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COUNCIL
WORKING PARTY ON SHIPBUILDING

OFFSHORE VESSEL, MOBILE OFFSHORE DRILLING UNIT & FLOATING PRODUCTION UNIT
MARKET REVIEW

Please note that the complete version of this document is only available in pdf format.

Laurent Daniel

JT03368685

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FOREWORD

This report was prepared for the Council Working Party on Shipbuilding (WP6) by Douglas Westwood, to aid the WP6's discussions regarding shipbuilding and the offshore industry. WP6 delegates discussed the report at their meeting on 25 November 2014 and agreed to declassify the report so that it could be made available to a wider audience. The views expressed are those of the consultant and do not necessarily represent the views of the OECD or the WP6.

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Scope of Work

1. Energy Outlook to 2025

- a. Key underlying market drivers & indicators to include:
 - i. Regional (including all OECD member countries) review of hydrocarbon supply / production
 1. Oil vs. gas
 2. Onshore vs. offshore
 3. Shallow vs. deep
 - ii. Demand outlook:
 1. Evolution of energy sources
 2. Growth in energy demand and impact on O&G sector
 - iii. Supply / demand scenarios:
 1. Impact of previous recession on supply and demand
 2. Future upside and downside drivers & implications
 - iv. Regulation:
 1. Overview of regional regulation
 2. Local content
 3. Exploration incentives (e.g. tax breaks)
 - v. Renewable energy review:
 1. Historic and forecast supply by type (offshore wind, wave & tidal etc)
 2. Key drivers and indicators
 3. Offshore wind turbine installation forecast

2. Outlook for Offshore Vessel Demand to 2025

- a. Forecast demand days / vessels required to satisfy demand in part 1. to include segmentation by vessel type, namely:
 - i. AHTS
 - ii. Barges
 - iii. Crewboats / workboats
 - iv. Jackup drilling rigs
 - v. Drillships / semisubmersible drilling rigs
 - vi. ERRV
 - vii. FPS (FPSO, FPSS, TLP, Spar) and FSO
 - viii. PSV
 - ix. Construction vessels
 - x. Wind Turbine construction vessels
- b. Historic deliveries by vessel type above and forecast to 2025 of future deliveries required including analysis of:
 - i. Evolution of vessel requirements / specifications
 - ii. Retirement of old tonnage and impact on shipbuilding markets
 - iii. Upside and downside factors
- c. Use across cycle of oil & gas and offshore wind, i.e. exploration, development, operation, decommissioning
- d. Upside and downside factors impacting on vessel markets:
 - i. Life extension of old assets
 - ii. Operator use of old or lower spec assets

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Executive Summary & Conclusions

Executive Summary & Conclusions

Macro-Economic Outlook

- Underlying macro fundamentals are supportive of continued growth in demand for oil & gas.
 - The positive macro outlook gives a favourable indication towards the requirement for additional offshore infrastructure. However, this should also be supported by supply and demand dynamics of each individual infrastructure market.
- Over the next decade, total oil & gas demand is expected to grow by 34%. This increase is expected to show a larger growth compared to the past decade, largely driven by the increase in requirements from emerging countries, such as China.
 - Growing energy demand will drive investment in offshore oil & gas projects. Increased activity in turn drives an increase in demand for offshore assets to support these drilling and production activities. However, the requirement for additional assets is supported by required supply and demand dynamics of each market.
 - Vessel demand is fundamentally driven by medium to long-term oil & gas prices which will in turn drive the sanctioning of offshore projects.
 - Till 2020, it is expected that oil prices will continue to hover around the \$90-110/bbl which is favourable for additional exploration activities to be sanctioned.
 - The increase in upstream capital cost over the past years have deterred operations from increasing their total offshore expenditure. Despite oil price being at a high, profit margins have decreased dramatically due to this increase.
 - The reduction in spending, increase in cost inflation and supply chain constraints may challenge the viability of offshore projects.

See Pages 8-17 for full details

Market Outlook

- Solid growth forecast for both the OSV and MODU market is expected over the next decade, supported by increasing offshore drilling activities.
- An increase of 3.3% CAGR for OSVs and 4.8% CAGR for MODUs are expected till 2025. This growth is largely attributed to the increase in activity in Latin America, Africa and Asia.

OSVs

- The OSV market will likely see prominent growth over the next 10 years largely within the AHTS (45% increase in vessel days) and PSV (50%) segments. Regions leading this growth are Asia, Africa and Latin America.
- DW expects additional requirements of 25% (AHTS), 12% (PSV) and 25% (Crewboats / ERRV) of current fleet.
- Currently total operational supply is 2,779 AHTS, 1,819 PSV and 1,159 Crewboats / ERRV.
- OSV deliveries are highly cyclical in nature and are correlated to oil prices which influences the increase in offshore activity.

MODU

- Given the increasing trend towards deepwater drilling, there will be substantial growth within the semi-sub and drillship markets over the next decade, outpacing the increase in jack-up requirements.
- Currently there are a total of 508 jack-ups, 221 semisubs and 97 drillships estimated globally. DW expects 27% additional jack-ups and 50% additional semisubs or drillship fleet required over the forecast period.
- Drilling activities are more reactive to short-term oil price shocks as compared to the activities in the production phase. Hence, the drilling and drilling support markets are more susceptible to the change in oil price.

See Pages 34-41 for full details

Market Outlook (Cont.)

- DW expects growth in the FPU market given the increase in offshore production activity.
- Besides subsea and SURF vessels, the requirement for construction vessels will be driven by the replacement market.
- Wind construction vessels is expected to grow rapidly with continued government subsidies.

FPUs

- The FPU market will see large growth over the next decade driven by FPSO (60%) and FPSS (34%).
- DW expects additional requirements of 40% (FPSO), 23% (FPSS), 24% (SPAR), 36% (TLP) and 25% (FSO) of current fleet.
- Currently, total operational supply is 163 (FPSO), 39 (FPSS), 20 (SPAR), 24 (TLP), 82 (FSO).
- The increase in offshore and deeper water developments will drive the increase in demand for FPUs particularly in Latin America and Africa.

Construction Vessels

- Over the next decade, DW expects the increase in demand for construction vessels to be led by subsea (176%) and SURF vessels (62%) due to an increase in subsea infrastructure installations. Despite this, additional requirements are a mere 10% of current fleet, due to the recent build cycle.
- Offshore construction vessel demand is expected to decrease by 14% and barges a mere 35%. Despite this decrease, the replacement market will drive requirements for these asset types.
- Despite the large increase in demand for wind construction vessels (100%) over the next 10 years, the sanctioning of projects going forward is a function of support from local government (e.g. subsidies). Demand will be led largely by UK and China.

See Pages 42-53 for full details

Executive Summary & Conclusions

	Current Fleet Size	2014 – 2025 CAGR	Vessels Required	Regional Market Share	Key Barriers to Entry
Crewboats/ERRV	1,159	1.9%	160-350		<ul style="list-style-type: none"> Crewboats are considered less technically complex and tend to compete on a price basis. Proximity of yards is a key criteria due to relatively high mobilisation cost as a proportion of newbuild price.
AHTS	2,779	3.4%	465-670		<ul style="list-style-type: none"> Larger AHTS tend to require yards with a higher level of technical capability. However, Chinese yards have increasingly taken up market share for this vessel type. AHTS tend to compete on a price basis particularly for smaller <8000 horsepower vessels.
PSV	1,819	3.7%	170-350		<ul style="list-style-type: none"> Similar to AHTS, larger PSVs tend to require yards with a higher level of technical capability. However, Chinese yards have increasingly taken up market share for this vessel type. PSVs tend to compete on a price basis particularly for smaller <2000 DWT vessels.
Jackup	508	3.4%	40-140		<ul style="list-style-type: none"> The majority of global jackups are constructed in Singaporean yards with Chinese increasingly taking up more orders in recent years. While track record (timely delivery) and a yard's technical know-how acts as a key differentiator, contractors have been seen to be willing to contract with yards with less track record for a lower cost. These yards tend to be supervised/supported by major design houses.
Semi-Submersible	221	5.1%	50-80		<ul style="list-style-type: none"> Drilling contractors tend to contract yards with ample track record for newbuild rigs. Timely delivery is a key decision factor for contractors. However, favourable financing terms and lower cost offered by Chinese yards have seen their market share increase over the most recent build cycle. Rig designs are heavily affected by regulatory and market changes.
Drillship	97	4.5%			<ul style="list-style-type: none"> Drillships are considered the most technically challenging rig type. Currently, the market is dominated by the big three Korean yards with Singaporean yards actively moving into the market (such as Keppel's speculative "Can Do" Drillships). Similar to semisubs, rig designs are heavily affected by regulatory and market changes.

Legend ■ Asia ■ Western Europe ■ North America ■ Other Regions

Executive Summary & Conclusions

	Current Fleet Size	2014 – 2025 CAGR	Vessels Required	Regional Market Share	Key Barriers to Entry
Subsea Vessels	380	7.7%	36-42		<ul style="list-style-type: none"> Subsea vessels have seen a shift towards Asian yards. However, a higher proportion of Western Contractors tend to prefer Western yards while Middle Eastern and Asian contractors have been seen to award newbuild programs to yards that are comparatively newer in the market. One key push factor from low end yards lies in the lack of IP regulations, resulting in yards distributing designs made by contractors.
SURF Vessels	148	10.0%	30-36		<ul style="list-style-type: none"> SURF contractors are generally more consolidated as compared to other markets and may have preferred design houses and yards. Similar to subsea vessels, there has been a shift towards Asian yards.
Offshore Construction	110	-1.5%	15-26		<ul style="list-style-type: none"> Offshore construction vessels range from high-end heavy-lift vessels to low-end construction barges. Lower-end barges tend to compete on a price basis while higher-end vessels such as Heerema's Aegir are typically contracted to top tier shipyards.
Accommodation Barges	98	3.2%	19-24		<ul style="list-style-type: none"> Accommodation barges range from high-end DP barges used to support deepwater construction and lower end non-DP barges. Similar to offshore construction vessels, lower-end barges tend to compete on a price basis while higher-end vessels tend to be contracted to top-tier yards.
WTIV	33	15.8%	40-42		<ul style="list-style-type: none"> WTIVs is a relatively new market. As vessels are considered less technically complicated, a large proportion of newbuilds have been taken up by large Chinese yards (approximately 55% of builds in the past 10 years)
FPU	328	3.3%	~185		<ul style="list-style-type: none"> Key drivers of competitiveness for FPU include the yard's EPC capabilities. Typically, turnkey projects are awarded to yards which in turn outsource various hull and topsides contracts. Engineering capability is also a key success factor. Top tier yards in this market tend to have strong internal engineering capabilities.

Legend ■ Asia ■ Western Europe ■ North America ■ Other Regions








Macro-Economic Review

A review of long-term macro-economic factors impacting the offshore marine industry

Summary of Key Macro-Economic Factors



The most significant macro-economic factor impacting the offshore vessel market is cost inflation, followed by increased penetration of onshore shale in the global energy supply mix.

Macro-Factor	DW Forecast	Potential Threat & Risk	Risk Level
 Energy Demand	<ul style="list-style-type: none"> DW expects global demand to grow by 34% between 2014-2030. Gas demand is expected to outpace oil. 	<ul style="list-style-type: none"> Slowing of Asian demand growth will lower global demand growth. 	Major potential impact but limited perceived real risk.
 Oil Price	<ul style="list-style-type: none"> Prices are projected to continue to hover around the \$90-\$110/bbl mark. 	<ul style="list-style-type: none"> Sustained low price environment below \$90-110/bbl. 	Some potential impact but limited perceived real risk.
 Gas Price	<ul style="list-style-type: none"> Gas prices are expected to converge with Japan LNG, European gas prices expected to decrease while US gas prices are expected to increase. 	<ul style="list-style-type: none"> Further weakening in prices in Asia and Europe. 	Some potential impact and some perceived real risk.
 Oil Supply	<ul style="list-style-type: none"> DW projects proportion of subsea production to increase from 8% to 10% between 2014-2020. Iranian offshore crude is not expected to affect the market over the forecast period. 	<ul style="list-style-type: none"> Return of "off market" crude. Impact of increased unconventional supply. 	Some potential impact but limited perceived real risk.
 Gas Supply	<ul style="list-style-type: none"> DW projects proportion of subsea production to increase from 3% to 4% between 2014-2020. Shale production is expected to account for 12% of gas supply by 2020. 	<ul style="list-style-type: none"> Impact of increased unconventional supply (US exports). 	Major potential impact and notable perceived real risk.
 Capex Compression	<ul style="list-style-type: none"> Upstream capital costs have increased 230% since 2000 and are expected to continue increasing. Cash return on investment at 1998 levels despite higher oil price. 	<ul style="list-style-type: none"> Cost Inflation & Supply Chain constraints. 	Massive potential impact and significant perceived real risk.
 Renewables	<ul style="list-style-type: none"> DW expects robust growth with annual added capacity increasing from 2.0 GW in 2014 to 12.1 GW in 2020 	<ul style="list-style-type: none"> Decreasing government subsidies may impact project sanctioning. 	Some potential impact but limited perceived real risk.

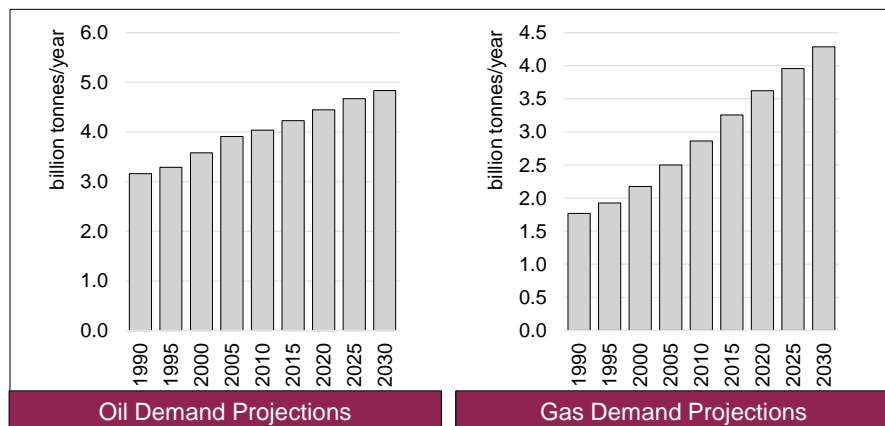
Energy Demand



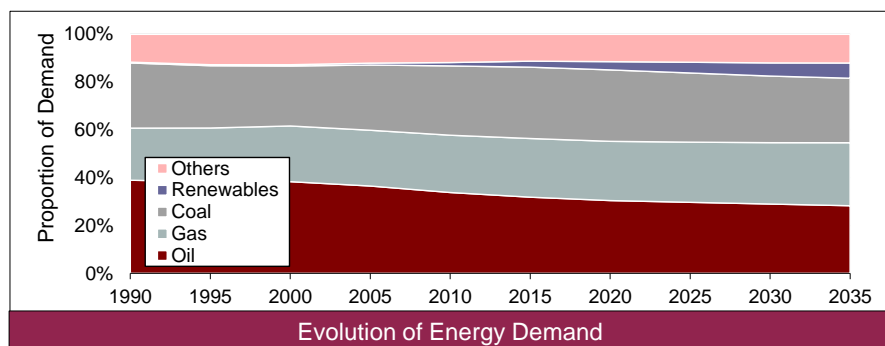
Energy demand is a major indicator of energy-related spend – this is a macro factor which will affect the requirements for vessels / rigs within the exploration and production phase.



- Energy demand is the principle indicator of energy-related spend including offshore installations, which in turn drive demand for offshore vessels.
 - Rapid demand growth since 1990 has been a major driver of a higher oil & gas price environment during this time, which has subsequently led to the viability of complex subsea/deepwater projects.
 - Sustained demand growth is therefore a significant factor in ensuring a favorable commercial environment for O&G related offshore projects.



- Oil & gas is used in a wide variety of essential services such as power generation, transportation fuels, and consumer products. Driven by an increasing population and purchasing power of individuals in developing economies, total global energy (oil & gas) consumption is expected to increase by 34% from now to 2030.
- Oil demand will increase by 14% with 70% of incremental requirements coming from Asia (mostly China) due to the region's robust economic growth.
- Demand for natural gas will be a major feature of the evolution of the global energy mix. Gas demand growth is expected to outpace oil and is projected to increase by 31% between now and 2030, taking up 26% of demand in 2035 as compared to 22% in 1990.
- Demand for other energy types such as coal is expected to decrease slightly from 30% in 2014 to 27% in 2035. Renewables on the other hand will see an increase from 3% in 2014 to 6% by 2035.



Potential Threat & Risk

- Slowing of Asian demand, particularly a lower growth in the Chinese economy, may lower global demand growth.
- A decreasing demand will potentially impact supply and subsequently oil & gas prices. This will in turn lead to a decrease in viable projects in the offshore sector, lowering demand for all types of offshore vessels.
- While the impact of lower demand will have adverse effect on the entire offshore industry, DW expects limited risk fall from such a scenario.

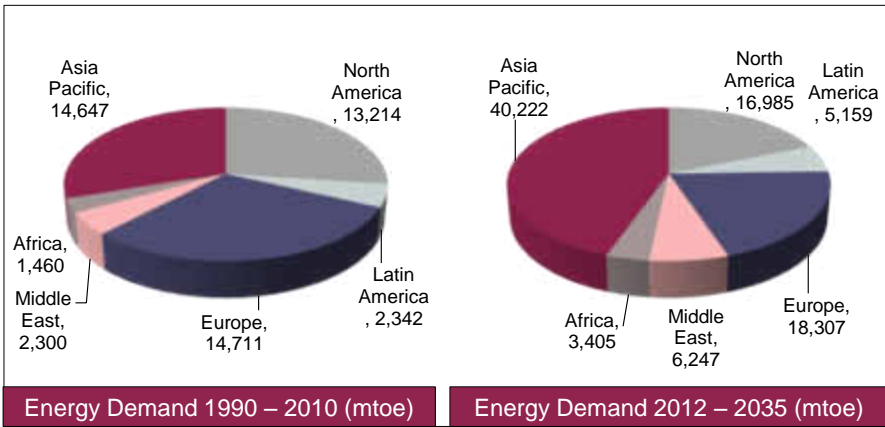
Source: BP Statistical Review & Douglas-Westwood

Energy Demand cont.

 Energy demand is a major indicator of energy-related spend – this is a macro factor which will affect the requirements for vessels / rigs within the exploration and production phase.



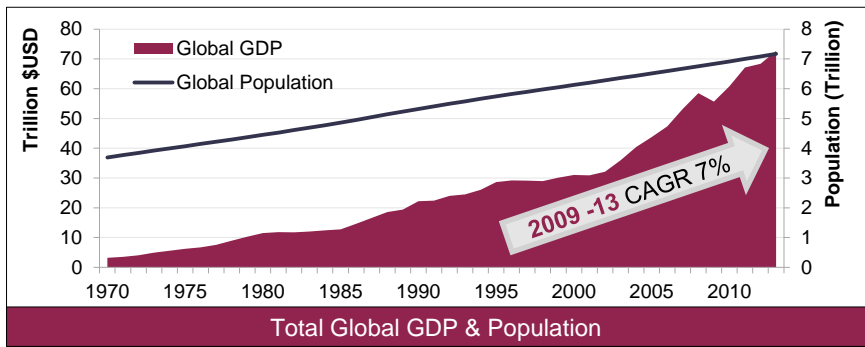
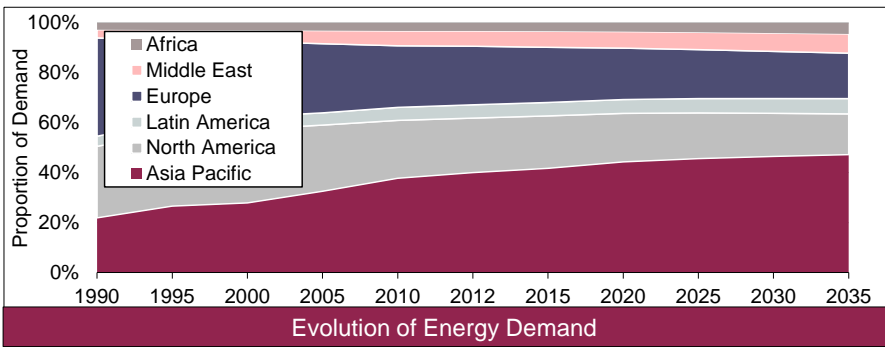
- Both global population and GDP have shown an upward trend in the past and will continue with the increase in globalization.
 - The increase in global energy consumption will be led largely by China given the country’s industrial sector. Asia is expected to become the largest energy consumer.
 - Europe will see a decrease in energy demand compared to the past decade as the intensity of industrialisation is not as it was before.



• Over the past decade, both global population and GDP, the two biggest indicators for the increase in energy demand, have shown substantial growth. This is expected to continue over the next decade with the increase in globalization.

• Going forward, global energy demand will predominantly be driven by Asia, with China likely becoming the largest energy consumer globally as its growing industrial sector continues to account for the largest share of delivered energy consumption.


Asia’s total energy demand will increase at the expense of Europe. Asia’s growing energy demand will continue to drive investments in offshore oil & gas projects, which will in turn increase demand for offshore assets.



Source: BP Statistical Review & Douglas-Westwood

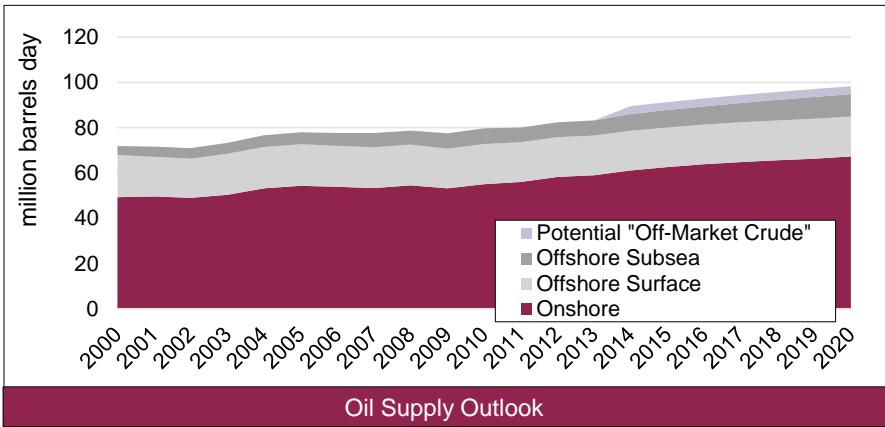
Source: United Nations

Oil Supply

 Despite the potential short-term volatility that could be caused by a sudden influx of crude, we believe the actual risk of this on offshore vessel demand to be negligible.

