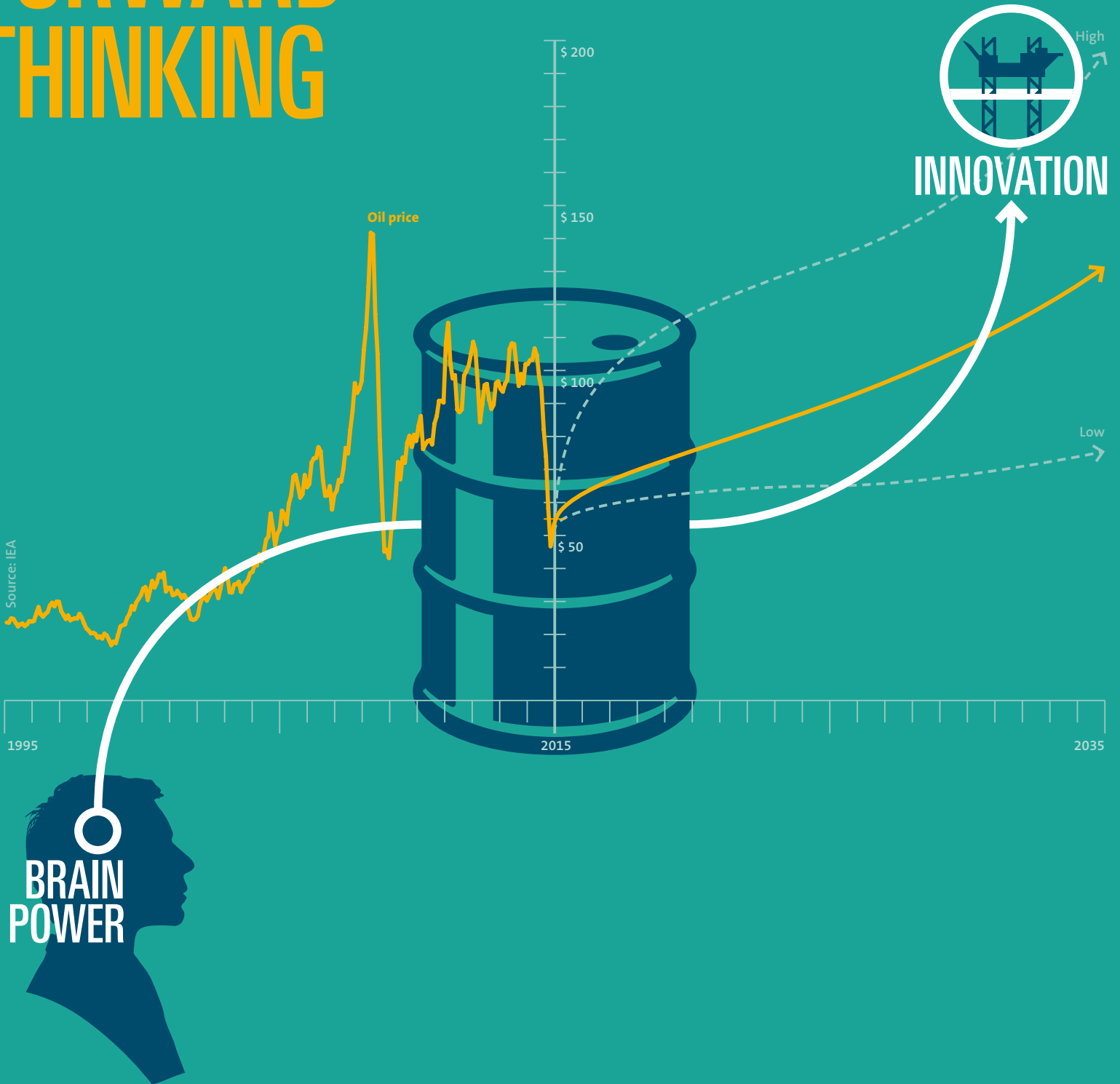


INSIDE

MAY 2015 # 23

FORWARD THINKING



Source: IEA

1995

2015

2035

BRAIN
POWER

GustoMSC

THE PIONEERS OF OFFSHORE ENGINEERING

CONTENTS

4 NEWS IN BRIEF & AGENDA

10 FACTS & FIGURES

Take a closer look at the AJ70 accommodation jack-up, the solution for harsh offshore environments, such as the North Sea.

12 ASSOCIATED EQUIPMENT

New offshore jack-ups relocate more frequently and therefore require appropriate jacking systems. GustoMSC anticipated these challenges with its variable speed controlled rack & pinion jacking system.

17 COLUMN

Dr. Carl Arne Carlsen explains how safety in mobile offshore units has largely been driven by serious accidents.

18 RECOGNIZED MARKET LEADER

Since 1975, GustoMSC delivered the designs for 64 accommodation and maintenance units, of which 13 are currently under construction.

23 CARTOON



INTERVIEW ACCOMMODATION UNITS FOR PROSAFE

14

Prosafe is presently building two accommodation vessels based on the GustoMSC OCEAN500 design. James MacGregor, Chief Technical Officer of Prosafe, looks back on the development and customization of the OCEAN500 project.



