Agenda

Maersk Drilling - Facts

Value chain and cost drivers

Innovation Process in Maersk Drilling

Energy storage/ Flywheel:
  Deep Water Drilling
  Energy storage

Project Description

Questions
Maersk Drilling - part of the A.P. Moller – Maersk Group

Maersk Line  Maersk Oil  APM Terminals  Maersk Drilling  Services & Other Shipping
Maersk Drilling – The numbers

The Maersk Group
The Maersk Group has five core businesses which include Maersk Line, APM Terminals, Maersk Oil, Maersk Drilling and APM Shipping Services. The last business area is comprised of Maersk Supply Service, Maersk Tankers, Damco and Svitzer.

47.6  5.2  89,200
Revenue for 2014 USD billion  Profit for 2014 USD billion  FTE employee count

Maersk Drilling
Maersk Drilling supports global oil and gas production by providing high-efficiency drilling services to oil companies around the world. The company’s advanced fleet is comprised of harsh environment jack-up rigs, deepwater semi-submersibles, a 3,000 ft semi-submersible, 350 ft & 375 ft jack-up rigs and containerized drilling barges.

2.1  478  4,741
Revenue for 2014 USD billion  Profit for 2014 USD million  FTE employee count

VISIT MAERSKDRILLING.COM
Highlights from Maersk Drilling’s history

- **1972**: Maersk Drilling established
- **1975**: Delivery of Maersk Explorer – world’s largest jack-up rig
- **1990**: Maersk Drilling moves into Norway with Maersk Guardian
- **1993**: Delivery of Maersk Gallant – world’s largest jack-up rig
- **2003**: Delivery of Maersk Innovator – world’s largest jack-up rig
- **2012**: World’s most advanced drilling simulator built
- **2013**: 20K project with BP initiated
- **2014**: Delivery of Maersk Intrepid – world’s largest jack-up rig
- **2015**:
Maersk Drilling is a worldwide operator

Headquarter:
Denmark – Copenhagen
4,700 employees

NW Europe
7 Ultra Harsh Jack-ups
4 Harsh Jack-ups

US GoM
1 Ultra Deepwater Semi
2 Drillships

Caspian Sea
1 Mid-water Semi

Egypt
1 Ultra Deepwater Semi

Korea (yard)
1 Ultra Harsh Jack-up

W Africa
1 Ultra Deepwater Semi
1 Ultra Harsh Jack-up
1 Drillship

Egyptian Drilling Company
(50/50 Joint Venture)
61 land and workover rigs
3 low spec jack-ups
2 Premium jack-ups

Philippines
1 Drillship

SE Asia
2 Premium Jack-ups
The Fleet - Exploration and development drilling

**DRILLSHIP**
Operates at water depth of: 500-3,650 meters

**SEMI-SUBMERSIBLE**
Operates at water depth of: 500-3,000 meters

**JACK-UP RIG**
Operates at water depth of: 25-150 meters

**DRILLING DEPTH:**
- **DRILLSHIP:** 12,000+ meters
- **SEMI-SUBMERSIBLE:** 9,000 meters
- **JACK-UP RIG:**

**HORIZONTAL DRILLING MAXIMUM:** 4,000 meters
The Fleet: It’s Big!
Maersk Drilling Safety Performance
Safety has the highest priority within the Oil & Gas industry

Maersk Drilling Onshore & Offshore

Danish Industry

Maersk Drilling consolidated numbers 2013 --> YTD Aug. 2015

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<th>Year</th>
<th>Work-Hours</th>
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<tr>
<td>2013</td>
<td>9,312,073</td>
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<tr>
<td>2014</td>
<td>10,491,629</td>
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<tr>
<td>2015 YTD end Aug</td>
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LTI – Lost Time Injuries

<table>
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<th>Maersk Drilling</th>
<th>Danish Industry</th>
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<td>~ 0.5</td>
<td></td>
<td>~ 10</td>
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Source: DI Stat – Arbejdsulykker 2015
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The Oil & Gas Industry Value Chain

Concessions → Seismic Surveys → Field Study / Well Planning → Drilling → Production → Field abandonment

Oil Company → Oil & Service Companies → Oil Company → Oil Company → Oil & Service Companies
Maersk Drilling provides offshore drilling services to the upstream part of the oil and gas industry.
Total well cost – not just the cost of the drilling rig

Example of Total Daily Well Cost for an Oil Company

- Admin; 7%
- Equipment and materials; 10%
- Logistics; 12%
- Fuel cost; 5%
- Drilling Rig; 34%
- Services; 32%

~1,000,000 USD/Day

Maersk Drilling scope - only a part of the total well cost

Challenge: Fuel savings will in the current setup only benefit the Oil Company
Significant declines in oil prices have resulted in decreased upstream spending

**Oil prices have steadily deteriorated over the past year (Brent Crude daily oil price)**

**Oil companies reducing capital expenditures by USD 200 billion in 2015**

Note: Capital expenditures include all exploration, development, drilling and operational costs
Source: Thomson Reuters Datastream, Rystad Energy, Maersk Drilling
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Our Business Objectives

“Maersk Drilling’s overall business objective is to become a significant and stable contributor to the APMM Group profit by developing and growing our business within the ultra deepwater and ultra harsh environment segments.