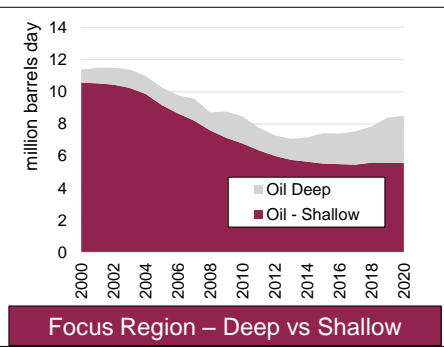
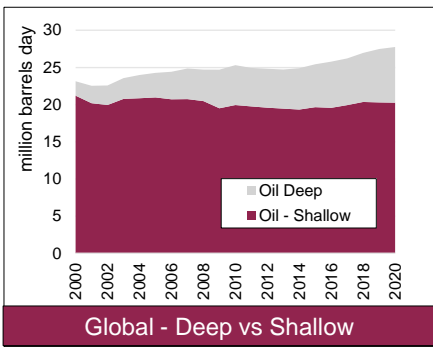


- The projected mix of oil supply is a major driver for offshore-related infrastructure.
- The oil industry is mature and generally considered to be struggling to keep up with demand and offset natural decline. As such most new capacity is expected to be absorbed with few predicting a supply glut over the next ten years.
- However, a sudden influx of new capacity, such as the return of Iranian crude via reduced sanctions could create some short-term volatility.



- Offshore subsea production currently accounts for 8% of global supply. This share is forecast to increase to 10% by 2020 albeit at the expense of offshore surface production.
- On a deep vs shallow basis, DW expects shallow water production to continue to account for the majority of oil supply. Deepwater production is however projected to grow at a higher rate. This is particularly so for West Africa and Latin America.

It is estimated that around 3.5 million bpd of crude is currently off the market due to either conflict or geopolitics. This supply is expected to return for conflict hit producers such as Libya and Syria but the potential for Iranian crude is less certain. Iran accounts for an estimated third of off-market crude.



Potential Threat & Risk

- While the return of potential "off market" crude depends on geopolitics and is difficult to predict or forecast, the impact on such a scenario is expected to affect a relatively small number of offshore projects – potentially projects with higher Capex requiring higher breakeven prices.
- Hence, while such risks are likely, DW does not expect the offshore vessel market to be adversely impacted over the long-term.

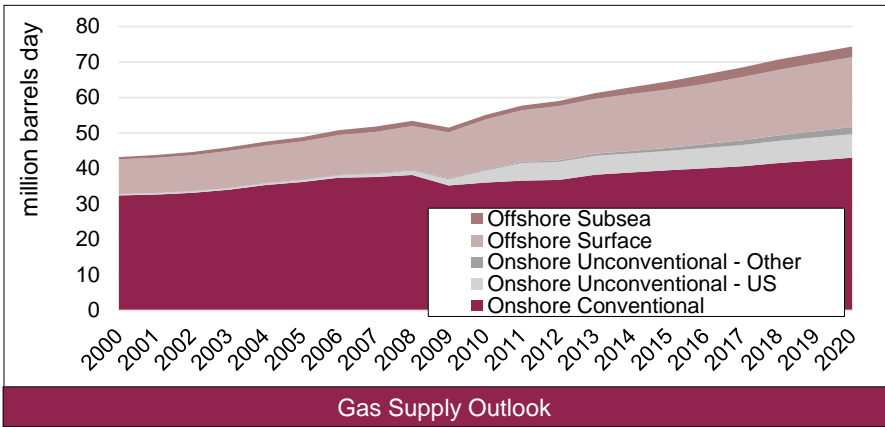
Source: FGE & Douglas-Westwood

Gas Supply

 The potential influx of “cheap” US shale gas is likely to pose a more significant risk to offshore gas projects, potentially decreasing demand for offshore vessels involved in these gas developments.

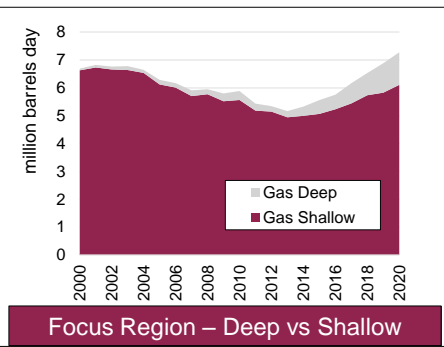
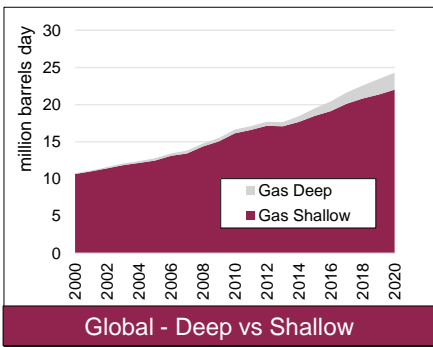


- Similar to oil, the make-up of global gas supply is a major driver for offshore infrastructure and investment.
- However, the global gas industry is less mature and as such significant new capacity additions are expected over the next ten years which could even outstrip demand growth and create supply gluts (similar to the oil industry in the 1980s).
- The most significant threat to our reference case is the increased supply of onshore unconventional gas which could supplant more costly subsea/deepwater developments and limit the market potential for SURF infrastructure.



- Subsea production currently accounts for 3% of global supply with this figure rising to 4% by 2020.
- On a deep vs shallow basis, DW expects shallow water gas projects to account for the majority of offshore production.
- Shale production is expected to grow rapidly in our forecast, growing from 1% in 2000 to 12% by 2020. The majority of additional supply will come from the US.

US shale production is currently impeded by the lack of local LNG export infrastructure which has caused Henry Hub prices to hover around ten-year lows. Acceleration of sanctioning of these facilities could see increased shale gas production from the US – potentially at the expense of the subsea/deepwater market.




Potential Threat & Risk

- An influx of gas from the US will affect regional gas prices, particularly in Asia and Europe. Projects requiring higher gas prices to be economically viable (subsea tiebacks and deepwater developments) will therefore be impacted.
- Export countries are more likely to be affected compared to countries producing for domestic use due to NOC requirements.
- DW expects gas supply to be affected by US exports, particularly over the long-term.

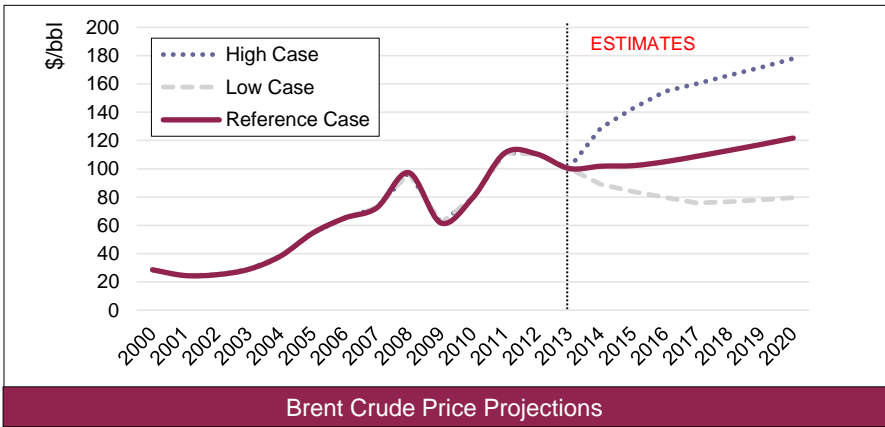
Source: Douglas-Westwood

Oil Prices

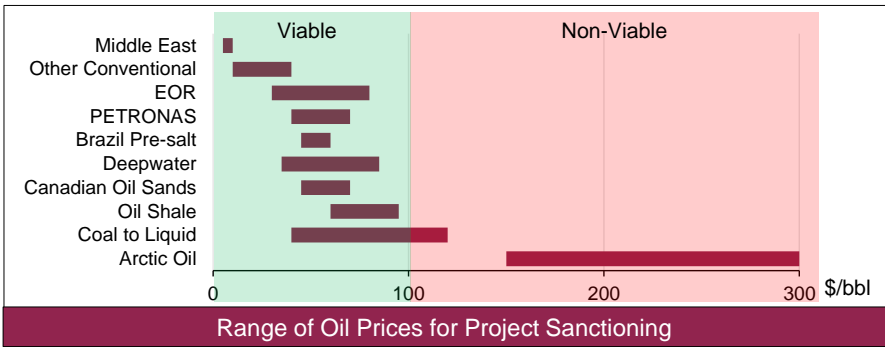
 Oil prices are an influential driver of offshore vessel demand. However, considering analyst projections, we expect the actual risk of this factor to be minimal.



- Oil prices are a key indicator of industry profitability and therefore the willingness of oil companies to invest in new infrastructure and their tolerance for more complex, capital-intensive projects.
- Recent high oil prices have been a major enabler for subsea and deepwater developments over the past ten years.
- Oil companies will typically benchmark their project portfolio against anticipated oil price projections to assist in their final investment decision, therefore confidence that oil prices will stay stable and high is vital for new project sanctioning.



- Since a peak of oil price in 2011 at \$111/bbl, prices have been sustaining at the \$90-\$100/bbl level. Between now and 2020, the industry wide expectation is that prices will continue to hover around the \$90-\$110/bbl mark with leading analysts such as the EIA citing \$80/bbl as a price floor.
- **Project Viability:** The breakeven oil price considers the costs involved in producing a barrel of oil over the life of the development, including exploration, drilling, construction of infrastructure and lifting costs.
- Factors that can influence the breakeven oil price include the availability of government subsidies, geological factors, and availability of existing infrastructure.
- The breakeven price for most developments range from \$10/bbl to \$90/bbl with offshore deepwater developments being at the top end of the range. Thus, at the forecasted price level, most types of oil developments driving demand for offshore vessels (with the exception of the Arctic) are considered economically viable.



- ### Potential Threat & Risk
- Sustained periods of low oil price below \$90-100/bbl will affect offshore development plans. In general, larger offshore developments with a longer time horizon tend to have a lower breakeven price, while short-term and marginal field developments tend to require a higher oil price to be economically viable.
 - Drilling and field development phases also tend to be more affected by oil price movements as compared to production relation activities.
 - DW expect limited risk from a low oil price environment due to strong demand fundamentals.

Source: EIA & Douglas-Westwood

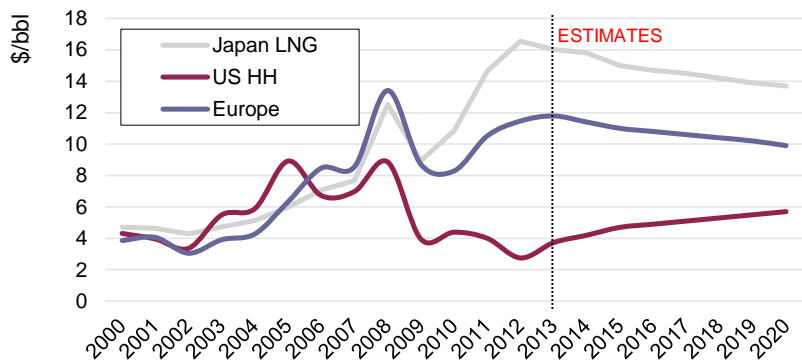
Gas Prices



We believe that gas prices alone will have little impact on offshore vessel demand as Asian NOCs continue to invest in subsea gas projects. Despite some short-term concern, we do not expect US shale exports to hold a major price advantage over European gas after the cost of liquefaction and shipping is factored in.

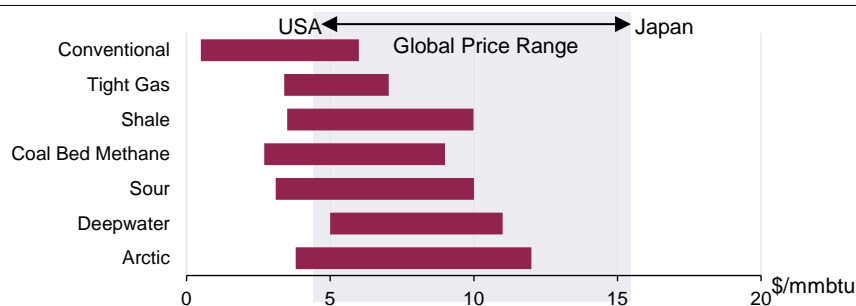


- The recent focus on natural gas as an energy source has seen greater emphasis on prices to determine the viability of subsea developments.
- Gas prices are substantially more regionalised compared to oil and massive recent US shale gas production has seen major variance with HH trading at a 75% discount compared to Japan-bound LNG.
- Asia's high price tolerance has been a major enabler for highly Capex-intensive Australian export projects in recent years, however the potential to ship cheap US gas via LNG could create substantial arbitrage and threaten higher cost export projects.



Brent Crude Price Projections

- Since 2006 and the start of the US shale boom, regional gas prices have diverged significantly. Henry Hub has decoupled from oil prices and is trading at ten-year lows.
- The potential to ship US gas to other consumer markets is expected to harmonise regional pricing, albeit this is expected to be a drawn out process.
- The net result is that gas is expected to become cheaper for importers in Asia and Europe as trade routes are established, with pricing for producers in these regions expected to weaken causing concerns over future project viability.
- Offshore and onshore projects require an additional \$0.30/mmbtu to \$1.2/mmbtu to be considered viable while LNG projects will require an additional transport cost of \$3.1/mmbtu to \$4.7/mmbtu due to liquefaction, transportation, and regasification requirements.



Range of Gas Prices for Project Sanctioning

Potential Threat & Risk

- Weakening prices in Asia and Europe may affect offshore gas projects, particularly projects characterised with high Capex such as Australian export projects.
- DW expects some risk from lower gas prices. While this is largely mitigated by NOCs due to a requirement to meet domestic gas demand, a lower gas price will potentially affect developments in export countries.

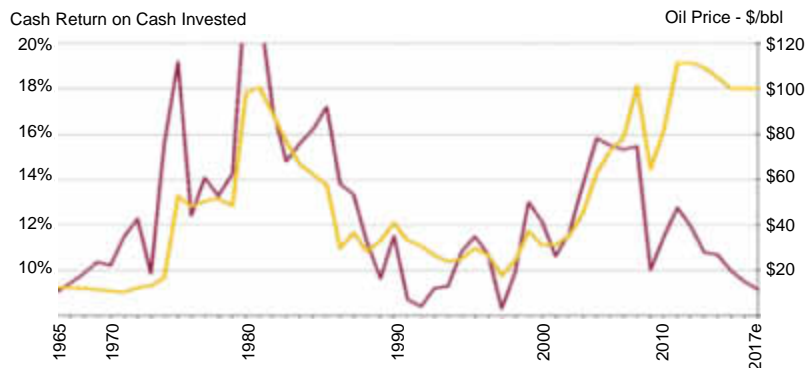
Capex Compression (Cost Escalation)



Capex compression driven by escalating industry costs is viewed as the biggest risk facing the offshore industry and related offshore vessel demand.



- A reduction in E&P spend by oil companies (or Capex compression) is a major threat to projected levels of offshore vessel demand.
- Since 2000 industry costs have increased dramatically which has impacted project profitability despite an all time high oil price environment.
- Rising costs have been blamed on supply chain constraints, increased project complexity and a lack of standardisation.
- Falling profitability is causing E&P companies to defer and even cancel more expensive subsea/deepwater projects which will undoubtedly have a knock-on effect for offshore vessel demand.



Cash Return on Cash Invested for Major Oil versus Real Oil Price

- Cost escalation has had a major impact on sector profitability. Goldman-Sachs recently announced that despite an all time high oil price environment, cash returns on cash invested (CROCI) for oil majors is at 1998 levels when oil prices were at \$20-\$30/bbl.
- Upstream capital costs are now approximately 230% higher when compared to 2000. DW expect average upstream capital costs to continue to increase over the forecast period.
- Key issues driving increased upstream cost over the past decade include equipment/material shortages, rapid declining production in mature fields, increasing complexity in green field developments (deepwater, pre-salt, sour gas) and wage inflation.
- Cost overruns have become a well-documented problem in Australia (US\$21bn for Gorgon), causing delays or restructuring of projects. Rising labour costs, a strong Australian dollar and changes in project scope are the principal factors behind this.




Upstream Capital Index*

Source: IHS & Douglas-Westwood

Potential Threat & Risk

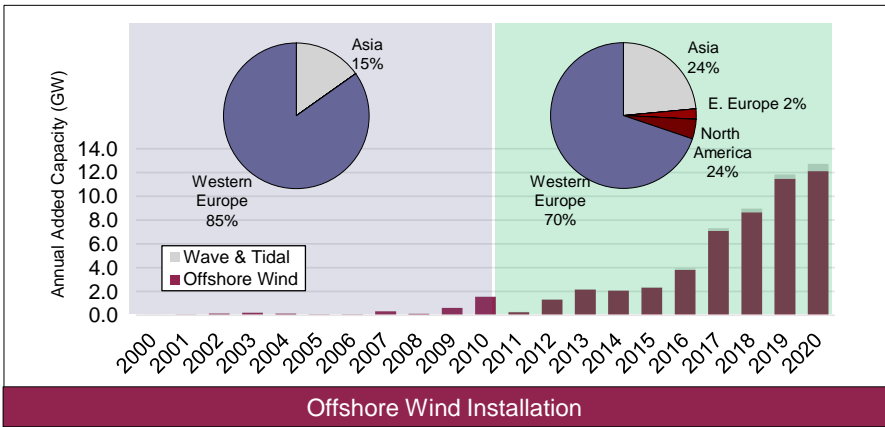
- Cost escalation has been one of the key reasons for high project deferrals by Chevron, Statoil and Shell in recent years.
- Project deferral or cancellation due to Capex compression represents a significant impact on offshore vessels. In addition, operators have also reevaluated offshore projects, opting for cheaper developments - Browse project in Australia represents such a scenario, with the operator opting for FLNG in place of a more expensive subsea tieback solution, reducing demand for offshore vessels due to lower levels of subsea installation work.

Renewables

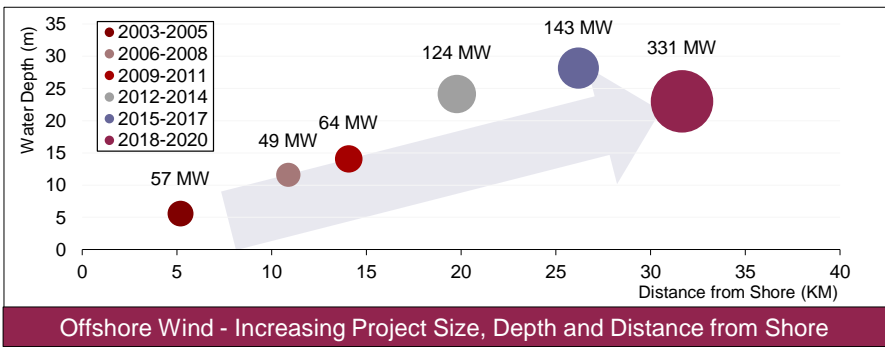
 The offshore wind market is expected to see robust growth driven by ambitious long-term investments. Given high capital cost, the market is highly reliant on government subsidies.



- Offshore Wind accounts for the largest proportion of offshore renewable energy supply and is driven by both political and economic factors.
- Political drivers include globally agreed regulations, such as the Kyoto protocol, and various regional and national measures are being undertaken in order to directly cut or cap greenhouse gas emissions.
- Economic drivers include increasing global energy needs and concerns regarding over-reliance on energy imports.



- The majority of the offshore renewables market is accounted for by wind with wave & tidal accounting for 3.5% of forecast annual added capacity. Over the 2014-2020 period we expect robust growth with annual added capacity increasing from 2.0 GW to 12.1 GW for offshore wind and 19 MW to 615 MW for wave & tidal.
- On a regional basis, Western Europe and Asia (mostly China) is expected to account for the largest share of new capacity additions at 94% over the 2010-2020 period.
- In addition to an increasing number of developments, the offshore wind market is also growing in terms of project size. Technological breakthroughs have seen turbines with increasing MW being installed from 3.5 MW to 5+ MW.
- These new projects are also found further from shore in increasing water depths, requiring new installation vessels capable of operating in this environment.



Potential Threat & Risk

- The offshore renewables market is highly reliant on government subsidies due to the high capital cost involved. Therefore, a change in policy or a reduction in subsidies can adversely impact anticipated levels of activity in the industry.

Regulations: International



A set of international regulations govern the maritime industry, impacting standards with regard to ship design, equipment, safety and maritime pollution amongst others. While some regulations are mandatory, there are guidelines such as the SPS code and OSV code which are non-mandatory.

- IMO (International Maritime Organisation) is a specialised agency accountable for the prevention of marine pollution by ships as well as the safety and security of shipping. IMO is responsible for setting global standards by creating a set of guidelines, both mandatory and non-mandatory, to ensure objectives are met and universally adopted.
- IMO covers all facets of international shipping, ranging from ship design, construction, equipment, manning, operation and disposal.

OSV Code

- OSV code represents a code of safe practice guidelines for the carriage of cargo and persons by OSVs so as to ensure safe operations and management when interfacing with offshore installations.
- This OSV code is non-mandatory but covers aspects including port operations, sea transport and operations at offshore installations.

SOLAS

- SOLAS is short for International Convention for the Safety of Life at Sea and applies to all passenger ships and cargo ships embarking on international voyages. Although SOLAS does not directly refer to OSVs, an OSV carrying more than 12 passengers would fall under SOLAS.
- SOLAS allows for a wide range of exemptions and equivalents by Administrations (flag states). Administrations may permit any other fitting, material or other provision to be made in that ship, if it is satisfied that they are at least as effective as required by regulations.
- Made mandatory the International Code on Intact Stability 2008 (2008 IS Code), influencing ship design.
- SOLAS specifies requirements on fire protection, detection extinction, life saving appliances and arrangements, radio-communications, safety of navigation, carriage of cargo and dangerous goods, nuclear ships amongst others.

SPS Code

- The SPS Code is a code of safety for special purpose ships (SPS) which acknowledges that by virtue of the specialised work undertaken by these ships, special personnel are carried, who are neither crew nor passengers. (Special personnel may include scientists, trainees, fishermen, salvage, pipe-laying, cable-laying, seismic diving, crane operators).
- An SPS is defined as a self-propelled ship which by reason of its function, carries more than 12 special personnel. The SPS Code applies to SPS of not less than 500GT certified on or after 13 May 2008. However, administrations may choose to employ SPS Code for SPS less than 500GT or those constructed before 13 May 2008.
- The SPS Code covers the following aspects including stability, machinery installations, electrical installations, periodically unattended machinery spaces, fire protection, dangerous goods, life saving appliances, radio communications, safety of navigation and security.
- As with the IS Code in the SOLAS regulation, the SPS Code dictates criteria on metacentric height, righting level, weather criterion, effect of free surfaces and icing and watertight integrity.
- The SPS Code is non-mandatory.

