case

Units to Award 2010-2014: 129
Units to Start-up 2010-2014: 85

Source: Quest Offshore Resources, Inc.
Top Operator Analysis
Worldwide FPSO Top Operators

Flowing and Under Construction Top 11 Operators (87 of 211 Units)

Source: Quest Offshore Resources, Inc.
Worldwide FPS-Semi Top Operators

Flowing and Under Construction Top 4 Operators (37 of 49 Units)

Source: Quest Offshore Resources, Inc.
Worldwide TLP Top Operators

Flowing and Under Construction Top 7 Operators (17 of 24 Units)

Operator

- Royal Dutch/Shell
- BHP Billiton
- ConocoPhillips
- Eni
- ExxonMobil
- Hess
- Statoil

Source: Quest Offshore Resources, Inc.
Worldwide Spar Top Operators

Flowing and Under Construction Top 4 Operators (13 of 18 Units)

Operator | Number of Units
--- | ---
Anadarko Petroleum | 5
bp | 3
Murphy Oil | 3
Chevron | 2

Source: Quest Offshore Resources, Inc.
Normalized Forecast
Worldwide Forecast Floating Activity by Year 2010-2014e
Normalized Case - 85 Unit Startups

**Forecast Demand Drivers:** Deepwater exploration, marginal field exploitation, and early production / phased developments

Source: Quest Offshore Resources, Inc.
Activity Share by FPS Type 2010-2014e Startup Year
Normalized Case - 85 Units

Source: Quest Offshore Resources, Inc.
Global Award Analysis
Worldwide FPS Awards 2002 (A) – 2014 (e) (Mean Case)

Source: Quest Offshore Resources, Inc.
Worldwide FPS Forecast Awards 2010 (e) – 2014 (e)  
Area Activity Share By Region (129 Units Mean Case)

Hull Award Year

<table>
<thead>
<tr>
<th>Hull Award Year</th>
<th>Africa/Medit.</th>
<th>Asia Pacific/Middle East</th>
<th>North America</th>
<th>North Sea/Arctic</th>
<th>South America</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>2011</td>
<td>4</td>
<td>8</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>2012</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>11</td>
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<tr>
<td>2013</td>
<td>8</td>
<td>10</td>
<td>4</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>2014</td>
<td>8</td>
<td>11</td>
<td>2</td>
<td>3</td>
<td>11</td>
</tr>
</tbody>
</table>

Source: Quest Offshore Resources, Inc.
# Worldwide FPS Awards 2010 (A) – 2014 (e) Mean Case

By FPS Type (129 Units)

![Graph showing the number of FPS units awarded by type and year from 2010 to 2014.](image)

<table>
<thead>
<tr>
<th>Hull Award Year</th>
<th>FPSO</th>
<th>FPS-Semi</th>
<th>Spar</th>
<th>FLNG</th>
<th>TLP</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>17</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2011</td>
<td>13</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>1</td>
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<tr>
<td>2012</td>
<td>20</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
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<tr>
<td>2013</td>
<td>24</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2014</td>
<td>26</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Quest Offshore Resources, Inc.
World Wide **FPSO Awards** 2010 (e) – 2014 (e) Mean Case

Source: Quest Offshore Resources, Inc.
South America and Asia will be the key drivers for increases in spending, while the project mix causes spending to drop off in 2012 despite an increase in the number of units awarded.

Source: Quest Offshore Resources, Inc.
Despite the large numbers of Asian FPSO units to be awarded, their relatively low value decreases their importance to spending.
Leased FPS Units
### Forecasted Off Contract FPS Leased Fleet Availability by Type and Year 2010-2014 (Likely to be retired and EWT excluded)

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>9</td>
</tr>
<tr>
<td>2011</td>
<td>0</td>
</tr>
<tr>
<td>2012</td>
<td>1</td>
</tr>
<tr>
<td>2013</td>
<td>3</td>
</tr>
<tr>
<td>2014</td>
<td>6</td>
</tr>
</tbody>
</table>

Source: Quest Offshore Resources, Inc.
Leased **FPSO** Market Share by Owner

Owners with >1 Unit

- Aker Floating Production
- Bluewater Offshore
- Bumi Armada
- BW Offshore
- FPS Ocean
- Fred Olsen Production
- Maersk
- MODEC
- Nexus/APL
- Nortech
- Prosafe Production
- SBM
- Sea Production
- Sevan Marine
- Tanker Pacific
- Teekay Shipping Corp