We create value with our customers through a unique service delivery concept where we customize safe and efficient drilling services. We build our service around our highly skilled and committed work force, our state-of-the-art offshore drilling rigs and our 40 years of experience of operating in the most challenging environments.”

“Moving boundaries within offshore drilling”
Four innovation priorities
To support of MD’s vision of moving boundaries

- CLOSER: Anchoring MD in the value chain of oil majors
- DEEPER: Building a unique position in the UDW segment
- LEANER: Driving efficiencies across the value chain
- SMARTER: Harnessing our innovation potential

MAERSK DRILLING VISION
MOVING BOUNDARIES WITHIN OFF-SHORE DRILLING
Online system for capturing innovative ideas from all employees

Maersk Drilling idea campaign:
Ideas for the next generation ultra deep water rig

549 ideas and 204 comments
Balanced Innovation Portfolio

- Real time drilling
  - Down hole data
- Energy storage
  - Flywheel project
- Arctic Drilling
- Project 20K
- Reduction of maintenance cost (SPS)

Capabilities
Agenda

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Offshore drilling – The basics

https://www.youtube.com/watch?v=YQtDiX2Dbr0
Very complex technology and systems

- Power plant: ~42 MW (same size as a medium-sized city in Denmark)
- Control system: ~80,000 I/O’s
- DP (Dynamic Positioning), satellite DGPS and acoustic reference system
- Thruster capacity for station keeping: 33 MW
- Vessel speed (transit): 12.5 knots (23 km/t)
Power distribution system - simplified

- **Power plant**: ~42 MW
- **Azimuth Thrusters**: ~33 MW
- **Drilling loads**: ~12 MW

- **Base load**: ~4 MW
- **Drawwork (hoisting system), TopDrive, Mud and Cement pumps**
Energy Storage - perspectives

- Saving fuel cost and emissions
- Safer operation
- Supporting increased drilling efficiency
- Saving maintenance cost
- Long term goal: Reducing Total Cost of Ownership

“Moving boundaries within offshore drilling”
Offshore challenges.

Illustration of fluctuating loads during tripping operating in DP mode

Load curve Active Heave Drawworks

Power peak 6-7 (MW) in 1.5 sec

Aux Drawwork
Main Drawwork
DP Operation
Baseload

Azimuth thrusters

Drawwork
Drilling process – Tripping sequence

Huge power peaks from drawwork

Improvements in tripping speed equals time and cost savings for our Clients.
Energy storage – Common scenarios

**Constant load scenario**
- Standby start level - 3rd engine
- Energy storage to level out short power peaks to avoid unnecessary standby start of additional engines

**Peak Load / Peak Shaving**
- Charge energy storage
- Discharge energy storage
- Optimal corresponding engine load during tripping operations

Energy storage to level out power peaks to obtain constant load on the engines, allowing higher load and engine performance/ specific consumption.
Energy storage – Stable power plant

A stable power plant is an important parameter for:

1) Maintaining vessel position (operating envelope)

2) Maintaining power to drilling equipment.

**Risk associated with loss of power:**

- Unable to maintain position (drift off)
- Not sufficient time to close well (safety)
- Damage/ loss of equipment (high CAPEX)
Energy Storage – Part of the solution

• To pursue and maintain our leading position in providing safe and efficient drilling services by state-of-the-art-drilling rigs, we need continuous close co-operation and innovation with key partners in the industries.

• We see the capabilities of energy storage as a possible part of a total system solution for further improving the stability and efficiency of offshore power plants.

• In addition to our close cooperation with key partners, the cooperation with Universities is new to Maersk Drilling.
Flywheel Energy Storage System
Development of flywheels for Offshore/Marine use

**Den Maritime Fond**
Funding: 1.9 mDKK

**MAERSK DRILLING**
Project Management

**Innovation Fund Denmark**
Funding: 8.5 mDKK

**WattsUp Power**
Development of Flywheel

**Aalborg University**
Micro Grid Simulation

**DTU – Lyngby**
Active magnetic bearing system
Maersk Drilling expectations to the project

Development of the flywheel technology for:
- Offshore application.
- High Efficiency
- Long life time (20 years)

Total project budget: 20mDKK

Timeline:
- Project start: March 2015
- Onshore test: Autumn 2015
- Offshore test: Spring 2017->

“Moving boundaries within offshore drilling”
Questions ?