MLC

- MLC (Maritime Labour Convention) encompasses all labour standards and covers five titles (minimum requirements for seafarers to work on ship, conditions of employment, accommodation, recreational facilities, food and catering, health protection and compliance & enforcement).

MARPOL

- MARPOL, short for the International Convention for the Prevention of Pollution from Ships, are a set of requirements with the objective of regulating control of emissions from ships.
- Regulation 13 sets limits for NO_x and Regulation 14 sets limits for SO_x. Regulation limits differ depending on whether the area is considered an emission control area (ECA).
- Regulation 13 ECAs apply to North American area (off Pacific coast, Atlantic coast, Hawaii), US Caribbean sea area and any other sea area that may be designated by IMO.
 - Limits vary and are based on a tiering system which groups ships based on their construction years, taking into account operations in ECAs.
- Regulation 14 ECAs apply to Baltic Sea, North Sea, North American area (off Pacific coast, Atlantic coast, Hawaii), US Caribbean sea area and any other sea area designated by IMO.
- Regulation 14 has set the following targets for 1 January 2020.
 - International: 0.5% m/m SO_x limit internationally.
 - ECAs: 0.1% m/m on or after 1 January 2020.
- In order to adhere to limits under MARPOL, vessel designs must follow increasingly stringent engine emissions regulations. In addition to complying with MARPOL regulations, there is an increasing trend towards Clean class notations.

* Source: IMO website and presentations

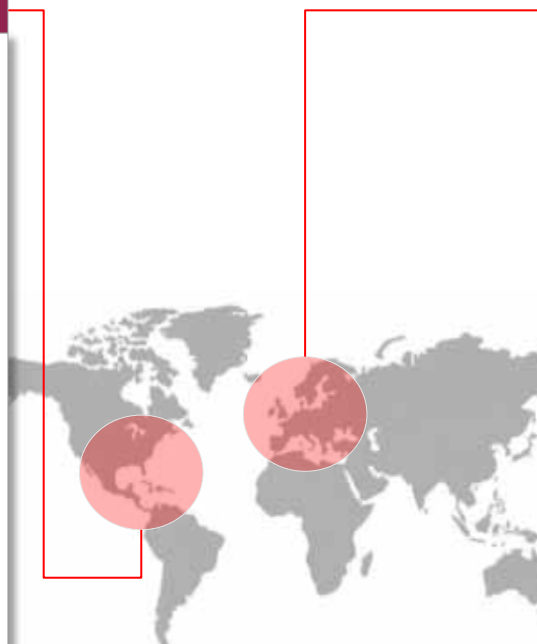
Regulations: International cont.



The two key regions where decommissioning activities are largely present are North America and the North Sea. Both these regions have their own distinctive requirements for decommissioning with one common goal to eliminate hazards and overcrowding of non-operating pipelines and platforms.

North America

- The Idle Iron policy introduced by the Bureau of Safety and Environmental Enforcement (BSEE) has been introduced to keep inactive facilities and structures from littering the Gulf of Mexico by requiring companies to dismantle and responsibly dispose of infrastructure after they plug non-producing wells. BSEE enforces these lease agreements primarily for two reasons:
 - Environmental effects – toppled structures pose a potential environmental hazard due to the topsides and the associated equipment, electronics, wiring, piping, tanks, etc., that are left on the bottom of the Gulf of Mexico. These items pose a financial, safety and environmental burden, and must be removed.
 - Safety – severe weather such as hurricanes have toppled, severely damaged or destroyed the structures associated with oil & gas production. While any structure could be destroyed during a hurricane, idle facilities pose the unnecessary risk of leaks from wells into the environment and potential damage to the ecosystem, passing ships and commercial fishermen.
- Retired petroleum platforms are required to be removed from the marine environment and taken to shore for disposal within one year of the termination of the oil & gas lease. An alternative to onshore disposal is the conversion of retired platforms to permitted and permanently submerged platform artificial reefs, commonly referred to as Rigs to Reefs.



North Sea

- Based on the Convention for the Protection of the Marine Environment of the North-East Atlantic, a regime came into effect in February 1999 which stipulated a ban on the disposal of offshore installations at sea as well as requiring topsides of all installations to be moved back to shore.
- This is in addition to the requirement for all subsea structures weighing less than 10,000 tonnes to be completely removed.
- Due to the difficulty of removing larger subsea structures, those built before February 2009 can be exempted. These are considered on a case by case basis as there is still the presumption that they will be completely removed.
- In the case where this is not deemed possible due to damage or deterioration, the following alternative scenarios are generally considered:
 - Concrete-based structures left in situ with vertical structures above water level with illumination. Footings of heavy steel jackets left on the seabed.
 - Vertical structures are removed to at least 55m below sea level of the lowest astronomical tide as this may be a hazard to shipping vessels.
 - A 500m zone around any abandoned platform and areas 100m either side of a pipeline should be debris free.
 - Any installations which are not entirely removed should be indicated on nautical charts in terms of its position, depth and dimensions.

Regulations & Incentives: Key Regions



Regulations vary regionally with Africa having significant local content requirements enforced mainly for the construction of FPS. North Sea and North America follow a set of international regulations with the US requiring higher levels of country-specific regulations.

North Sea

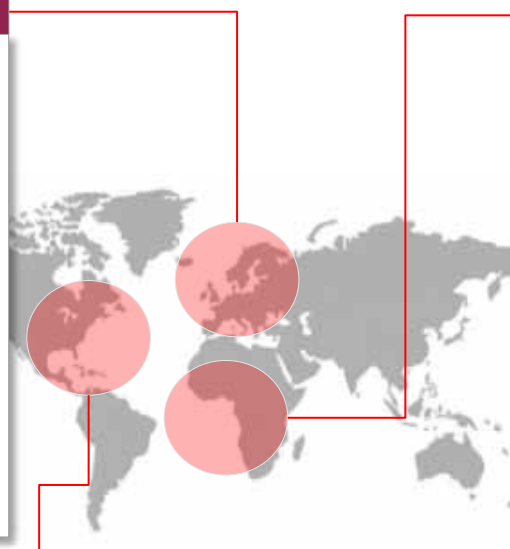
- The North Sea is viewed as a pioneer in technology and industry standards.
- To-date, the North Sea is not governed by a set of local content requirements, although there has been an added emphasis on environmental and safety issues.
- Following the US Macondo incident in 2008, the North Sea has been proactive in reassessing existing regimes in the North Sea, undertaking further research into creating a robust framework of legislation and standards so as to ensure the highest safety standards in place.
- The North Sea places an emphasis on environmental protection and is governed by the MARPOL ECA act which limits SO_x emissions.
- A new incentive scheme has been introduced by the UK government that will allow companies a £200m tax relief for every £1bn spent on HPHT field developments. In Norway, an upstream company can be refunded its tax value of exploration expenses for each tax year loss, including direct and indirect expenses related to exploration activities.

North America

- There are currently no explicit local content requirements in the region for offshore vessel construction, however, a variety of regulations govern offshore vessels that can be operated within the US, including US Coast Guard (USCG) for vessel components, Mineral Management Service (MMS) for production-related systems and the Jones Act for the flagging of vessels which are operating in the country. These are being classified under three groups by the US Coast Guard Regulatory:
- Floating Offshore Installations: These include offshore production units such as SPARs, TLPS and FPSS and does not include FPSOs. In addition to the international class requirements, regulatory inputs for these offshore units include Safety, Operations and Citizenships which will mainly affect operations.
- MODU: These include units such as jackup, semisubmersible and drillship. Regulations overseeing these vessels include the USCG, IMO MODU Code and various class societies. US-specific regulations tend to have a larger focus on the operation, maintenance and flagging of these units rather than design and construction. It may be important to note that after the Macondo Incident, stringent requirements were placed pertaining to subsea components such as BOP requirements etc.
- Specialty Vessels: This category includes FPSOs. Regulatory requirements include class certifications, international requirements (SOLAS, MARPOL etc.), and country-specific USCG and MMS requirements. US-specific regulations have a focus on operations and environmental requirements such as disposal of hazardous material etc.
- Exploration incentives are given in the form of tax deductions where intangible drilling and completion costs for assets located in the US are immediately deductible for income tax for independent producers and 70% for integrated producers.

Africa

- The shipbuilding industry in Africa is currently going through major changes as the region struggles to meet local demand (mainly in the oil & gas industry)
- South Africa recently announced it is to mandate local content in the country's shipbuilding industry under the revised Preferential Procurement Policy Framework Act (PPPFA) regulations. While the details of the regulations are underway, DW expects this trend to be picked up by the region's major oil & gas countries.
- Current local content requirements have a focus on production platforms. Countries with such requirements include Nigeria which requires fabrication/integration of production units up to 10,000 tonnes to be done domestically, piles/decks anchors buoys are required to be fabricated domestically and 50% of FPSO topside is required to be fabricated domestically. In the scenario of inadequate Nigerian capacity, exemptions may be authorised with 1% to be paid to the Nigerian Content Development Fund. A project-specific local content plan is also required.
- Several other countries including Uganda and Ghana require a local content plan to be put forth for the construction of production units to be installed in the country.
- From the year of commercial production, a contractor may claim tax depreciation on petroleum capital expenditure at a rate of 20% on a straight line basis. A subcontractor is also entitled to tax depreciation on assets used to generate business income.



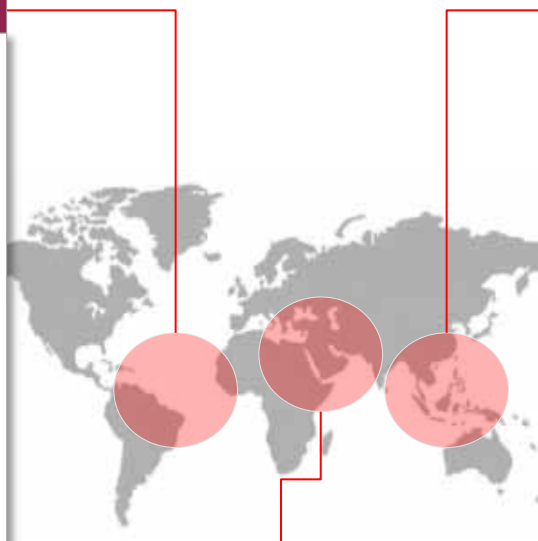
Regulations & Incentives: Key Regions cont.



Brazil enforces stringent local content requirements within vessel construction and operations. There are no explicit local content requirements for vessel construction in South East Asia and the Middle East.

Latin America

- Brazil has introduced several local content requirements in an attempt to strengthen the local industry by increasing local employment, developing technology through the transfer of knowledge and expertise and building a robust supply chain.
- Created in 2008, PROREFAM's objective is to increase the national share of the Brazilian support fleet. Policies dictate that local content must comprise 60% of the PSV and OSRV construction work while AHTS units require 50%. Operation of the vessels must be 70% locally sourced.
- While local content policies are in place, the local industry struggles to meet Petrobras' ambitious E&P plans due to both a lack of expertise and a lack of capacity, possibly creating bottlenecks and inefficiencies.
- There are minimum local content requirements in licensing rounds for the award of O&G exploration and production rights. For the exploration phase, the minimum local content is 37% and in the development phase, the corresponding figure is 55% for first oil.
- Petrobras has also stepped up its fuel efficiency regulations by ranking vessels by their daily fuel cost. In evaluating proposals, the daily fuel cost of each vessel will be added to day rates offered before ranking takes place. The policy penalises vessels which have a higher consumption of fuel.
- Brazil in general provides a variety of tax incentives intended to attract business and foster the development of certain under developed regions in the country. These include a reduction of 75% of the 25% corporate income tax for projects considered to be vital developments of the SUDAM and SUDENE regions. This incentive is granted until 31 December 2018 which can be a benefit for a maximum ten-year period.



Middle East

- There are no explicit regulations regarding the construction of offshore vessels in the Middle East.
- Historically, contractors in the region have acquired vessels from both Western and Asian yards.
- Iran is looking to boost its income once international sanctions are lifted. National Iranian Oil Company will form joint ventures with international companies to manage projects, provide financing and maximise hydrocarbon recovery. Partners conducting exploration projects will be paid for their work with a share of the output, according to presentations at the conference.


South East Asia

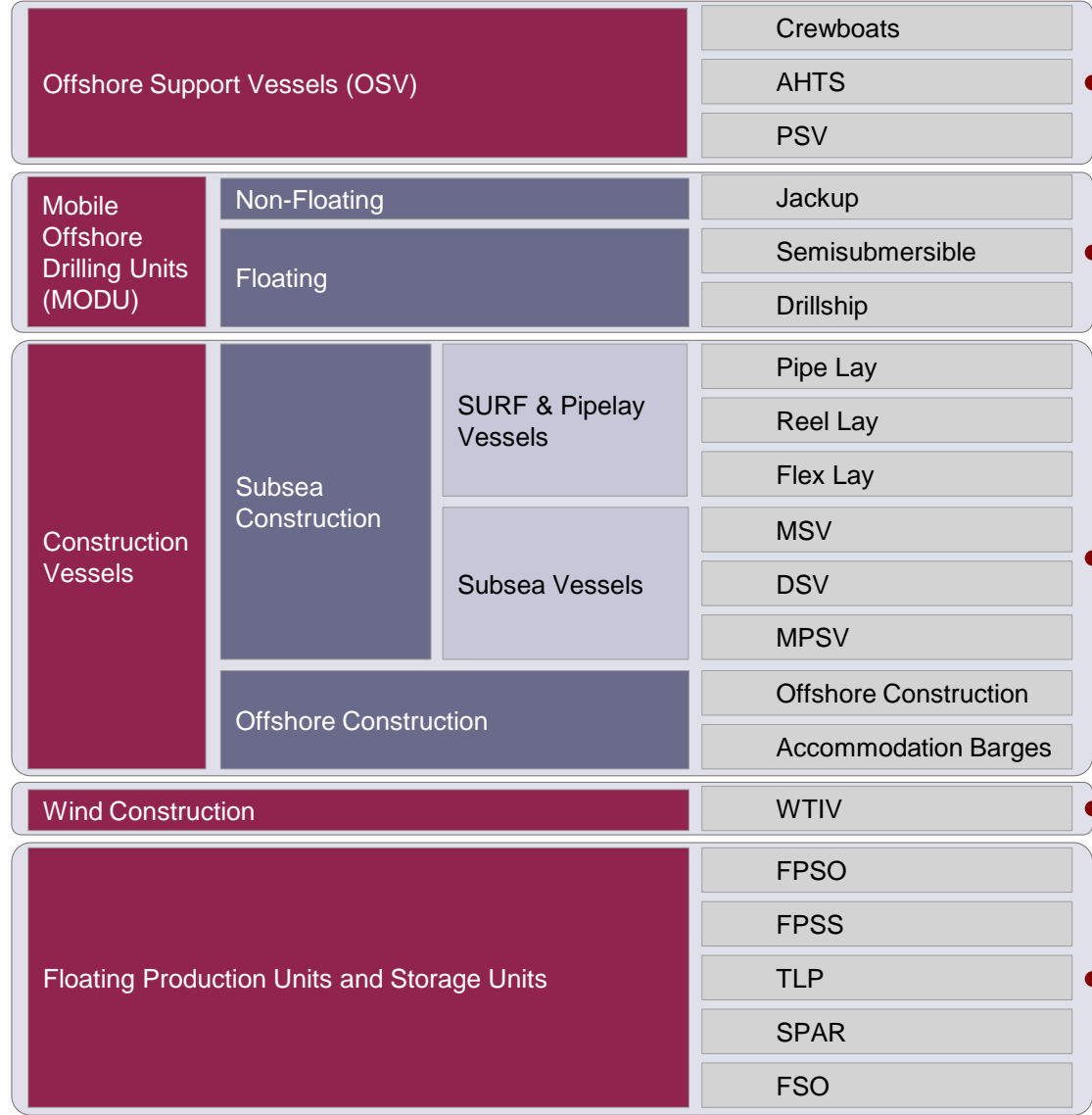
- South East Asia can be seen as a relatively protectionist region with SEA countries implementing cabotage policies to protect local players. While there are no explicit construction local content requirements governing SEA countries, local content policies on vessel contracting are abundant.
- In Indonesia, there are strong local content requirements where all offshore drilling vessels have to be Indonesian-flagged. Exemptions are however given to drilling and offshore support operations. These exemptions are often given when there is insufficient supply of Indonesian-flagged vessels. Foreign vessels need to obtain a permit from the country's Minister of Trade.
- In Malaysia, local content requirements pose a barrier to entry for international contractors. Not only are most E&P contracts production sharing agreements with NOC Petronas, the Petroleum Development Act and Petroleum regulations require supplies and service providers to have a valid license produced by Petronas.
- While local content policies and protectionist measures limit the participation of foreign vessel contractors, DW do not expect it to impact vessel design and construction.
- Malaysia has announced incentives to promote its upstream development and boost commercialisation of hard-to-reach oil fields. These include tax allowances of capital intensive projects, reduction of tax rates from 38% to 25% for marginal fields, accelerated capital allowances of up to five years and waiver of export duty on oil produced from marginal fields.

Key Definitions & Drivers

Key Project Definitions and Drivers Driving the OSV and Subsea Vessel Market

Definitions Vessel Overview

 Vessel definitions and categories can often be different between shipyards and contractors alike. DW have categorised vessels included in this study based on workscope, demand drivers and specifications.



Vessels included in this study have been grouped into five main categories given similar workscope and demand drivers.

Offshore Support Vessels – OSVs are used in a variety of roles throughout the lifecycle of an offshore development and can be further divided into three main vessel types.

Mobile Offshore Drilling Units – mobile offshore rigs are used mainly for drilling activities. These are further divided into floating and non-floating rigs.

Construction vessels – being a broad category, construction vessels can be divided into subsea and offshore construction. Offshore construction tends to refer to conventional construction activities associated with topsides and jacket installations. Subsea construction can be further segmented into SURF & Pipelay vessels and subsea vessels. SURF & Pipelay are involved in flexibles and rigid lines such as umbilicals and pipes whereas subsea vessels are involved in the installation of subsea trees, manifolds, connectors, and IRM related activities.

Wind Construction – wind construction vessels are mainly exposed to the renewables market. However, more and more jackup barges which have been involved in the oil & gas construction market historically have been moving into the wind market.







Floating Production & Storage – this refers to offshore units that are involved in the production and storage of oil & gas. These tend to be installed for extended periods of time.

Further definition of each vessel type can be found in the following pages.

Definitions


 Definition of offshore vessel types, overview of each vessel's workscope, capabilities and key specifications are as listed.

Offshore Support Vessels (OSV)	Mobile Offshore Drilling Units (MODU)
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Crewboat/ ERRV	AHTS	PSV	Jackup	Semisubmersible	Drillships
<ul style="list-style-type: none"> Crewboats are used to transport personnel to, from and in between offshore facilities including rigs and production platforms. ERRVs provide emergency response and are stationed near offshore installations. These are sometimes used as security patrols in volatile regions. Both crewboats and AHTS may be used as an ERRV. 	<ul style="list-style-type: none"> Used for towing and anchor handling purposes. Larger vessels are more specialised to handle drilling rig movements, while smaller vessels are typically more multi-purpose and can be used to do supply runs to platforms and rigs. 	<ul style="list-style-type: none"> PSVs are used to support offshore platforms by providing cargo transportation including drilling muds and other fluids. These vessels can be outfitted with additional equipment for various light duty offshore support work. 	<ul style="list-style-type: none"> Jack-up rigs are primarily used for shelf-based drilling operations with modern units able to operate in water depths up to 150 metres. Water depth limitations are based on the length of the unit's legs which are fixed to seabed during drilling operations. During mobilisation jack-ups are towed to location using anchor handling tug boats. 	<ul style="list-style-type: none"> Semi-submersible rigs are floating drilling platforms that provide excellent station-keeping and a large deck space, making them an ideal MODU solution for development drilling in deepwater or rough sea conditions. Water depth range for semi-subs is limited to 3,000m due to the necessity for mooring systems. 	<ul style="list-style-type: none"> Drillships are vessel-shaped floating rigs capable of drilling in deepwater. Historically, most units have been converted from tankers, however, now purpose built units are the norm. Drillships are differentiated from semi-subs as they are entirely independent and able to move to location under their own propulsion.

Key Specifications					
<ul style="list-style-type: none"> Passenger capacity Deck space 	<ul style="list-style-type: none"> Bollard pull Brake horsepower 	<ul style="list-style-type: none"> Storage tank capacity (Deadweight tonne is typically used to determine size of PSV) Deck space 	<ul style="list-style-type: none"> Length of legs (Max water depth) BOP rating 	<ul style="list-style-type: none"> Dual derrick capabilities BOP rating Variable Deck Load 	<ul style="list-style-type: none"> Dual derrick capabilities BOP rating Variable deck load

Definitions



Definition of offshore vessel types, overview of each vessel's workscope, capabilities and key specifications are as listed.

Subsea Construction - SURF & Pipelay Vessels	Subsea Construction - Subsea Vessels
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PIPE LAY	REEL LAY	FLEX LAY	MSV	DSV	MPSV
<ul style="list-style-type: none"> Used for complex pipe laying operations in shallow and deep waters often in remote areas. Pipes are typically welded together on the vessel. Pipelays can be further broken down into J-lays, S-lays and pipe lay barges each with different laying methods and depth limitations. In general J-lays are able to operate in the deepest water, followed by S-lays and barges. 	<ul style="list-style-type: none"> Used for complex pipe and flowline laying operations in shallow and deep waters. A reel lay uses a coiled pipe on a spool unlike pipelay, and lays pipes in a continuous manner by unwinding it from the reel. 	<ul style="list-style-type: none"> Subsea flexible pipelines and umbilicals are normally installed by dedicated vessels that can handle subsea flexible pipe up to 16" in diameter. These typically have large lifting capacities capable of doing other subsea tasks. 	<ul style="list-style-type: none"> MSVs are employed for light construction and IRM related work. Key enabler includes ROVs, offshore crane capacity and working deck space. Some MSVs can be refitted with diving modules to compete with DSVs. 	<ul style="list-style-type: none"> DSVs are used for light construction and IRM related work specifically in shallow water. Key enabler includes saturation diving bell, divers, offshore crane capacity and working deck space. Demand for DSV and MSV may overlap as these vessels can be fitted with ROVs. 	<ul style="list-style-type: none"> Multi-purpose support vessels (MPSV) are considered a new vessel category that can be seen as a hybrid between MSVs and PSVs. Key specifications include ROVs & offshore cranes and storage tanks, allowing it to compete with both an MSV and PSV. MPSVs are grouped together with subsea construction vessels as DW expects these vessels to compete for similar work.