Includes JV Shares

Source: Quest Offshore Resources, Inc.
## Leased FPSO Market Share by Owner

### Owners with >1 Unit

<table>
<thead>
<tr>
<th>Owner</th>
<th>Grand Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODEC</td>
<td>15</td>
<td>16.3%</td>
</tr>
<tr>
<td>SBM</td>
<td>12</td>
<td>13.0%</td>
</tr>
<tr>
<td>BW Offshore</td>
<td>9</td>
<td>9.8%</td>
</tr>
<tr>
<td>Bluewater Offshore</td>
<td>7</td>
<td>7.6%</td>
</tr>
<tr>
<td>Prosafe Production</td>
<td>7</td>
<td>7.6%</td>
</tr>
<tr>
<td>Sevan Marine</td>
<td>6</td>
<td>6.5%</td>
</tr>
<tr>
<td>Aker Floating Production</td>
<td>4</td>
<td>4.3%</td>
</tr>
<tr>
<td>Teekay Shipping Corp.</td>
<td>4</td>
<td>4.3%</td>
</tr>
<tr>
<td>Bumi Armada</td>
<td>2</td>
<td>2.2%</td>
</tr>
<tr>
<td>Fred Olsen Production</td>
<td>2</td>
<td>2.2%</td>
</tr>
<tr>
<td>Maersk</td>
<td>2</td>
<td>2.2%</td>
</tr>
<tr>
<td>Nexus</td>
<td>2</td>
<td>2.2%</td>
</tr>
<tr>
<td>Nortech</td>
<td>2</td>
<td>2.2%</td>
</tr>
<tr>
<td>SBM/MISC</td>
<td>2</td>
<td>2.2%</td>
</tr>
<tr>
<td>Tanker Pacific</td>
<td>2</td>
<td>2.2%</td>
</tr>
<tr>
<td>Other</td>
<td>14</td>
<td>15.2%</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>92</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

Includes JV Shares

Source: Quest Offshore Resources, Inc.
Operator Owned FPS Market Share by Owner

Source: Quest Offshore Resources, Inc.
Global Hull Fabrication Analysis
Market Share – **FPSO Hull Fabrication (Number of Units)**
Major FPS Shipyards 2003-2010 By Fabrication Start Year

Source: Quest Offshore Resources, Inc.
Market Share – **FPSO Topsides** Fabrication (Number of Units)
Major FPS Shipyards 2003-2010 By Fabrication Start Year

Source: Quest Offshore Resources, Inc.
Market Share – FPS-Semi **Hull** Fabrication (Number of Units)
Major FPS Shipyards 2003-2010 By Fabrication Start Year

Source: Quest Offshore Resources, Inc.
Market Share – **FPS-Semi** *Topsides* Fabrication (Number of Units)
Major FPS Shipyards 2003-2010 By Fabrication Start Year

![Bar chart showing market share for FPS-Semi topsides fabrication by major shipyards from 2003 to 2007 by construction start year. The chart includes data for Aker Verdal, Gulf Island Marine, J Ray - Morgan City, Keppel FELS, Kiewitt, and MMHE.](chart.png)

Source: Quest Offshore Resources, Inc.
Conclusions
Conclusions

- MOPS market continues to expand
- Leased FPSOs are approximately 1/2 of the FPSO market
- FPSOs are by far the most common type of MOPS
- A number of FPSO units are available today
- Floating Production Systems are the only option for surface facilities in water depths greater than 1,750 ft
Questions?
Selecting a MOPS Unit Type: Principal Determining Criteria

- Surface or Subsea Completions
- Need for Well Access and Intervention
- Drilling Program Requirements
- Access to Existing Hydrocarbon Export Infrastructure
- Water Depth and Environmental Regime
- Size and weight of process equipment
Principal Operational Sensitivities

- Oil Export Method / Storage and Offloading Systems

- Environmental Parameters and the Mooring System
  - Permanent moorings
  - Disconnectable options
  - Weathervaning (single-point) vs. spread moorings

- Process System Sensitivities
Operational Considerations

- System Availability / Uptime
  - Is redundancy required?
  - What cost for the final %?

- Achieving Safety and Environmental Protection Objectives

- Recruiting and Retaining Competent Crew

- Maintenance Criteria