Key Specifications					
<ul style="list-style-type: none"> Top tensioner DP Crane capacity 	<ul style="list-style-type: none"> Crane capacity Multi-lay capabilities Top tensioner 	<ul style="list-style-type: none"> Crane capacity Top tensioner 	<ul style="list-style-type: none"> Crane capacity ROV capabilities Moon pool 	<ul style="list-style-type: none"> Crane capacity SAT diving capacity Moon pool 	<ul style="list-style-type: none"> Crane capacity ROV capabilities Storage tank capacity

Definitions

 Definition of offshore vessel types, overview of each vessel's workscope, capabilities and key specifications are as listed.

Offshore Construction

Offshore construction vessels are typically used to install fixed platform topsides and jackets. Accommodation barges are a separate category that are used to support these construction activities.



Offshore Construction

Accommodation Barges

WTIV

- Offshore construction vessels include heavy-lifts and construction barges.
- Key vessel features include high capacity cranes which are typically used for topside or fixed platform jacket installation.
- Other differentiating specifications include free working deck space and dynamic positioning for operations in deeper water depths.

- Accommodation barges are typically used to support offshore activities including construction, modification and well intervention.
- Other than accommodation capacity, crane and deck space are considered key differentiators.
- Vessels with larger crane capacities may see overlapping workscope with offshore construction vessels.

- Wind turbine installation vessels (WITVs) are used to install offshore wind turbines. Larger vessels may also be used to install foundations.
- Key differentiator includes storage capacity for larger turbines and ability to operate in deeper water (longer legs)

Key Specifications

- Crane capacity
- Deck space

- PoB
- Crane capacity
- Deck space
- DP

- Jacking speed
- Crane capacity






Definitions

 Definition of offshore vessel types, overview of each vessel's workscope, capabilities and key specifications are as listed.

Floating Production Units and Storage Units



Floating production units are used to produce oil & gas mostly in deeper water. Different unit types are selected based on operator preferences and operating conditions of the field. Storage units are used to hold and transfer oil to shuttle tankers and do not produce oil & gas.

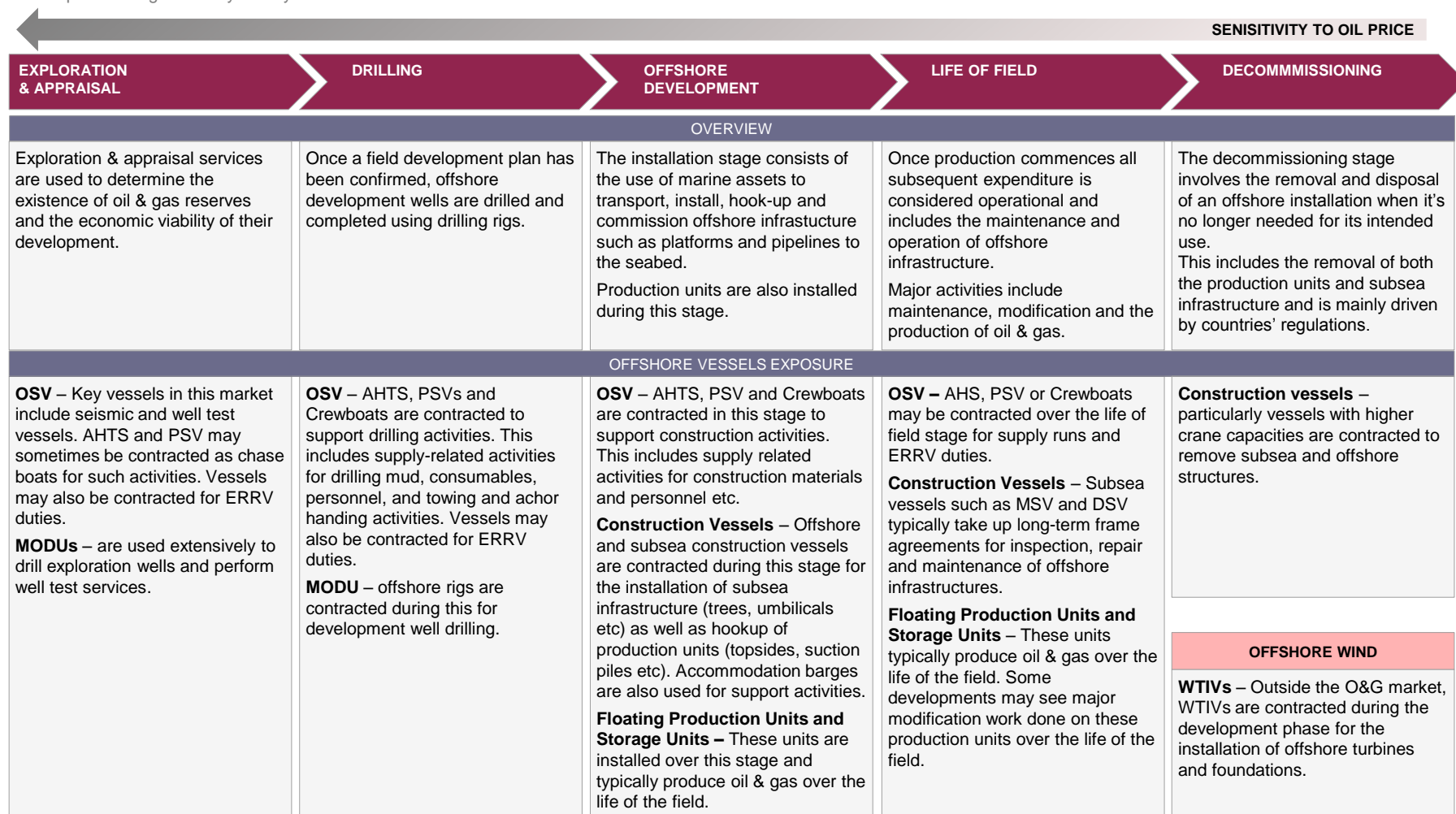
				
FPSO	FPSS	TLP	SPAR	FSO
<ul style="list-style-type: none"> Floating, Production, Offloading & Storage units are the most commonly used method of deepwater production. Units are typically ship-shaped and are often converted from VLCCs. FPSOs are spread-moored on location but can be re-deployed to several fields over its lifespan. FPSOs only process oil & gas from subsea wells. 	<ul style="list-style-type: none"> FPSS systems offer all the advantages of semi-submersible drilling rigs such as the ability to provide a highly stable workstation in water depths up to 3,000m. Wells can be completed on the surface of the platform allowing for greater well control. 	<ul style="list-style-type: none"> TLPs are permanently tethered to the seabed which eliminates vertical movement on the surface. This allows for wells to be completed on the platform which can increase recovery rates of deepwater fields. These units are used in water depths up to around 2,000m. 	<ul style="list-style-type: none"> Spar platforms consist of a topside facility that sits on a long cylindrical buoy submerged and conventionally moored to the seabed. A counter weight at the bottom of the buoy provides excellent vertical stability which allows for surface completed wells. Spars can be used in ultra-deep waters with Shell's Perdido spar installed in 2,438m. 	<ul style="list-style-type: none"> Floating storage & offloading units (FSO) are used to hold oil production from offshore platforms until shuttle tankers can arrive to transport it to shore. The ability to use converted oil tankers to store oil significantly reduces the required size and cost of fixed infrastructure and ensures minimal disruption to production.
Key Specifications				
<ul style="list-style-type: none"> Throughput rate Topside weight Storage capacity 	<ul style="list-style-type: none"> Throughput rate Topside weight Storage capacity 	<ul style="list-style-type: none"> Throughput rate Topside weight 	<ul style="list-style-type: none"> Throughput rate Topside weight 	<ul style="list-style-type: none"> Storage capacity

Oil & Gas Lifecycle & Vessel Exposure



Different offshore vessels are required throughout the lifecycle of an offshore oil & gas development.

The life cycle of an offshore oil & gas field can be tracked from its initial discovery during the exploration & appraisal stage, to the construction and installation of production infrastructure and final export and transportation of produced hydrocarbons. Throughout this lifecycle, a number of EPC contracts will be awarded, some indirectly (such as drilling rigs and seismic vessels) and others directly (production platforms and pipelines). As a general rule the earlier the stage in the supply chain the greater the vulnerability to oil price fluctuation with the E&A and drilling sectors prone to significant cyclicality.



Methodology



Energy demand effects on the lifecycle of the offshore oil & gas market.

Energy Demand 1

- Energy demand has increased by 25% since 2000 and is expected to increase by another 40% till 2035.
- This demand translated from increased global consumption will be the principle indicator of energy-related expenditure, including offshore assets.

Globalization and Growth in Global Population and GDP

- Since 2000, global GDP and population has increased by 134% and 17% respectively. This will continue to increase given continuity of globalisation.
- These increment factors will adversely effect the requirements for energy to support ongoing sustainability of human nature and industrialisation.

Offshore Production 4

- The move towards deepwater production has sparked an increase in required floating production units, particularly in weather adverse countries.
- FPSOs will see the largest requirements among these FPU units.

Vessel Types Employed

FPU

Exploration, Appraisal and Drilling Activities 2

- The increase in energy demand will drive larger amounts of exploration activities with the offshore segment growing quicker compared to onshore.
- This growth will continue to positively impact both the MODU and OSV market.

Vessel Types Employed

MODU

OSVs

Offshore & Subsea Construction 3

- Following drilling activities, offshore construction of both offshore production assets and subsea assets will be installed.
- The increase of viable production wells will require more subsea assets to be constructed driving requirements for subsea construction vessels.
- The drive towards deeper waters has shifted demand towards floating platforms and subsea infrastructure, hence reducing requirements for offshore fixed platform construction vessels.

Vessel Types Employed

OSVs

Construction Vessels

Decommissioning 6

- Construction vessels within this cycle will largely be required within GoM and North Sea regions.
- This segment is not expected to contribute substantially to the requirements for construction vessels given the scale of decommissioning activities compared to offshore and subsea installation activities.

Vessel Types Employed

Construction Vessels

Life Of Field 5

- Following commencement of production, ongoing production, maintenance and inspection activities are carried out throughout the lifecycle of the field.
- The increase in deeper water and maturing fields will provide an increasing market particularly for the subsea vessel market.
- The increased requirement for OSV / ERRVs within this segment will show a low profile growth due to available supply and increased utilisation of helicopters.

Vessel Types Employed

OSVs

Construction Vessels

FPU

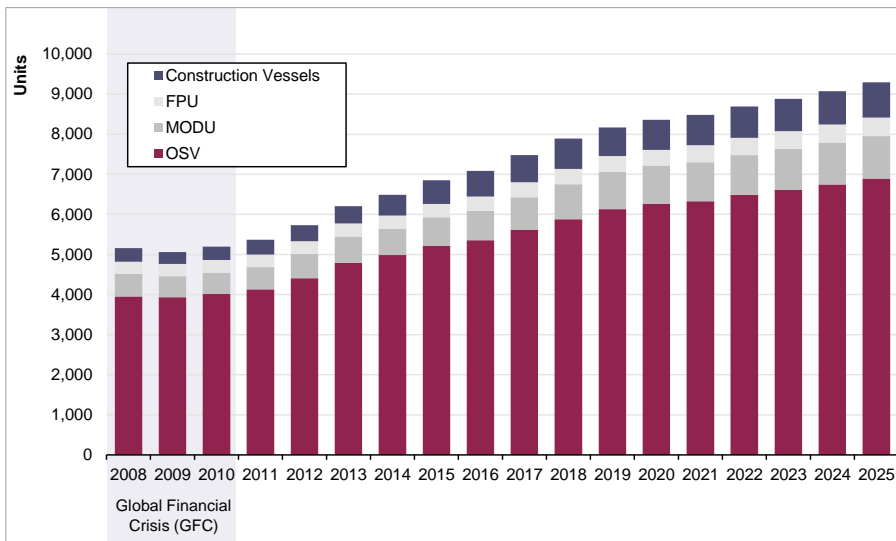
Market Summary

Market Summary



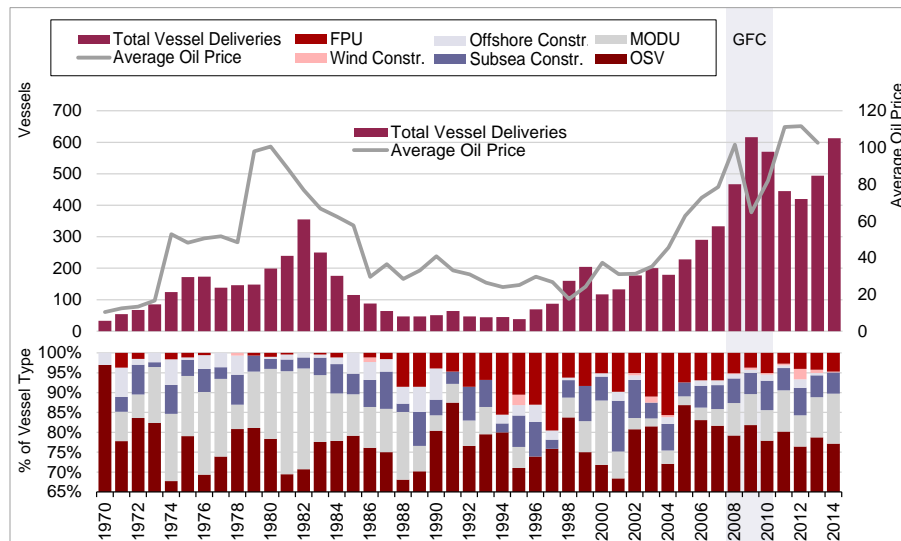
Total offshore vessel demand is expected to increase by a CAGR of 3.7%. Each vessel category is driven by a different set of drivers, supply and demand profile, and will thus experience different periods of build intensity over the forecast period.

Market Demand Outlook 2008-2025



- **Demand Summary** – Over the 2014-2025 forecast period, demand for all vessel types is expected to increase by 3.7% CAGR. Each vessel category, along with different market drivers, is expected to have varying growth rates:
- **OSV** – Demand for OSVs, driven by all stages in the oil & gas lifecycle, are expected to grow by a CAGR of 3.3%.
- **MODU** – DW expects demand for rigs to increase at a CAGR of 4.8% mainly due to developments in Africa and Latin America.
- **Subsea Construction** – Growth in subsea infrastructure is driven by both shallow and deepwater markets, demand for subsea vessels and SURF vessels anticipated to see a higher CAGR of 8.5% and 5.0% respectively.
- **Offshore Construction** – Driven by conventional shallow water platform installations and conventional pipelay market, the demand for offshore construction vessels is expected to see lower growth of 2.3%.
- **Wind Construction** – Being a market in its infancy, demand for WTIV is expected to see the highest CAGR at 11.8%, driven by Western Europe and China.
- **FPU** – FPU will see continued growth, particularly from deepwater regions (North and Latin America, and Africa). DW expect demand to grow at a CAGR of 3.6%.

Historical Supply

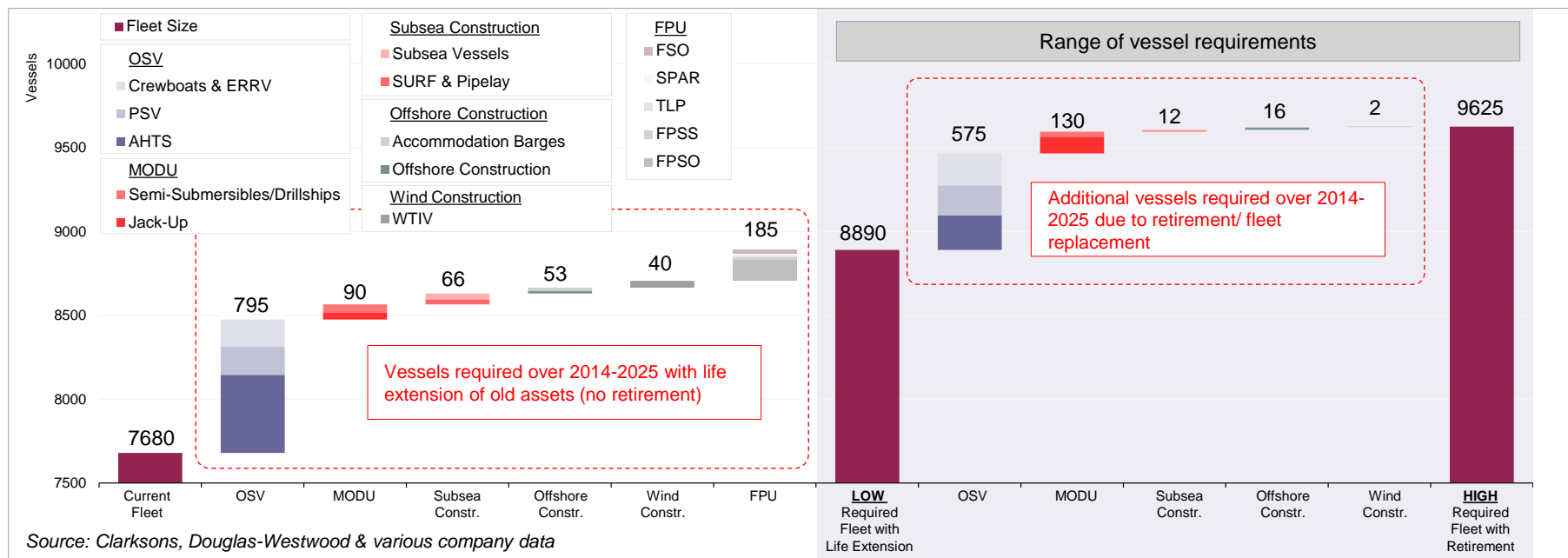


- Historical supply and building activities have experienced two distinct build cycles. The first cycle marked the advancement of the global offshore oil & gas industry, which consequently led to a spike in offshore construction. The last decade has seen higher building activity, driven by both a high oil price environment and a need for fleet replacement.
- OSV and MODU deliveries are highly cyclical in nature and are correlated to oil prices which influence the increase in offshore activity. Other vessel types such as offshore construction, subsea construction and FPUs tend to be relatively less cyclical in nature due to higher exposure to the field development and life of field stages within the oil & gas lifecycle. Fewer contractors in this market have also resulted in more disciplined building programs as compared to OSV and MODU markets which have seen a higher number of speculative builds.
- **Effect of previous recession** - In general, short-term movement in oil prices tends to have a smaller effect on vessel demand and supply. The 2008 GFC saw demand plateau as projects, particularly drilling activities and smaller marginal field developments, were delayed. Similarly, vessel deliveries saw a dip in 2011 and 2012 due to lower orders made from 2008-2010. The market has since recovered with prices stabilising around the \$100/bbl mark.

Vessel Requirements



Over the 2014-2025 period, DW expects 1229-1964 newbuild vessels to be required depending on retirement, fleet replacement programs and operator's preference for a younger fleet.



Source: Clarksons, Douglas-Westwood & various company data

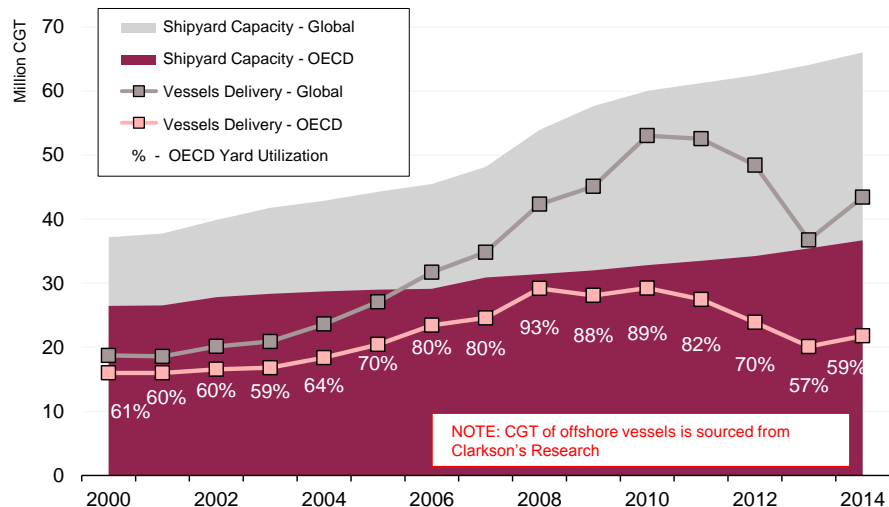
- Total vessels required over the 2014-2025 period ranges from 1229 units to 1964 units. It is important to note the supply and demand profile for each of these vessels varies, leading to different intensity in terms of orders over the 2014-2025 period.
- **OSV** – AHTS, PSV, Crewboats and ERRV will account for the largest volume of vessels required over the forecast period. These vessels however are typically smaller, less complicated in nature and have seen Chinese and Malaysian yards take up a large percentage of market share over the most recent buildcycle. These vessel types will also see the biggest range due to differing requirements. While operators are becoming more stringent in age requirements, older vessels >30 years of age continue to be contracted, particularly in the Middle East and Asia.
- **MODU** – Jackup rigs and floating rigs (including semi-submersibles and drillships) are expected to see a range of 90-240 units required. Unlike OSVs, DW expect actual orders to fall closer to the upper range as operators have become more stringent with age requirements. Contractors are also looking to replace older rigs to remain competitive in the market.
- **Subsea Construction** – DW expects 66-82 subsea construction vessels over the forecast period. Due to a recent newbuild cycle, particularly for SURF vessels (with a low average age of 5.6 years) DW does not expect fleet replacement to drive the market.
- **Offshore Construction** – DW forecast 34-50 vessels required to the forecast period. Due to higher average age of vessels in this category, both demand growth and fleet replacement will be a key driver to newbuild vessels.
- **Wind Construction** – The infancy of the wind industry has seen relatively recent builds for WTIVs. Over the forecast period, newbuilds will mainly be driven by demand growth.
- **FPU** – Offshore production units are mostly driven by upcoming development projects rather than supply and demand dynamics. As such, DW does not expect retirement and vessel age to affect newbuild requirements.

Historical Orders and Shipyard Capacity

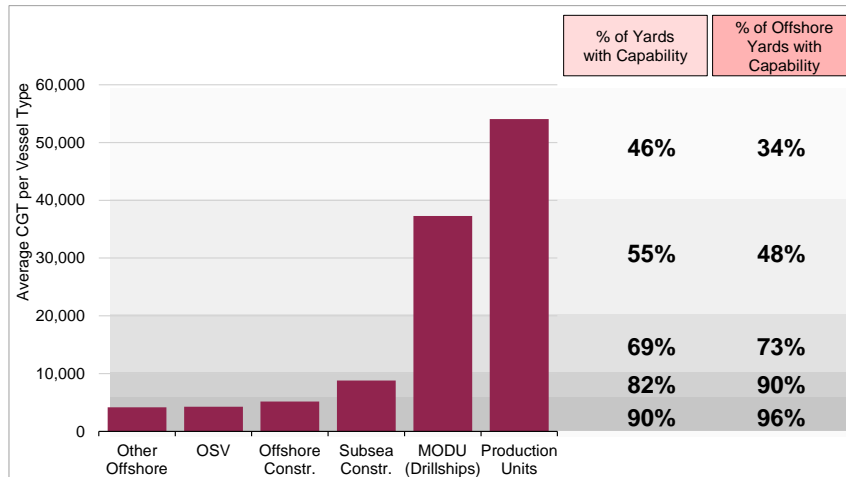


Offshore vessels account for a relatively small percentage of yard's output due to the high volume of marine shipbuilding activities. Gaps however do exist for OECD shipyards trying to target larger, more complex vessel types.

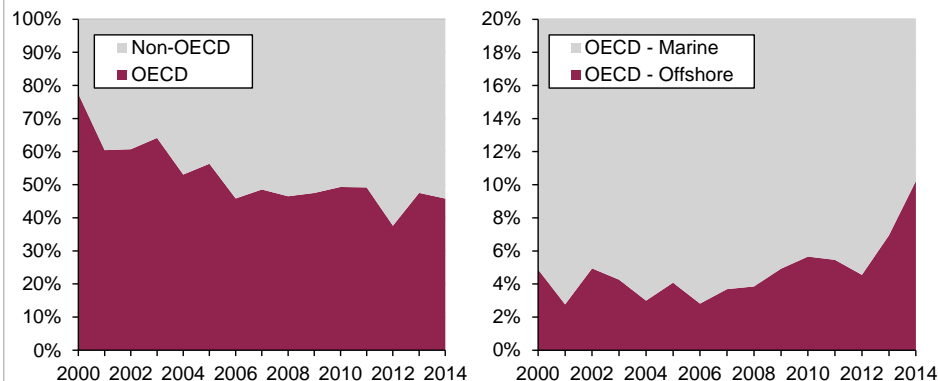
Historical OECD Vessels Delivery



OECD Yard Capabilities (CGT) vs Offshore Vessel Requirements (CGT)



Vessel Delivery Breakdown




- Shipyard capacity** – Historically, OECD shipyards have averaged 71% utilisation over the 2000-2014 period with a peak in 2006-2010 where utilisation reached 93%.
- Offshore building capacity** – Offshore vessels account for 4-6% of total CGT. This saw an increase over the last few years to 11.3% due to an increasing offshore market coupled with a slowing marine shipbuilding market. Regionally, OECD yards have been losing market share to non-OECD yards mainly due to lower cost of construction and favourable financing terms.
- Yard Capabilities** – Based on maximum CGT of each yard, 34% of OECD offshore yards are able to construct production units such as FPSOs and 48% have sufficient yard capacity to produce drillships. The vast majority of yards (96%) are able to produce smaller, less complicated vessels such as OSVs. It may be important to note that this matrix does not take into account other key factors such as engineering capabilities, EPC capabilities and other commercial factors.
- Future Capacity** – DW expects current capacity to meet requirements for future deliveries given the small proportion of utilisation taken up by offshore units. Upgrades however may be required for yards planning to construct higher value offshore units as these are currently only taken up by the largest yards such as HHI, Samsung, Japan Marine and IHC.

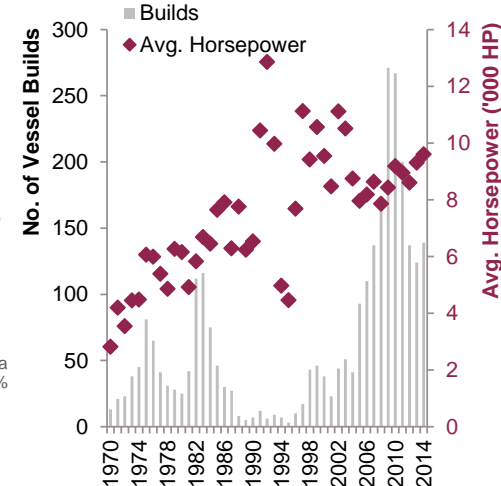
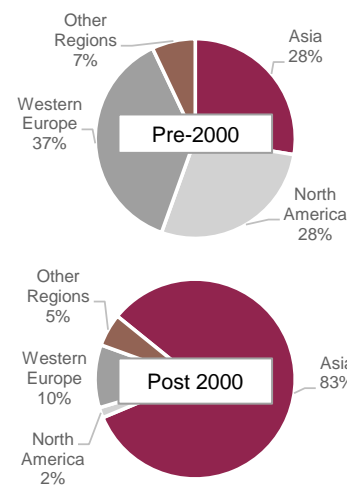
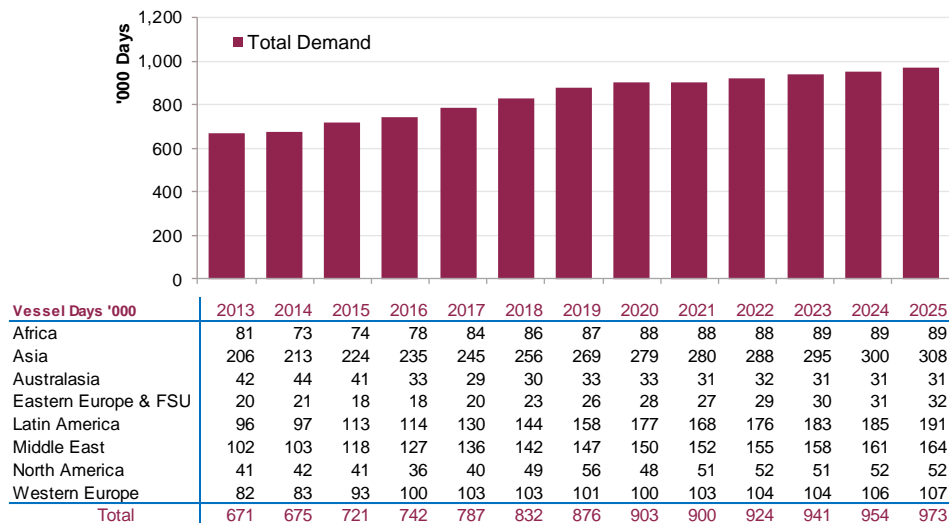
Source: Clarksons, Douglas-Westwood & various company data

Market Outlook OSV

AHTS Supply & Demand Analysis



The AHTS market is driven by a combination of large assets supporting deepwater drilling and smaller multi-purpose service vessels. An additional 465-670 units will be required.



Source: Douglas-Westwood & various company data

AHTS Regional Demand

- The AHTS market can be segmented into <8000HP multi-purpose service units and >8000HP vessels which are predominantly used to tow and support deepwater drilling rigs.
- Demand for AHTS globally is expected to show an increase of 45% between 2014-2025.
- The majority of demand will be accounted for by smaller AHTS (<8000HP) while a larger growth will be attributed to the increase in large AHTS (>8,000HP) demand as a result of growing deepwater drilling activities.
- Asia is expected to require the largest amount of AHTS until 2025. Latin America shows the strongest growth.

Additional Vessels Required by 2025 : 465 – 670 (25% of current fleet)

- By the end of the next decade, DW expects an additional 465 – 670 additional AHTS to be built from 2018 onwards.
- DW expects the additional required number of AHTS to fall within the lower bound of the scale as older AHTS will still be on contract in certain regions despite being older than 30 years.

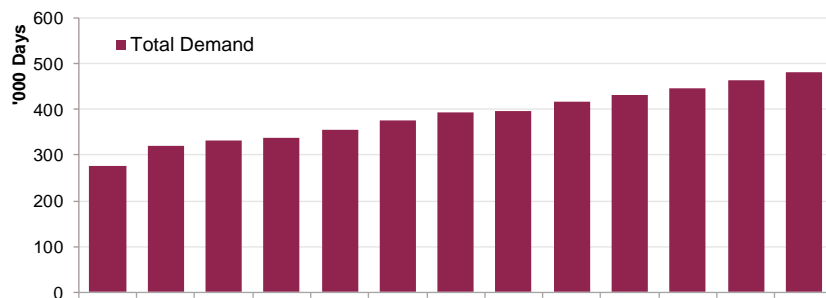
AHTS Regional Supply Analysis

- Supply** - Total operational supply of AHTS is estimated at 2,779, with a further 183 units currently on order; a 6.6% book to fleet ratio. The AHTS market has undergone an aggressive build cycle between 2002-2012, with an estimated 1524 vessels added to the fleet within the ten-year timeframe. Given the large number of additions to the fleet, average age of operational AHTS' has been lowered to approximately 15.8 years.
- Specifications** – There is a growing trend towards the building of higher horsepower (HP) vessels, particularly in the >8,000 HP bracket. This trend is a direct result of a growing demand of deepwater drilling, particularly for semisub drilling rigs, which require towing, anchoring support and supply related activities. The increasing size of semisubs is also directly impacting the need for larger HP rated vessels.
- Region** – Post-2000, the majority of AHTS builds have shifted towards Asian shipbuilding, particularly in China due to lower cost and attractive financing terms.

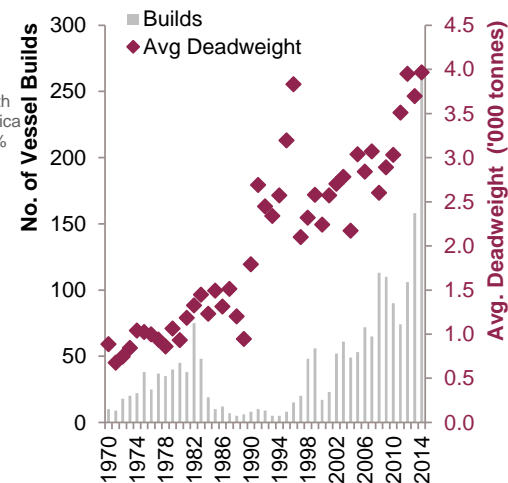
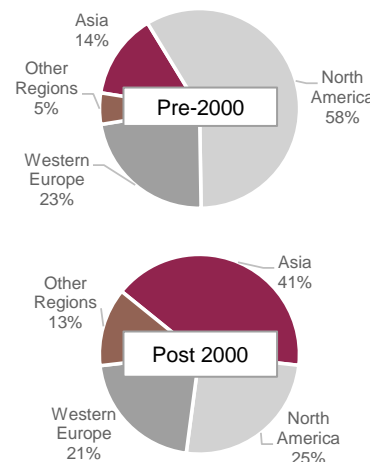
PSV Supply & Demand Analysis



The PSV market is expected to see the strongest growth out of all OSV types as a result of increased demand for floating production systems and drillships. An additional 170-350 orders will be required.



Vessel Days '000	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Africa	40	45	44	47	51	53	55	55	57	59	60	62	64
Asia	41	49	51	55	57	59	61	62	66	69	72	76	79
Australasia	14	16	13	10	8	8	8	8	8	8	8	8	9
Eastern Europe & FSU	6	9	8	8	9	10	12	13	14	16	17	18	20
Latin America	55	66	74	76	85	91	97	105	108	114	120	125	132
Middle East	21	23	24	25	26	26	27	27	28	28	29	30	30
North America	51	57	57	55	55	62	67	60	65	66	66	68	69
Western Europe	48	57	60	63	65	66	66	65	70	71	73	76	78
Total	277	321	332	338	357	375	393	396	416	431	445	464	481



Source: Douglas-Westwood & various company data

PSV Regional Demand

- Demand for PSVs globally is expected to show an increase of 50% between 2014-2025.
- Driven by increasingly complex vessel requirements and growing deepwater activities, larger PSVs (>2,000 DWT) are expected to show a sharper growth profile. Demand for large PSVs are expected to grow by 80% compared to 11% for smaller PSVs (<2,000 DWT) between now and 2025.
- Latin America is expected to account for the largest share of demand for PSVs at 25%. The region will also show the largest growth at 8% CAGR.

Additional Vessels Required by 2025 : 170 – 350 (12% of current fleet)

- DW expects 170 – 350 new PSVs to be required globally over the next ten years however, given recent build intensity, we would expect the majority of these orders to be placed in the later part of the forecast period.

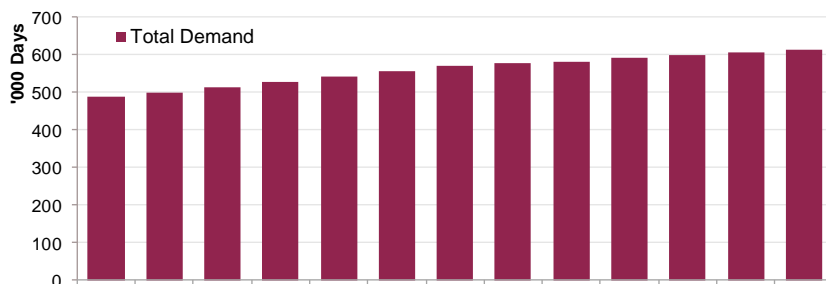
PSV Regional Supply Analysis

- **Supply** - Total operational supply of PSV is estimated at 1,819, with a further 409 units on visible order books; a 22.5% book to fleet ratio. Average age of the operational fleet is estimated at 16.9 years.
- **Specifications** - Vessel contractors operating in this space have recently shown an increasing interest to build larger vessels, with greater deck space and storage tanks, typically indicated by the vessel's dwt ratings. The significant versatility offered by >2000dwt PSVs has encouraged substantial volumes of speculative building over the past three years. These are largely by Asian yards eager to increase their footprint in what they perceive to be an attractive market.
- **Region** - Higher tonnage premium PSVs have historically been built in Western Europe and North America. However, Asian yards – in particular Malaysian and Chinese – have been challenging and intensifying competition, providing a lower cost package in comparison to Western counterparts.

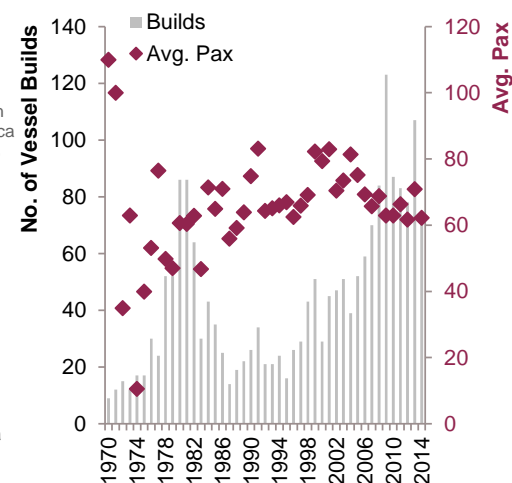
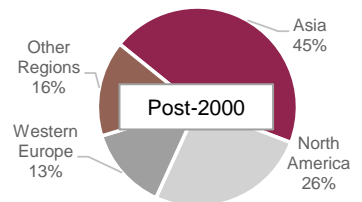
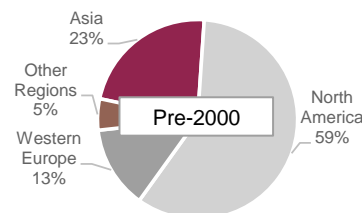
Crewboats / ERRV Supply & Demand Analysis



Typically, the crewboat/ERRV market is less subjected to industry cyclicity given the greater exposure to longer term life of field contracts and a relatively consolidated supply chain. With the exception of the largest vessels, the majority of construction activity is highly localised.



Vessel Days '000	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Africa	108	108	111	113	115	116	117	118	119	119	120	121	122
Asia	100	104	107	112	116	120	123	125	127	130	132	134	136
Australasia	4	5	4	5	5	5	5	5	5	5	5	5	5
Eastern Europe & FSU	7	7	7	7	8	8	10	10	10	11	12	12	13
Latin America	47	50	50	51	53	55	57	59	59	60	61	62	63
Middle East	117	120	129	134	139	143	147	150	152	155	158	160	163
North America	74	73	74	74	75	77	79	79	78	78	78	78	78
Western Europe	33	32	32	32	32	33	33	33	33	33	33	34	34
Total	490	500	514	527	543	558	570	579	583	591	599	606	614



Source: Douglas-Westwood & various company data

Crewboats / ERRV Regional Demand

- Demand for crewboats / EERVs globally is expected to increase by 23% over 2014-2025.
- This category of OSVs is expected to show the lowest growth profile due to its exposure to the life of field market, coupled with increasing utilisation of helicopters for offshore crew and equipment transport and emergency rescue support works.
- Middle East and Asia are expected to require the largest number of Crewboats / ERRVs till 2025 with the Middle East showing the largest growth.

Additional Vessels Required by 2025 : 160 – 350 (25% of current fleet)

- DW expects 160-350 additional Crewboats / ERRVs to be required over the next ten years. Despite wider uppercase range of additions, we expect that the real requirement will fall within the lower boundary of the range given that crewboats / ERRVs are likely to be utilised longer than other OSV types.

Crewboats / ERRV Regional Supply Analysis

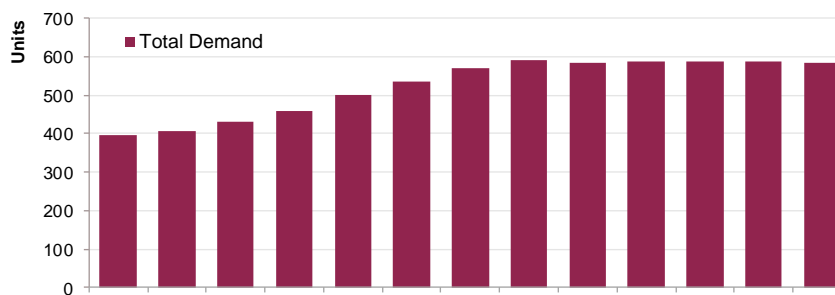
- **Supply** – Total operational supply of crewboats, workboats and EERVs is estimated at 1,159, with a further 99 units currently on order, a 8.5% book to fleet ratio. Average age of the operational fleet is 15.7 years.
- **Specifications** – Whilst high profile helicopter groundings have driven oil & gas companies to request larger crewboats as a matter of contingency, actual deliveries in recent years have shown a reduction in the average passenger capacity of such vessels.
- **Region** – The Crewboat / ERRV market is highly localised due to relatively high mobilisation expenses as a proportion of total cost. Pre-2000, North America accounted for 59% of crewboats, workboats and ERRV newbuilds but Asia has since taken an increasing share of construction with 45%.

Market Outlook MODU

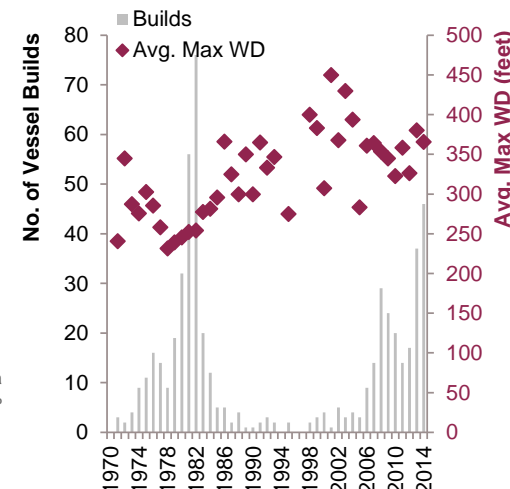
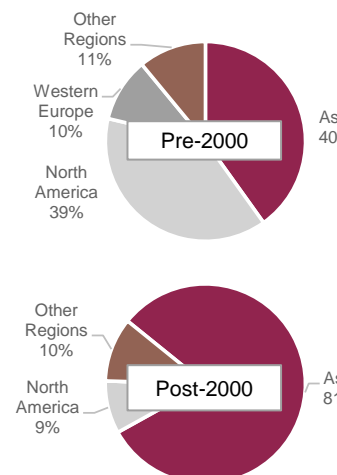
Jackup Supply & Demand Analysis



Significant growth is expected in the shallow water jackup drilling market before a plateau between 2020-2025. The market is also trending towards larger 400ft and above rated units.



Units	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Africa	40	34	42	42	47	51	54	55	56	57	57	58	58
Asia	120	126	126	132	143	155	167	174	172	174	174	174	174
Australasia	2	3	2	2	2	2	2	2	2	2	2	2	2
Eastern Europe & FSU	13	15	10	10	11	13	16	19	18	19	20	21	22
Latin America	44	52	45	47	52	59	65	69	64	65	66	66	66
Middle East	95	97	117	129	140	148	156	160	160	160	159	158	157
North America	36	34	33	33	36	40	42	44	40	40	40	39	38
Western Europe	44	45	55	62	68	67	67	67	72	71	69	69	68
Total	395	407	430	458	500	535	569	591	585	589	589	587	586



Source: Douglas-Westwood & various company data

Jackup Regional Demand

- Demand for jackups globally is expected to increase by 45% by 2025.
- The increase in demand is attributed to the ongoing shallow water drilling activities in regions such as Asia and the Middle East to offset declining production from existing matured fields.
- Beyond 2020, DW expect demand to plateau as the industry continues to transition towards deepwater and subsea developments.

Jackup Regional Supply Analysis

- **Supply** – Total operational supply of jackups is estimated at 508, with a further 148 currently on order, a 29.1% book to fleet ratio. This high ratio can be largely explained by the relatively high average age of the operational fleet at 23.1 years.
- **Specifications** – The major characteristics in jackup building have been a trend towards deeper water ratings. Notably, max water depth has been increasing from an average of 250 ft in 1970s-1980s to an average of 400 ft in the past decade. In recent years, industry leader Keppel FELS have begun construction of a 500ft jackup.
- **Region** – Over the past decade, the market has been dominated by Singapore yards such as Keppel and Sembcorp. More recently, China has established significant footprint in this market, currently accounting for 46% of the orderbook.
- Keppel Offshore & Marine is still expected to maintain its leading position in jackup newbuilding construction despite upcoming strong competition from Chinese and Korean yards.

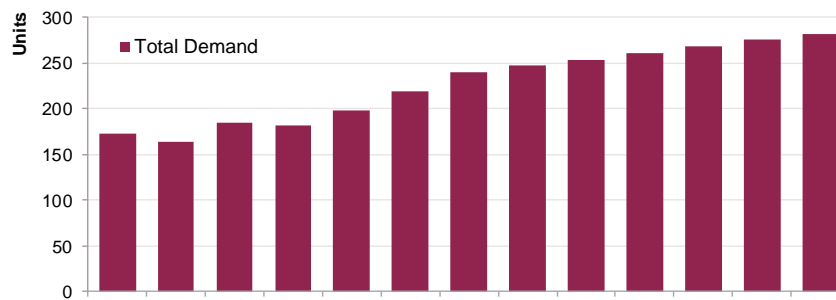
Additional Vessels Required by 2025 : 40 - 140 (27% of current fleet)

- DW expects 40-140 additional jackups to be required over the next ten years. Build intensity is expected to pick up post-2017.

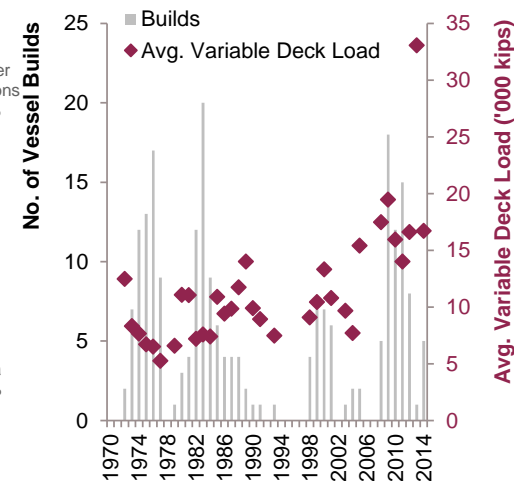
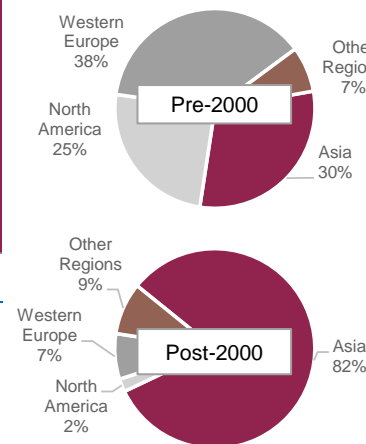
Semisub Supply & Demand Analysis



The semisub market is driven by deepwater demand in harsh operating environments such as the North Sea, Latin America and Australasia.



Units	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Africa	27	28	29	31	32	34	35	37	39	41	43	45	47
Asia	17	16	21	24	25	26	27	28	28	28	28	28	27
Australasia	11	10	8	9	9	9	10	10	10	10	10	10	10
Eastern Europe & FSU	6	5	5	5	6	7	8	8	7	7	7	8	7
Latin America	58	51	68	66	77	85	93	104	108	114	119	125	132
Middle East	2	2	1	1	1	1	2	2	2	2	2	2	2
North America	23	23	22	17	18	27	34	25	26	27	28	28	26
Western Europe	28	28	29	30	30	31	32	33	33	32	31	31	30
Total	172	163	184	182	198	220	240	247	253	260	268	275	281



Source: Douglas-Westwood & various company data

Semisub Regional Demand

- Demand for semisubs globally is expected to increase by 72% between 2014-2025.
- Semisubs offer a deepwater drilling solution for harsh ocean environments, as such, they are used extensively in Latin America, the North Sea and Australasia. Semisubs also offer a cost-effective alternative to drillships in medium water depths (200-1000m).
- Latin America will account for the majority of the market, growing from 51 units to over 130 units by 2025.


Additional Vessels Required by 2025 : 50 – 80 (50% of current fleet)

- DW expects an additional 50-80 units of floating drilling assets to be required by the end of the decade with additional units required by 2017.
- Due to the variance in operator preference, regional geological and meteorological conditions and drilling scope, these 50-80 drilling units are options between both semisubs and drillships.

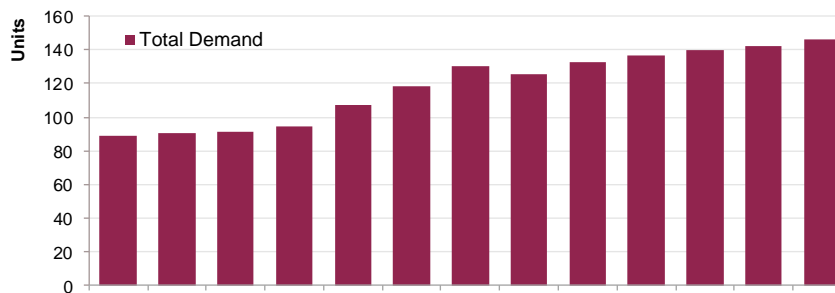
Semisub Regional Supply Analysis

- **Supply** – Total operational supply of semisubs is estimated at 221, with a further 29 units on visible orderbooks, indicating a 13.1% book to fleet ratio.
- **Specifications** – Average age of operational fleet is 23.5 years. Average variable load is a key specification for semisubs as it determines its capability to hold logistical and variable loads. Having larger storage capacity has increased in importance given that developments are increasingly further from shore.
- History indicates that the simplest and most cost-effective construction of a semisubmersible is in the form of four columns arranged on twin pontoons with a water-tight, upper-hull deck box. Such an arrangement allows the redundant alignment of critical structural members in all three elements. The result not only satisfies global strength and fatigue requirements, but does so with a minimum quantity of steel.
- **Region** – The majority of semisub builds are dominated largely by the Asian region namely South Korea, China and Singapore.

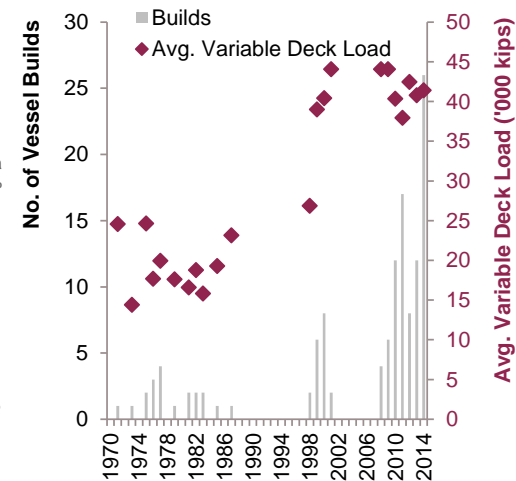
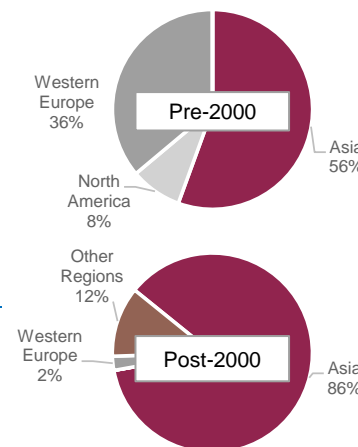
Drillship Supply & Demand Analysis



Demand for drillships is expected to see robust growth, driven by the deepwater triangle – West Africa, Latin America and North America.



Units	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Africa	25	27	18	24	28	27	26	24	30	32	34	36	37
Asia	13	12	14	16	17	18	19	19	19	19	19	19	20
Australasia	2	2	1	1	1	1	1	1	1	1	1	1	1
Eastern Europe & FSU	0	0	0	0	0	0	0	0	0	0	0	0	0
Latin America	27	26	36	35	41	45	50	56	55	56	57	58	59
Middle East	1	1	1	1	1	1	1	2	1	1	1	1	1
North America	18	20	20	15	16	24	31	22	23	24	25	24	25
Western Europe	3	2	2	2	2	2	2	2	2	3	2	3	3
Total	89	90	91	94	107	118	130	126	133	137	140	142	146



Source: Douglas-Westwood & various company data

Drillship Regional Demand

- Demand for drillships globally is expected to increase by 62% between 2014-2025.
- The increase in ultra deepwater activities in the pre-salt basins in Latin America and in Africa is expected to drive the majority of drillship demand requirements over the next decade.
- Latin America (40%) is expected to account for the largest demand of drillships by 2025 followed by Africa (34%), North America (19%) and Asia (15%).

Additional Vessels Required by 2025 : 50 – 80 (50% of current fleet)


- DW expects an additional 50-80 units of floating drilling assets to be required by the end of the decade with additional units required by 2017.
- Due to the variance in operator preferences, regional geological and metocean conditions, and drilling worksopes, these 50-80 drilling units are options between both semisubs and drillships.

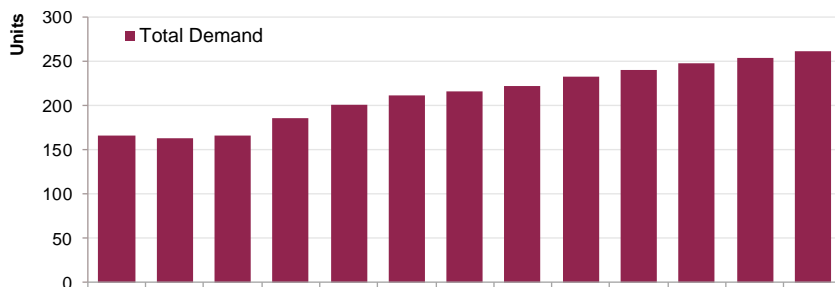
Drillship Regional Supply Analysis

- **Supply** – Total operational supply of Drillships is estimated at 97, with a further 80 units on visible orderbooks, indicating an 82.5% book to fleet ratio.
- **Specifications** – Average age of operational fleet is estimated at 12.0 years.
- Drillships are able to quickly and independently mobilise to remote locations, allowing completion of multi-well campaigns and regional transfer without the need for wet tow or costly heavy-lift operations. However, the ship-shaped hull has the disadvantage of being susceptible to motions from waves, winds and currents preventing drillships from operating in harsh metocean conditions. Today most ultra deepwater drillships are equipped with six diesel power generators with one emergency back-up unit.
- DP systems typically use a significant amount of fuel. However, semisubs – due to their more stable design – demand less fuel for DP than drillships. Over 90% of drillships currently operating have DP3 station keeping, with the rest having DP2.
- Given the increase in deepwater to ultra deepwater activities, we also expect the requirement for variable deck load to increase.
- **Region** – South Korea commands the majority of drillships worldwide with a few orders from Singapore. Despite this dominance, China is expected to raise its market share within this space given their competitive price mechanisms.

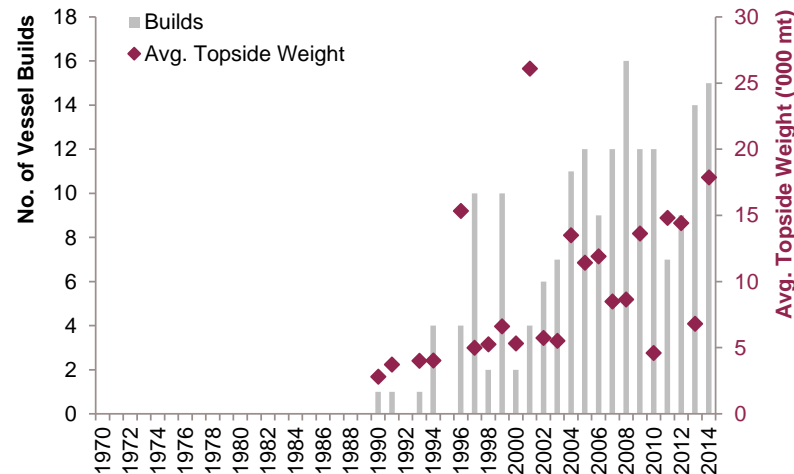
Market Outlook FPU

FPSO Supply & Demand Analysis

 The FPSO market is predominantly project-driven with an additional 129 units expected over the 2014-2025 period.



Units	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Africa	44	42	41	44	48	53	56	59	61	62	63	65	67
Asia	41	43	43	47	48	48	47	47	51	52	53	55	56
Australasia	12	12	12	13	13	12	13	11	11	12	12	12	13
Eastern Europe & FSU	0	0	0	0	0	0	0	0	0	0	0	0	0
Latin America	43	42	43	53	58	62	64	72	72	74	76	78	80
Middle East	0	0	0	0	2	2	2	2	2	2	2	2	2
North America	4	4	4	5	5	5	5	4	5	5	6	7	7
Western Europe	23	20	23	24	27	30	29	28	32	34	35	36	37
Total	167	163	166	186	201	212	216	223	233	241	248	254	262



Source: Douglas-Westwood & various company data

FPSO Regional Demand

- Demand for FPSOs globally is expected to increase by 60% between 2014-2025.
- The increase in global production is expected to drive the number of offshore production facilities, particularly in regions with adverse weather conditions or in marginal field conditions where tiebacks are not feasible.
- Latin America, Asia, Africa and Western Europe will account for the largest demand for FPSOs with Latin America and West Africa expected to indicate a 50-80% increase in demand by 2025.

Additional Vessels Required by 2025 : ~129 (40% of current fleet)

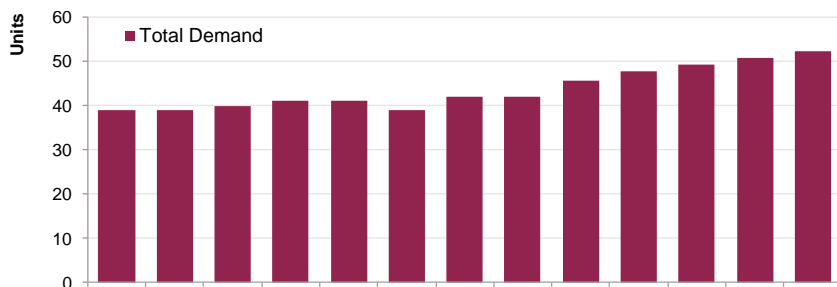
- Supply for FPSOs is driven by offshore oil & gas development projects, as opposed to supply and demand dynamics. DW expects 129 units based on both visible projects and demand extrapolated through long-term trends in offshore production.

FPSO Regional Supply Analysis

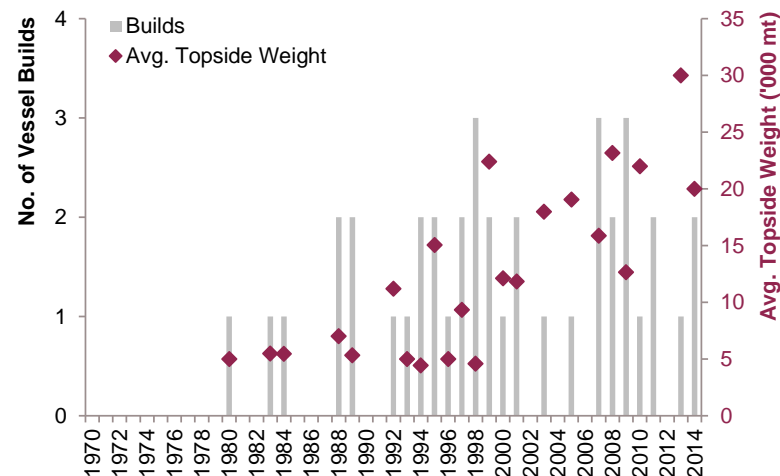
- **Supply** – Total operational supply of FPSOs is estimated at 163, with a further 21 units on visible orderbooks, indicating a 7.3% book to fleet ratio.
- **Specifications** – Average age of operational fleet is 8.6 years.
- With increasing efforts to boost production and deeper water fields such as in Africa and Brazil, DW expects the topside / throughput capacity of an FPSO to increase over the course of the next decade to cater for this shift in capacity.
- **Contractors** – In certain instances, the construction of FPSOs is split between the topside and hull, however, the majority of topside contractors are also designers and participate in the engineering process of the hull. Contractors such as Technip, KBR, AkerSolutions, Aibel, etc. are largely contracted for the topside module whilst yards such as Keppel, DSME and Cosco are common hull contractors.
- In general, Korean yards tend to be contracted for the largest FPSOs while Singaporean and Chinese have been dominating the conversion market.

FPSS Supply & Demand Analysis

An additional 12 FPSS may be required over the forecast period.



Units	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Africa	0	0	1	1	1	1	1	1	1	1	1	1	1
Asia	2	3	3	3	3	3	3	3	3	3	3	3	3
Australasia	0	0	0	1	1	1	2	2	2	3	3	4	4
Eastern Europe & FSU	0	0	0	0	0	0	0	0	0	0	0	0	0
Latin America	16	16	16	16	16	15	15	15	18	18	19	19	20
Middle East	0	0	0	0	0	0	0	0	0	0	0	0	0
North America	8	8	9	9	9	9	10	10	10	10	11	11	11
Western Europe	13	12	11	11	11	10	11	11	12	12	12	12	12
Total	39	39	40	41	41	39	42	42	46	48	49	51	52



Source: Douglas-Westwood & various company data

FPSS Regional Demand

- Demand for FPSS globally is expected to increase by 34% between 2014-2025.
- Given the suitability in harsh meteorological conditions and for surface completions, FPSS are typically used in Western Europe (North Sea) and Latin America.
- Both Latin America and Western Europe will continue to contribute to the demand for FPSS over the next decade, with Western Europe expected to indicate a larger increase in demand as it increases its depleting production.

Additional Vessels Required by 2025 : ~12 (23% of current fleet)

- Supply for FPSOs is driven by offshore oil & gas development projects as opposed to supply and demand dynamics. DW expects 12 units based on both visible projects and demand extrapolated through long-term trends in offshore production.

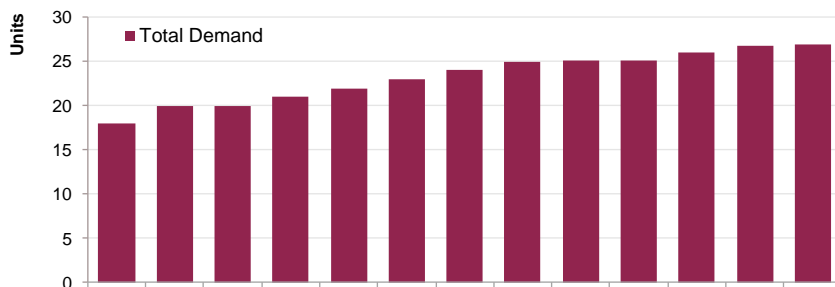
FPSS Regional Supply Analysis

- **Supply** – Total operational supply of FPSS is estimated at 39, with a further two units on visible orderbooks, indicating a 2.2% book to fleet ratio.
- **Specifications** – Average age of operational fleet is 14.9 years.
- Similar to FPSOs, there is a distinct trend towards larger topsides which indicates increasing requirements for larger production capabilities to maximise production rates.
- **Contractors** – Top contractors are largely Asian however there are also other non-Asian contractors such as Keppel, Sembcorp, SHI, Technip, Amec, Bechtel, etc.

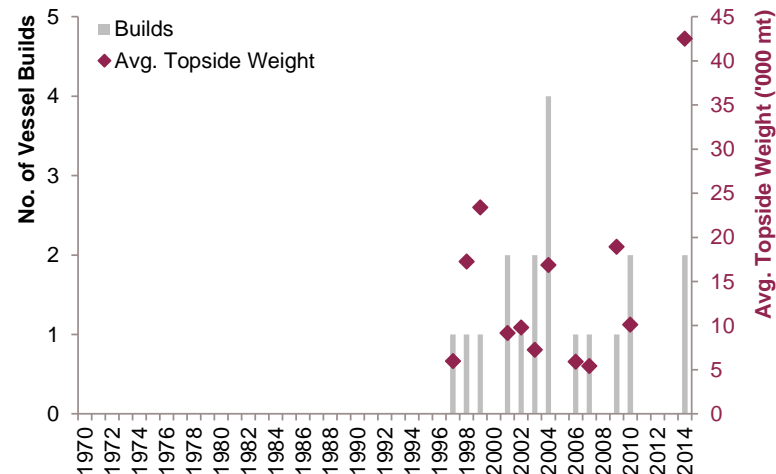
SPAR Supply & Demand Analysis



DW expects seven additional SPAR units to come onstream over 2014-2025 which will mainly be deployed in the North American market. A US-centric market will continue to see regional yards supplying topsides with European yards taking up hull contracts.



Units	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Africa	0	0	0	0	0	0	0	0	0	0	0	0	0
Asia	1	1	1	1	1	1	1	1	1	1	1	1	1
Australasia	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Europe & FSU	0	0	0	0	0	0	0	0	0	0	0	0	0
Latin America	0	0	0	0	0	0	0	0	0	0	0	0	0
Middle East	0	0	0	0	0	0	0	0	0	0	0	0	0
North America	17	19	19	20	21	22	23	23	23	23	24	25	25
Western Europe	0	0	0	0	1	1	1	1	1	1	1	1	1
Total	18	20	20	21	22	23	24	25	25	25	26	27	27



Source: Douglas-Westwood & various company data

SPAR Regional Demand

- Global demand for SPARs is expected to increase by 7 units between 2014-2025.
- Compared to FPSO and FPSS, SPAR installations are relatively infrequent and are predominantly used in North America (GoM). Currently one unit is installed outside the North American market on Murphy's Kikih field in Malaysia.
- Over the 2014-2025 period, Norway is expected to install their first SPAR in Statoil's Aasta Hansteen field which is expected to come onstream in 2017.

Additional Vessels Required by 2025 : ~7 (24% of current fleet)

- Supply for SPARs is driven by offshore oil & gas development projects rather than supply and demand dynamics. DW expects 7 units based on both visible projects and demand extrapolated through long-term trends in offshore production.

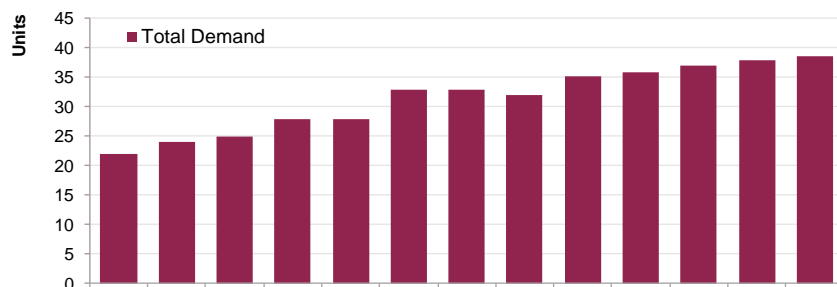
SPAR Regional Supply Analysis

- **Supply** – Current global SPAR population stands at 20 units with 7 units expected to come onstream based on visible projects, a book to fleet ratio of 35%.
- **Specifications** – Similar to most floating production units, the components of a SPAR include the hull, topsides, riser, mooring and offloading systems. These components are typically designed to fit each field on a project-by-project basis and are dependent on the operating environment and operator's preference with no clear trends in place.
- **Region** – SPAR topsides are mainly fabricated in USA while the hulls are typically constructed in Finland - Technip. With the majority of demand expected to stem from the GoM, DW does not expect yards in other regions to penetrate this market to a large extent.

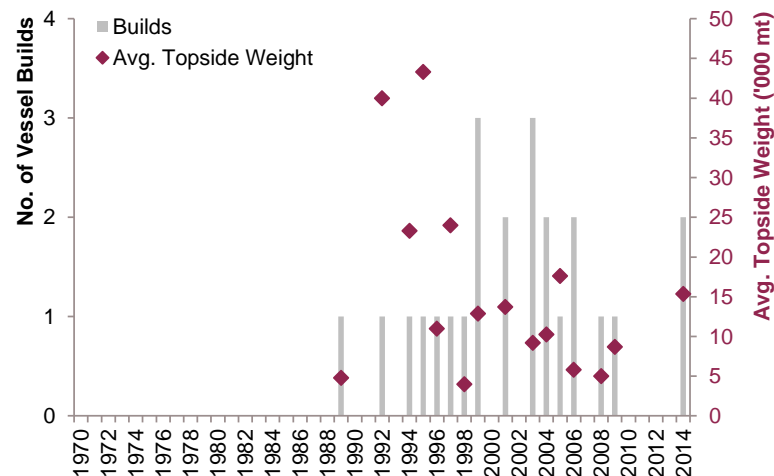
TLP Supply & Demand Analysis



DW expects 14 additional TLPs to come onstream over 2014-2025. Due to the project-driven nature of these production units, DW does not expect any clear trends in terms of specifications.



Units	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Africa	4	4	4	5	5	7	7	8	8	8	9	9	9
Asia	1	1	1	4	4	5	5	5	5	6	6	6	6
Australasia	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Europe & FSU	0	0	0	0	0	0	0	0	0	0	0	0	0
Latin America	0	1	1	1	1	1	2	2	2	2	2	2	2
Middle East	0	0	0	0	0	0	0	0	0	0	0	0	0
North America	15	16	17	16	16	18	17	15	17	18	18	19	19
Western Europe	2	2	2	2	2	2	2	2	2	2	2	2	2
Total	22	24	25	28	28	33	33	32	35	36	37	38	39



Source: Douglas-Westwood & various company data

TLP Regional Demand

- Demand for TLP globally is expected to increase by 15 units between 2014-2025, driven by increasing offshore production and a shift towards deepwater production.
- Due to a lack of storage, TLP are largely used in fields where pipeline tiebacks are available. These production units are typically installed in a relatively shallow portion of the deepwater market where tension tendons are able to be moored to the seabed. Currently, North America (52%), Africa (14%) and Asia (20%) account for the majority of demand over the forecast period.

Additional Vessels Required by 2025 : ~14 (36% of current fleet)

- Supply for TLPs is driven by offshore oil & gas development projects rather than supply and demand dynamics. DW expects 14 units based on both visible projects and demand extrapolated through long-term trends in offshore deepwater production.

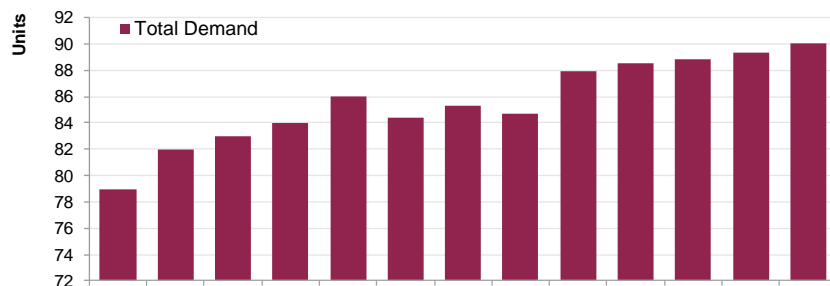
TLP Regional Supply Analysis

- **Supply** – Total operational supply of TLPs is estimated at 24, with a further 14 visible units expected to come onstream based on field development plans put forth by operators.
- **Specifications** – Key components of TLP include the hull, topsides, riser, mooring and offloading systems. These components are typically designed to fit each field on a project-by-project basis and are dependent on the operating environment and operator's preference with no clear trends in place.
- **Contractors** – Key EPC contractors for TLPs include Technip, McDermott and HHI. Location of fabrication yards can vary based on local content requirements and location of field.

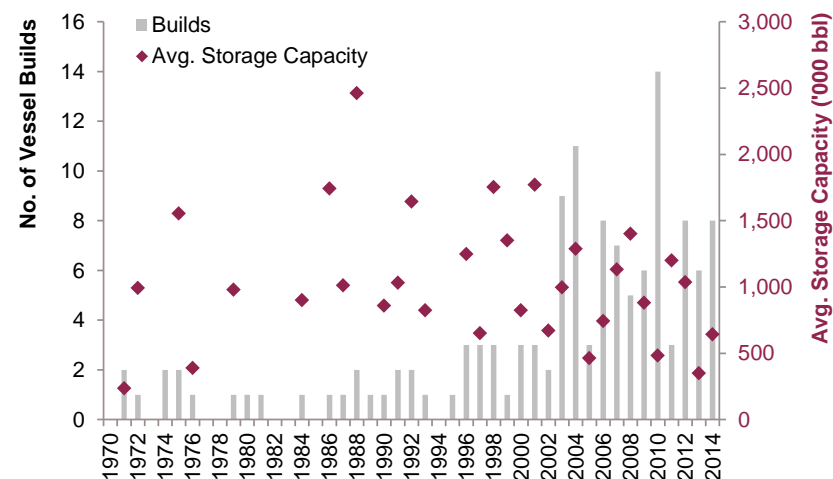
FSO Supply & Demand Analysis



DW estimates an additional 23 FSOs are required globally. Asian yards are expected to continue supplying these vessels due to relatively lower engineering requirements.



Units	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Africa	16	16	16	15	14	15	15	15	16	16	16	16	16
Asia	40	43	42	43	44	42	42	43	43	43	42	42	43
Australasia	3	3	4	4	4	4	5	5	5	5	5	6	6
Eastern Europe & FSU	1	1	1	1	1	1	1	1	1	1	1	1	1
Latin America	5	6	7	7	8	8	9	9	10	10	10	11	11
Middle East	8	8	8	8	7	7	6	6	6	6	6	6	6
North America	0	0	0	0	0	0	0	0	0	0	0	0	0
Western Europe	6	5	5	6	8	7	7	6	7	7	8	8	8
Total	79	82	83	84	86	84	85	85	88	89	89	89	90



Source: Douglas-Westwood & various company data

FSO Regional Demand

- Global demand for FSOs is expected to increase by 10% between 2014-2025.
- The increase in demand for FSOs is driven by an increase in the number of both fixed and floating offshore production platforms (particularly, platforms with minimal storage capacities) expected to come onstream over the 2014-2025 period.
- By 2025, Asia is expected to account for the largest proportion of demand for FSOs globally with Western Europe expected to have the highest growth profile.

Additional Vessels Required by 2025 : ~23 (15% of current fleet)


- Supply for FSOs is driven by offshore oil & gas development projects rather than supply and demand dynamics. DW expects 23 units based on both visible projects and demand extrapolated through long-term trends in offshore production (both deep and shallow water)

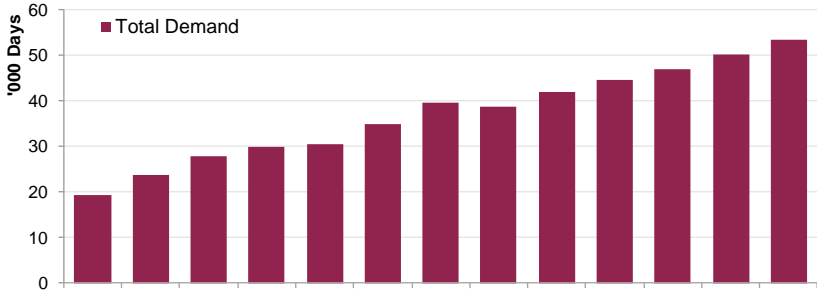
FSO Regional Supply Analysis

- **Supply** – Total supply of FSOs is estimated at 82, with an additional 23 visible units expected to come onstream, a book to fleet ratio of 11.7%.
- **Specifications** – Key specifications for FSOs lie in the storage capacity. Based on historical trends, these have remained largely similar. This is mainly due to conversions being the dominant build type – storage size is therefore limited by a more standardised vessel size (VLCC) that these FSOs were converted from.
- **Region** – Based on known build locations of current FSOs, Asia currently accounts for the majority of FSO builds and conversions (~70%) over the 1970-2000 period with Singapore and Malaysia leading construction. As Western yards shift towards higher value, engineering intensive vessels, DW expects Asia to continue to dominate future demand with Chinese yards taking up a higher share due to lower costs.

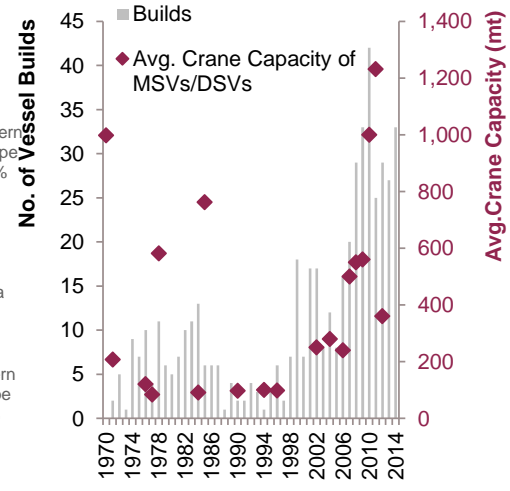
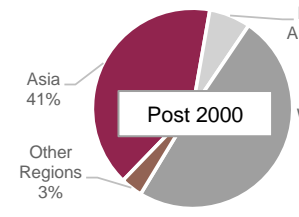
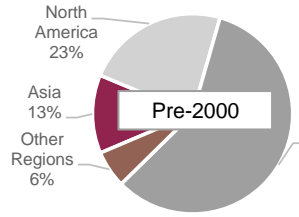
Market Outlook Construction Vessels

Subsea Construction Vessels - Subsea Supply & Demand Analysis

 Driven by an increasing volume of subsea installations coupled with a high volume of IRM activities, DW expect demand for subsea vessels to see robust growth particularly from Latin America and Africa.



Vessel Days '000	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Africa	3.0	4.0	4.1	6.4	6.5	6.2	10.2	7.8	8.2	8.9	8.4	8.7	8.8
Asia	4.7	4.8	6.2	7.2	5.5	5.4	6.3	6.0	6.2	6.5	6.5	6.7	6.9
Australasia	1.1	1.9	1.4	1.6	1.7	2.0	3.1	3.1	3.7	4.5	5.1	5.9	6.9
Eastern Europe & FSU	0.5	0.4	1.8	1.8	0.9	4.0	2.3	2.5	3.0	2.7	2.8	2.9	2.9
Latin America	3.4	3.2	4.2	4.4	6.0	7.3	7.0	8.0	8.9	9.5	10.5	11.4	12.4
Middle East	2.4	2.4	3.3	3.0	4.0	3.5	4.4	5.0	5.4	6.2	7.0	7.8	8.8
North America	1.7	3.1	2.6	1.5	1.7	3.4	2.5	2.6	2.9	2.8	2.8	2.9	2.9
Western Europe	2.7	4.0	4.3	4.1	4.2	3.0	3.8	3.7	3.6	3.8	3.8	3.8	3.9
Total	19.4	23.7	27.9	30.0	30.4	34.9	39.7	38.8	41.9	44.8	46.9	50.2	53.6



Source: Douglas-Westwood & various company data

Subsea Vessels Regional Demand

- The subsea vessels market is expected to grow by 176% between 2014-2025. This is driven by an increasing volume of subsea installations expected to be installed coupled with an ageing infrastructure requiring higher levels of inspection, repair and maintenance activities.
- Latin America (20%) and Africa (19%) are expected to take up the largest proportion of the market, mainly due to a larger volume of deepwater developments expected to come onstream over the forecast period.

Additional Vessels Required by 2025 : 36 – 42 (10% of current fleet)

- By the end of the next decade, DW expects an additional 36-42 subsea vessels to be required with supply and demand expected to tighten from 2020 onwards, due to a high volume of new orders over the last few years.

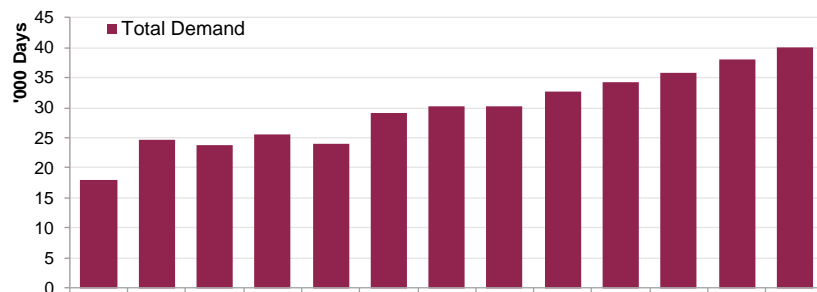
Subsea Vessels Regional Supply Analysis

- **Supply** – Total operational supply of subsea vessels is estimated at 380 units, made up of both DSV and MSV, with a further 17 on order. Current average age of the subsea fleet is estimated at 14.4 years.
- **Specifications** – the major characteristics in subsea vessels have been a trend towards larger crane capacity. This is mainly due to both increasing depths of subsea installations and increasing weight and size of subsea infrastructures. The average crane capacity has grown from <80mt to approximately >110mt in recent years.
- **Region** – In comparison to offshore support vessels which have seen a transition in shipbuilding to Asian players, Western shipbuilders continue to dominate the subsea vessel construction space given extensive engineering associated with building subsea vessels.

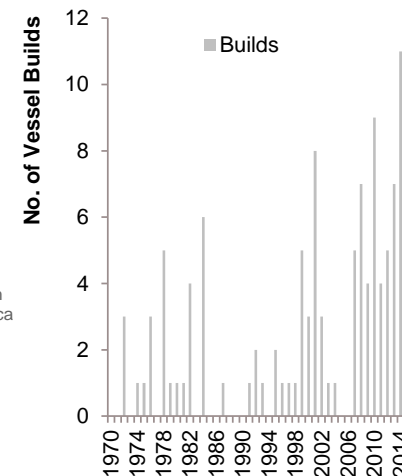
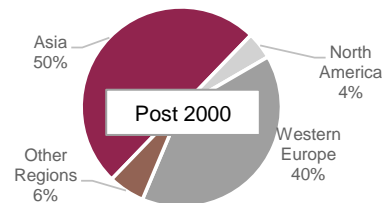
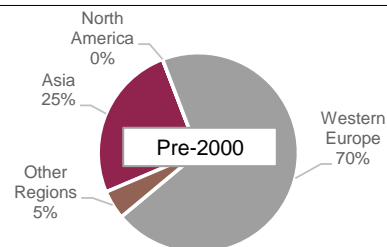
Subsea Construction Vessels – SURF & Pipelay Supply & Demand Analysis



SURF vessels are expected to enjoy higher growth due to an increasing volume of subsea installations particularly in Africa and Latin America. Convention pipelay will be driven primarily by increasing volumes in the Middle East and Asia.



Vessel Days '000	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Africa	1.9	2.0	2.4	5.6	3.5	3.4	5.3	4.1	4.3	4.7	4.5	4.6	4.7
Asia	3.5	4.9	4.7	5.4	4.0	4.9	4.9	4.7	5.0	5.0	5.1	5.2	5.2
Australasia	0.5	2.1	0.7	0.4	0.5	0.7	1.0	0.8	0.9	1.0	1.0	1.1	1.1
Eastern Europe & FSU	0.4	0.4	1.7	1.7	0.6	3.6	2.5	2.9	3.9	4.1	4.7	5.5	6.2
Latin America	2.7	3.2	3.5	3.9	5.1	6.3	5.2	5.7	5.8	5.7	5.8	5.9	5.9
Middle East	3.1	3.5	3.8	3.0	4.0	3.5	4.3	4.8	5.1	5.7	6.3	6.9	7.6
North America	2.6	4.0	2.5	1.5	1.7	3.5	2.6	2.7	3.1	2.9	3.1	3.2	3.2
Western Europe	3.3	4.4	4.6	4.2	4.6	3.1	4.5	4.6	4.6	5.2	5.4	5.7	6.2
Total	18.1	24.6	23.8	25.6	24.0	29.1	30.3	30.3	32.8	34.2	35.9	38.0	40.1



Source: Douglas-Westwood & various company data

SURF & Pipe Lay Vessels Regional Demand

- The SURF & Pipelay vessels market is expected to grow by 62% between 2014-2025.
- SURF & Pipelay vessels are mainly used to install SURF products including umbilicals, risers, flowlines and pipelines which are driven by increasing subsea infrastructures used in both deep and shallow water.
- On a regional basis, Latin America (17%), Africa (13%) and Western Europe (16%) are expected to see greater demand for umbilicals and flowlines (installed by SURF vessels) whereas regions such as the Middle East (16%) and Asia (16%) are expected to have export pipelines and inter-platform pipes accounting for the majority of vessel requirements (pipelays).


Additional Vessels Required by 2025 : 30 – 36 (29% of current fleet)

- DW expects 30-36 additional SURF & Pipelay vessels to be required over the next decade. Increasing demand particularly from Brazil will see the market tighten over the short-term.

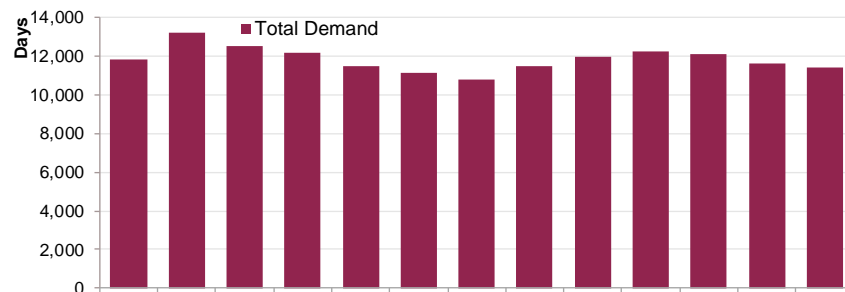
SURF & Pipe Lay Vessels Regional Supply Analysis

- **Supply** – Total operational supply of SURF and pipelay vessels is estimated at 148 units, made up reel lays, flexlay and pipelay vessels. Currently there is an additional order of 15 vessels, at a book to fleet ratio of 10%. Due to the high volume of newbuilds, SURF & Pipelay support currently have an average age of 5.6.
- **Specifications** – The key specifications for a SURF vessel lies in its top tensioner capacity. The top tensioner typically limits the weight and depth of flexibles and pipes these vessels can lay. DW expects these to see an increasing trend as the market moves towards deeper water.
- **Region** – Similar to subsea vessels, SURF vessels are considered higher value with more intensive engineering requirements. As a result, DW expects western shipbuilders to continue to dominate in the construction space over the 2014-2025 period.

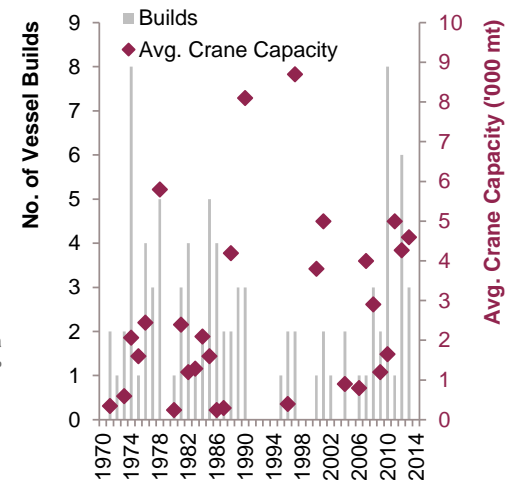
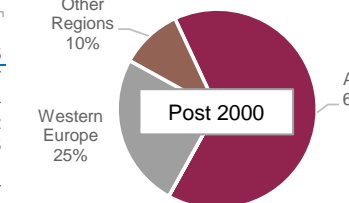
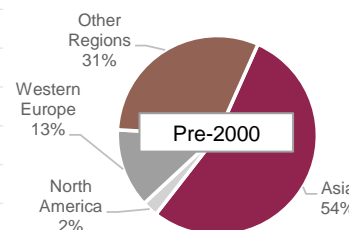
Offshore Construction Vessels Supply & Demand Analysis



DW estimates an additional 15-26 offshore construction vessels are required to meet demand over the 2014-2025 period. Key specifications include larger crane capacity due to larger offshore platforms.



Vessel Days '000	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Africa	0.8	0.8	1.4	0.9	0.7	0.4	0.7	0.8	0.9	0.9	0.8	0.8	0.7
Asia	4.2	4.9	4.6	5.2	4.3	4.3	3.8	4.2	4.6	4.6	4.7	4.5	4.4
Australasia	0.2	0.1	0.1	0.2	0.4	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Eastern Europe & FSU	0.5	0.8	0.4	0.5	0.3	0.7	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Latin America	0.9	1.7	1.6	1.1	1.2	1.1	1.1	1.2	1.2	1.3	1.3	1.2	1.1
Middle East	2.2	1.6	1.5	1.2	2.3	1.5	1.7	1.8	1.8	1.8	1.7	1.7	1.7
North America	1.4	1.4	1.1	1.3	1.0	1.6	1.6	1.5	1.3	1.2	1.3	1.3	1.4
Western Europe	1.8	1.9	1.7	1.7	1.2	1.4	1.3	1.4	1.6	1.7	1.6	1.5	1.4
Total	12	13	12	12	11	11	11	11	12	12	12	12	11



Source: Douglas-Westwood & various company data

Offshore Construction Vessels Regional Demand

- Demand for offshore construction vessels globally is expected to decrease by 14% by 2025.
- The trend towards deepwater exploration and production is expected to see the number of fixed platform installations plateau over the forecast period, driving lower requirements for conventional offshore construction vessels.
- DW expects key shallow water regions, North America, Middle East, Australasia and Asia to see growing requirements, particularly over the short-term (2014-2018) before a plateau over the long-term (2019-2025).


Additional Vessels Required by 2025 : 15 – 26 (28% of current fleet)

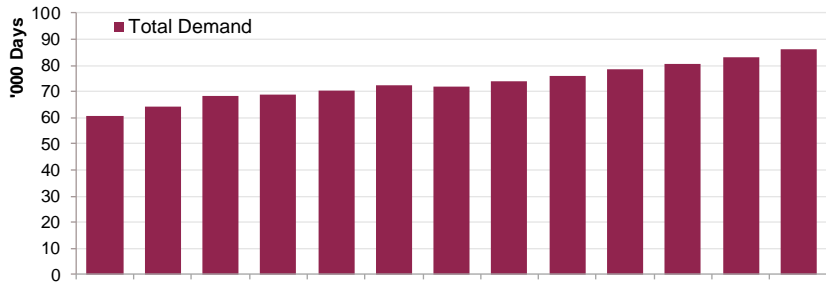
- The shift towards deepwater floating platforms and subsea infrastructure is expected to see less demand for conventional offshore construction vessels which mainly install fixed platforms. In addition, an increasing number of pipelayers are installed with similar crane capacities, competing for similar workscope.
- While DW expect fewer fixed platforms in the future, we expect these platforms to increase in size, requiring larger crane capacity. The shift towards Asian builds is also expected to continue as Western shipyards move towards higher value subsea vessels.

Offshore Construction Vessels Regional Supply Analysis

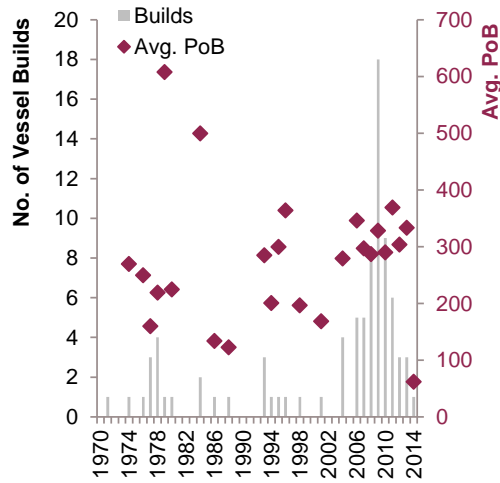
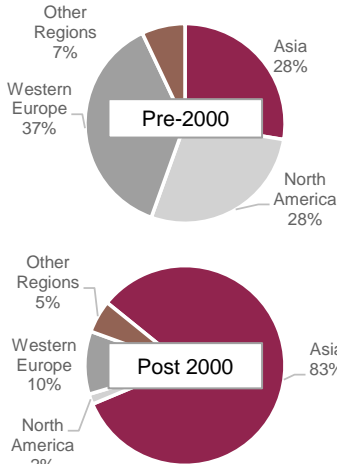
- **Supply** – Total operational supply of offshore construction vessels is estimated at 110, with a further two units on visible orderbooks, indicating a 1.8% book to fleet ratio.
- **Specifications** – Dedicated offshore construction vessels are considered old, with an estimated average age of 25.4 years. This is due to a growing population of non-dedicated offshore construction vessels which are not only able to perform heavy-lift duties but to carry out pipe installation.
- Crane capacities of offshore construction vessels range largely, with the smaller heavy lifts capable of lifting <500t. Larger vessels such as the Balder and Thialf have crane capacities in the 5,000-7,500mt space. These larger heavy lifts are typically required in platform installation as well as in decommissioning.
- **Region** – Asia continues to dominate the building of offshore construction vessels. In recent years, China appears to be a front runner, securing a decent number of contracts for the construction of newbuilds.

Barges Supply & Demand Analysis

 Increasing demand will see requirements for an additional 19-24 accommodation barges over the 2014-2025 period. Asia is expected to supply the majority of these vessels.



Vessel Days '000	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Africa	16	17	18	19	19	20	19	19	20	21	22	22	23
Asia	34	35	37	38	38	39	39	40	41	42	43	44	45
Australasia	1	1	1	1	2	1	2	2	2	2	2	2	2
Eastern Europe & FSU	3	4	4	4	4	5	5	6	6	6	7	7	8
Latin America	0	0	0	0	0	0	0	0	0	0	0	0	0
Middle East	2	2	3	2	3	3	3	3	3	3	2	2	2
North America	2	3	3	3	2	3	3	3	3	3	3	3	4
Western Europe	2	2	2	2	2	2	2	2	2	2	2	2	2
Total	61	64	68	69	70	72	72	74	76	78	81	83	86



Source: Douglas-Westwood & various company data

Barges Regional Demand

- Demand for barges globally is expected to increase 35% by 2025.
- Offshore accommodation solutions are typically employed throughout the entire lifecycle of a field/platform, with activities ranging from construction, life of field activities through to the decommissioning phase.
- Demand will largely arise from regions with relatively more benign operating conditions such as Asia and Africa which account for 30% and 38% of global demand respectively.

Additional Vessels Required by 2025 : 19 – 24 (21% of current fleet)

- DW expects relatively lower requirements for accommodation barges due to competition from other vessel types such as construction barges, hull-shaped and semisub units. With a larger exposure to the life of field market, DW expects a few additional units required per year over the entire 2014-2025 period with a slight tightening of supply 2022 onwards.
- As Western shipyards move higher into the value chain, DW expect the shift towards Asian accommodation barges to continue. PoB requirements have been mixed with contractors requesting a higher PoB in Western markets and similar PoB (current levels) in Asia.

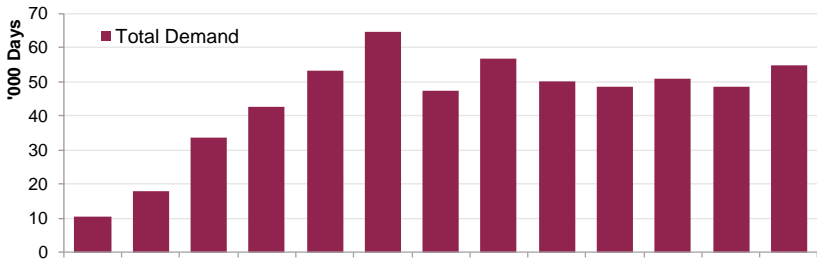
Barges Regional Supply Analysis

- **Supply** – Accommodation barges may serve multiple worksopes, with some operational in the pipelay or heavy lift space. In our analysis, supply of barges is limited to barges which are predominantly engaged in accommodation support contracts. In addition, competing for these contracts are alternative solutions such as liftboats and jackups, accommodation monohull vessels as well as semisubs, intensifying competitive pressure on the accommodation barge fleet.
- Total operational supply of barges is estimated at 98, with a further three units on visible orderbooks, indicating a 3.1% book to fleet ratio. Average age of accommodation barges is estimated at 12.5 years.
- **Specifications** – Average PoB of vessel builds have been trending towards approximately 350 Pax. These barges are also increasingly being equipped with DP capabilities, allowing them to be contracted in deeper but benign operation conditions.
- **Region** – Pre-2000, approximately 65% of vessel units were built in North America and Western Europe but construction has since shifted to price competitive Asian shipyards, with an estimated 83% of vessels built in Asia.

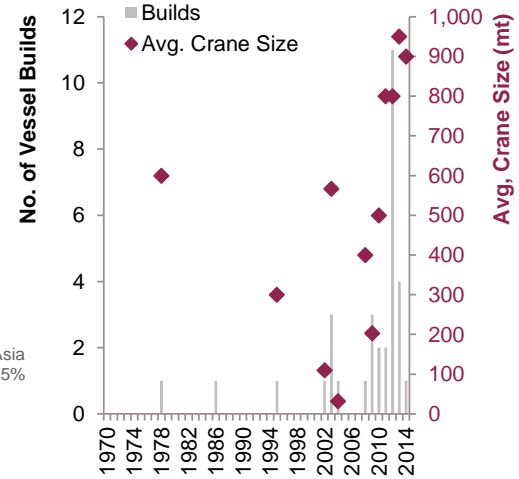
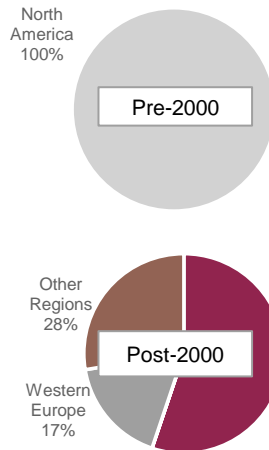
Wind Construction Vessels Supply & Demand Analysis



Robust growth in the offshore wind market is expected to require an additional 40-42 WTIVs. Increasing water depth and size of wind turbines is expected to drive higher requirements for larger cranes and deeper operational capabilities.



Vessel Days '000	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Africa	0	0	0	0	0	0	0	0	0	0	0	0	0
Asia	4	9	9	11	6	11	16	23	13	14	15	16	16
Australasia	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Europe & FSU	0	0	0	3	0	4	1	0	4	0	3	0	6
Latin America	0	0	0	1	0	0	0	0	0	0	0	0	0
Middle East	0	0	0	0	0	0	0	0	0	0	0	0	0
North America	0	2	5	3	2	15	0	3	0	0	0	0	0
Western Europe	7	7	20	24	45	35	30	31	33	35	33	33	33
Total	11	18	34	43	53	65	47	57	50	49	51	49	55



Source: Douglas-Westwood & various company data

Wind Construction Vessels Regional Demand

- Demand for wind construction vessels is expected to double by 2025 globally.
- This rapid growth is attributed to the increase in global efforts to raise energy contribution via alternative energy sources. However, given differing local regulations, variance in government subsidies and changing turbine specifications, installation projects are typically less certain compared to offshore oil & gas production.
- Nevertheless, Western Europe and Asia, driven largely by activities in UK and China, will lead requirements for wind construction globally.

Additional Vessels Required by 2025 : 40 – 42 (117% of current fleet)

- With demand expected to grow by 206% over the longer term, DW estimates 40-42 additional WTIVs to be required especially towards the 2019-2020 period where the market is expected to tighten. Other vessel types such as jackup barges or liftboats are expected to continue to participate in the market, limiting further growth for WTIVs.
- Increasing water depth and turbine size will likely see requirements for larger cranes and deeper operational capabilities. With the Chinese wind market expected to grow tremendously, DW expect Asian yards to continue taking up a larger share of newbuilds.

Wind Construction Vessels Regional Supply Analysis

- **Supply** – Total operational supply of dedicated WTIVs is estimated at 33 units, with a further 3 units on visible orderbooks, indicating a 9.1% book to fleet ratio. The WTIV fleet is relatively young, in part due to the emphasis placed on the renewables industry in recent years. Average age of the operational fleet is marked at 6.0 years. Prior to 2000, there were only three dedicated WTIVs in the industry – the 'Geosea', 'Tijil II' and 'Lisa-A'. In the last decade, the market has seen 30 additions to fleet.
- **Specifications** – Since 2000, WTIVs have been equipped with higher crane capacities to handle growing size of wind turbines. In addition, the water depth limit of each vessel has also seen an increase in given developments moving further from shore.
- **Region** – While some construction of WTIVs is in Western Europe, Eastern Europe and the Middle East, approximately 55% of builds in the past ten years have been built in Asia, specifically in Chinese yards such as COSCO and China Merchant.

Appendices

Abbreviation

Acronyms and Abbreviations

AHTS	Anchor Handling Tug Supply vessel
approx.	Approximately
BBL	Barrel
BHP	Brake Horsepower
Bn	Billion
CAGR	Compounded Annual Growth Rate
CAPEX	Capital Expenditure
CGT	Compensated Gross Tonnage
CSV	Construction Support Vessel
DCR	Daily Charter Rate
DP	Dynamic Positioning
DP1	Dynamic Positioning 1
DP2	Dynamic Positioning 2
DSV	Dive Support Vessel
dwt	Deadweight tonnage
ERRV	Emergency Rescue and Response Vessel
E&A	Exploration & Appraisal
E&P	Exploration & Production
EOR	Enhanced Oil Recovery
FPSO	Floating Production Storage & Offloading
FPSS	Floating Production Semi-Submersible
FSO	Floating Storage & Offloading
ft	Feet
GT	Gross Tonnage
GoM	Gulf of Mexico
HP	Horsepower
IMO	International Maritime Organisation
IOC	Integrated Oil Company
IRM	Inspection, Repair and Maintenance
kboepd	Thousand barrels of oil equivalent per day
KM	Kilometer
Kph	KM per hour
LoF	Life of Field
m	Meter
mmbtu	Million British Thermal Unit
MARPOL	Marine Pollution
mboepd	Million barrels of oil equivalent per day
MLC	Maritime Labour Convention
MMO	Maintenance, Modification and Operations
MODU	Mobile Offshore Drilling Unit
MPSV	Multi Purpose Support Vessel
MSV	Multi Support Vessels

NOC	National Oil Company
O&G	Oil & Gas
Opex	Operational Expenditure
OSRV	Oil Spill Response Vessel
OSV	Offshore Support Vessel
PAX	Passengers
PoB	Persons on board
PSV	Platform Supply Vessel
ROV	Remotely Operated Underwater Vehicle
ROVSV	ROV Support Vessel
SEA	South East Asia
SOLAS	Safety of Life at Sea
SPAR	Single Point Anchor Reservoir
Spec	Specification
SPM	Single Point Mooring
SPS	Special Purpose Ships
Sqm	Square Metres
SURF	Subsea Umbilicals Risers & Flowlines
t	Tonnes
TLP	Tension Leg Platform
UK	United Kingdom
WTIV	Wind Turbine Installation Vessel
WD	Water Depth

Douglas Westwood's Offerings

About Us

Established in 1990, Douglas Westwood is a leading provider of market research and consulting services within the engineering, OEM and field services sectors of the energy industry. We are an independent organisation supported by proprietary data, insight and knowledge. DW have one of the world's largest sector focused teams located in our offices in the Americas, Asia and Europe. We have provided our products and services to client organisations in more than 72 countries worldwide and have received 19 industry awards for our work.

Douglas-Westwood clients include the world's:

- Top:10 oilfield services companies
- Top:9 oil & gas companies

"Energy experts Douglas-Westwood" The Guardian



Consultancy

With an extensive advisory team spanning three continents, Douglas-Westwood delivers energy business consultancy services across the globe. DW consultancy services are focussed on the strategic planning process, helping our clients to make investment decisions, develop and test advanced competitive strategies for new products, new business streams, mergers and acquisitions. We provide consultancy services through advanced market insight, modelling and simulation to a client base which includes payers in oil & gas E&P, oilfield services, conventional & renewable energy and the public sector.

Douglas-Westwood has supplied consultancy services to 252 companies worldwide.

"Foremost oilfield services market consultant" Hong Kong client



Transactions

Douglas-Westwood provides sector-focussed commercial due-diligence and transactions services to major and mid-tier private equity firms, investment banks and debt providers. We have industry-leading credentials including both buy:side and sell:side mandates, public:to:private transactions, re:financing, IPOs and project financing ranging in enterprise value from \$5 million technology firms to \$1 billion oilfield service, engineering and equipment companies.

Douglas-Westwood clients include the world's:

- Top:10 private equity firms
- Top:9 investment banks

"Douglas-Westwood provides great value to us" Perth client



Research

Business research, analysis and market forecasting is our core activity. Over the years we have built a huge knowledge base of both sectors and players. Our experience of researching the oilfield services sector (OFS) is unparalleled worldwide. We specialise in emerging markets and technologies, from offshore windpower to subsea processing and difficult to access markets and geographies including Russia and the Middle East. Our custom research offerings include: gathering & analysis of market data, independent marketing and forecasting, measurement & analysis of competitive positions and industry consultation & in:depth perception surveys.

Douglas-Westwood have researched over 200 different business sectors to wide international acclaim.

"Top energy research group Douglas-Westwood" Financial Times

Publications

Douglas-Westwood produces original energy business market studies and forecasts, now highly acclaimed and used worldwide. In oil & gas we were the first firm to forecast & value the growth of key offshore markets such as deepwater, subsea production, global onshore drilling and pipelines..

Our reports are geared to meet senior executives' needs in business planning and decision:making and assume no previous reader knowledge of the subject area. Each offers a concise, region by region format. Analysis is based on our extensive in:house project databases and models combined with forecasting expertise developed over many years.

Douglas-Westwood has over 20 energy sector market forecast titles in print.

"An excellent report in all areas" Houston client



Douglas-Westwood Standard Terms & Conditions

The following terms of business apply to engagements accepted by Douglas-Westwood Limited. All work carried out is subject to these terms except to the extent that changes are expressly agreed in writing.

1 Douglas-Westwood Private Limited

We are Douglas-Westwood Pte Ltd, a limited private company incorporated in Singapore, with registered number 201308419N. References in these terms of business to “we”, “us”, “our” or “our partners” shall be construed accordingly. References in these terms of business to “you” or “your” shall refer to each and every party to this engagement letter (other than us).

2 Our fees and invoicing arrangements

Unless otherwise agreed in writing, our fees will be based on the number and seniority of staff required, the degree of skill and responsibility involved, the resources required to complete the engagement and the fee rates for the appropriate personnel. Our fee rates will be reviewed from time to time. We will also charge for any disbursements incurred during the engagement and we will add GST to charges and disbursements if chargeable. Any fee estimate we may provide is not an agreement to perform the services within a fixed time or for a fixed fee.

Disbursements will include travel and accommodation expenses based on business class air travel and/or first class rail travel and/or car mileage at SGD0.80 per km and accommodation at an appropriate class of hotel.

Any fee estimate agreed with you is necessarily based on the assumption that the information required for our work is made available in accordance with agreed timetables, and that your key executives and personnel are available during the course of our work. If delays or other unanticipated problems which are beyond our control occur this may result in additional fees for which invoices will be raised.

Payment terms – one third of the lump sum cost would be invoiced at start:up, one third following the completion of the draft report and the final third upon completion of the final report. Expenses would be invoiced at agreed times. All payments to be received within 30 days of invoice. The terms of The Late Payment of Commercial Debt Regulations 2002 would apply to this work. We shall be entitled to charge monthly interest at a rate of 2% above the base rate for the time being of DBS Bank Ltd on all invoices which remain unpaid 60 days after presentation. We reserve the right, where fees have been invoiced and payment is outstanding to us, to exercise a lien in respect of those outstanding fees over any documents Target ongoing to you which may be in our possession

3 Commissions

Where commissions are payable to us as a result of this engagement we will notify you of the amounts at the time the transactions concerned are carried out. We will not be liable to pay to you any such commission paid to us but we may take it into account in determining our fee.

4 Our responsibilities to you

We will provide the services described in our engagement letter (or such variations as may subsequently be agreed in writing between us) with reasonable skill and care and in a timely manner. The nature and content of any advice we provide will necessarily reflect the specific scope and limitations of our engagement, the amount and accuracy of information provided to us and the timescale within which the advice is required. If you ask us to provide our advice in an abbreviated format or timescale, you accept that you will not receive all the information you would have done had we provided a full written report or had been able to perform the work without an abbreviated timescale.

We are providing specific advice only for this engagement and for no other purpose and we disclaim any responsibility for the use of our advice for a different purpose or in a different context. If you plan to use this advice on another transaction or in another context please let us know and provide us with all material information so that we can provide advice tailored to the appropriate circumstances.

Douglas-Westwood Standard Terms & Conditions

Unless otherwise agreed with you, we may correspond by means of the Internet or other electronic media or provide information to you in electronic form. Because of the inherent risks associated with the electronic transmission of information on the Internet or otherwise, we cannot guarantee the security and integrity of any electronic communications or information sent or received in relation to this engagement. Whilst it is our policy to check our e:mail correspondence and other electronic information with anti:virus software, we similarly cannot guarantee that transmissions or other electronic information will be free from infection. You acknowledge that if we are working on your premises we may need to connect to the Internet through your internal network in order to access our systems.

5 Your responsibilities to us

In order to enable us to fulfill our responsibilities you agree, on request, to provide us with complete, accurate and timely information and to carry out any obligations ascribed to or undertaken by you or others under your control. You agree that any commercial decisions that you make, are not within the scope of our duty of care and in taking such decisions you must take into account the restrictions on the scope of our work and other factors, commercial and otherwise, of which you and your other advisers are, or should be, aware from sources other than our work.

6 Information and confidentiality

Where we receive confidential information we shall take such steps as we in good faith think fit to preserve confidential information from unauthorised disclosure or other misuse both during and after termination of this engagement. If, despite taking such steps, we disclose without authorisation or otherwise misuse the confidential information, thereby causing you loss, we shall be liable to you. Save where there is specific agreement to the contrary, our client relationship with you shall not be treated as confidential information and we may disclose this fact to clients, prospective clients, or other third parties.

Subject to our duty of confidentiality, you agree we may act for your competitors or for other clients, whose interests are or may be opposed to yours. The reports, letters, information and advice we provide to you during this engagement are given in confidence solely for the purpose of this engagement and are provided on the condition that you undertake not to disclose these, or any other confidential information made available to you by us during the course of our work, to any third party (being a party other than those to whom the report, letter, information or advice is addressed, or a potential or actual counterparty to a transaction, or your or their other advisers) without our prior written consent.

Neither we nor you will be prevented from disclosing confidential information:

- a) which is or becomes public knowledge other than by a breach of an obligation of confidentiality;
- b) which is or becomes known from other sources without restriction on disclosure; or
- c) which is required to be disclosed by law or any professional or regulatory obligation.

You agree that, for the purposes of carrying out our responsibilities in this engagement, we shall not be treated as having notice of information which may have been provided to individuals within this firm who are not involved in this engagement. Notwithstanding the restrictions on disclosure contained in this section, where we provide any oral or written statement to you as to the potential US federal income tax consequences that may result from a transaction, we expressly authorize you (and each employee, representative or other agent of yours) to disclose to any and all persons, without limitation of any kind, the US federal income tax treatment of the transaction, any fact that may be relevant to understanding this, and all materials of any kind (including opinions and other tax analyses) provided to you in relation to these. However, because our advice is solely for your benefit and is not to be relied upon by any other persons, as part of any such disclosure made by you, you must inform all such persons that they may not rely upon our advice without our prior written consent.

Douglas-Westwood Standard Terms & Conditions

7 Intellectual property rights

We retain all copyright and other intellectual property rights in everything developed, designed or created by us or any predecessor firm either before or during the course of an engagement including systems, methodologies, software, know-how and working papers. We also retain all copyright and other intellectual property rights in all reports, written advice or other materials provided by us to you, although the fees you pay us allow you to use those materials for the purposes for which they were created under this engagement.

8 Health and safety

We acknowledge our statutory responsibility to cooperate with your health and safety requirements, provided we are given notice of these. Whilst on your premises our partners, staff, agents and subcontractors shall be afforded by you the same protection for health and safety purposes as is due to your employees. If we are required by you to enter the premises of a third party you will use reasonable efforts to ensure that the third party also affords such protection to our partners, staff, agents and subcontractors as is due to its employees.

9 Our liability

By engaging us you agree that any claim of any sort whatsoever arising out of or in connection with this engagement shall be brought only against Douglas-Westwood Limited and that no claims in respect of this engagement will be brought personally against any other persons involved in performance of this engagement, whether actual or deemed servants or agents of us or not.

10 Limitation of liability

You agree that our total liability in respect of any loss shall be limited to the lower of the figures produced by the operation of the following two sections.

11 Cap

Our liability to you in respect of breach of contract or breach of duty or fault or negligence or otherwise whatsoever arising out of or in connection with this engagement shall be limited in total to £700,000 (approximately €1,000,000) to cover claims of any sort whatsoever (including interest and costs) arising out of or in connection with this engagement. This provision shall have no application to any liability for death or personal injury nor to any liability arising as a result of fraud on our part (or for which we are vicariously liable) nor to any liability which cannot lawfully be excluded or limited.

Where there is more than one party to this engagement letter (other than us), the limit of liability will have to be allocated among you. It is agreed that, save where an allocation is expressly stated in our engagement letter, such allocation will be entirely a matter for you and you shall be under no obligation to inform us of the allocation. If (for whatever reason) no such allocation is agreed, you shall not dispute the validity, enforceability or operation of the limit of liability on the ground that no such allocation was agreed.

12 Proportionality

Our liability to you in respect of breach of contract or breach of duty or fault or negligence or otherwise whatsoever arising out of or in connection with this engagement shall be limited to that proportion of the loss or damage (including interest and costs) suffered by you, which is agreed between us or ascribed to us by a Court of competent jurisdiction allocating proportionate responsibility to us having regard to the contribution to the loss and damage in question of any other person responsible and/or liable to you for such loss and damage. This provision shall have no application to any liability for death or personal injury nor to any liability arising as a result of fraud on our part (or for which we are vicariously liable) nor to any liability which cannot lawfully be excluded or limited.

For the purpose of assessing the contribution to the loss and damage in question of any other person pursuant to the preceding paragraph, it is agreed that no account shall be taken of any limit imposed or agreed on the amount of liability of such person by any agreement (including any settlement agreement) made before or after the loss and damage in question occurred.