LOOKING FORWARD TO THE OIL PRICE

What direction is the oil price going to take? Can we expect a recovery in the short term? Lucia van Geuns, senior consultant Petroleum Geosciences at TNO, reflects on these and other questions about the oil price.



FORWARD THINKING VERSATILE SOLUTION

20

A unit that can truly operate in the Offshore Wind and Oil & Gas markets creates a more solid base for investment. The new NG-5500X design covers the identified market needs.

COLOPHON

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PREFACE FORWARD THINKING



Nils van Nood
Managing Director GustoMSC

Anti-cyclic

These are turbulent times in which the offshore industry proves once again that it is anti-cyclical. During the aftermath of the financial crisis, our industry enjoyed high oil prices and record numbers of orders for new build Mobile Offshore Units (MOUs). Many offshore oil and gas related companies thrived. Other areas of the economy were less prosperous during these years and growth figures were moderate to low. And now we see more signs of economic optimism throughout the western economies, not in the least driven by low oil prices. Oil companies are now severely cutting their exploration budgets and the number of orders for new build MOUs is clearly drying up. The geopolitical situation in quite a number of areas is complicating the picture even further. Consequently, it is no longer a shame to confess that you do not have a crystal ball and you cannot forecast the short to medium-term developments in our offshore industry with any accuracy. Therefore, we are pleased that we found Lucia van Geuns prepared to give her expert insight in our main article and provide us with a reasonably optimistic scenario for the medium to longer-term development of the oil prices.

Downturn

But even if oil prices do rise in the medium term, it will take a while before investment levels actually increase and the number of orders for new build MOUs start to rise again. The shipyards that have gained experience over the years now face the challenge to cut their costs and maintain their expertise during

this downturn. The same applies to many others in the industry, also for designers and engineers such as GustoMSC. As a company, we are fortunate to a certain extent that the amount of assets on our books are limited and that we have been able to strengthen our balance sheet during the good years. Moreover, during a downturn, we are still able to provide continuity for our most important 'asset', which is of course our talented and experienced team of people. That team will be working on a number (albeit small) of new orders, on consultancy studies for our clients, on after sales and maintenance services, on further developing our in-house technologies and on innovations whereby we develop new solutions. We do these latter two activities at our own cost aiming to provide even safer, more reliable and more efficient MOUs in the future.

Obligation

Safety and reliability of MOUs is also the topic of this Inside's column by one of the industry's most esteemed technology leaders: Dr. Carl Arne Carlsen, a long-standing friend of GustoMSC. In his column, Dr. Carlsen briefly refers to the importance of 'institutional memory', which not only applies to individual companies, but also to the industry as a whole. It is to be hoped that the industry will be able to maintain its level of expertise during this downturn because when the market picks up again, we will all remember that for many years the three most important challenges for our industry were finding talented people, recruiting talented people

and keeping talented people. I see it as an important obligation to secure this continuity for GustoMSC in the long-term interest of our great offshore industry and I trust others will do their part to dampen the negative effects of the present market situation. One way of doing that is to make proper use of the time that becomes available to innovate and develop new solutions. At GustoMSC, we will certainly make use of this opportunity for that purpose and I look forward to cooperating with industry partners in doing this.

UP-TO-DATE



NPCC ORDERS DESIGNS FOR TWO MULTI-PURPOSE JACK-UPS

National Petroleum Construction Company (NPCC) awarded Shanghai Zhenhua Heavy Industries Co., Ltd. (ZPMC) with the order of two multi-purpose jack-up vessels based on the GustoMSC NG-2500X design. The two new builds, SEP-650 and SEP-750, will be exact copies of the SEP-550, which was successfully delivered in June 2014. Upon completion of the units, NPCC will own and operate four GustoMSC NG-2500X designs. These orders are part of NPCC's upgrading of their offshore marine fleet. NPCC will

accomplish further expansion with their self-elevating units through the repeat order of the GustoMSC designs. The NG-2500X enables NPCC to operate year round with a medium-sized unit in up to 70m water depth. 50% of the construction and accommodation jack-ups in operation are of GustoMSC's design. 'With four GustoMSC NG-2500X designs, NPCC has become one of our most loyal customers. It is a confirmation that the market acknowledges the advantages offered by the GustoMSC NG-2500X design,' says

Jan-Mark Meeuwisse, Sales Manager of GustoMSC. Once the SEP-650 and SEP-750 are completed, GustoMSC will have twelve NG-2500X designs in the market, with four influential operators, namely NPCC (4), Seajacks (3), GMS (3), and Vahana Offshore (2 units under construction).

Jan-Mark Meeuwisse
Sales Manager



FIRST RACK & PINION JACKING COURSE SUCCESSFUL

After receiving several requests from end-users, GustoMSC Customer Service and Equipment Department decided to set up a rack and pinion jacking course together with Siemens in 2014. Efficiency and safety on board depends greatly on the knowledge, skills and competences of those in charge of managing the operation of the jack-up, such as the jacking process of the unit, maintenance and troubleshooting. As the offshore industry requires qualified personnel on board of the units, this course offers a competitive advantage to end-users as the certificate can

be used as proof. This course is also beneficial for operational personnel and persons in charge for procuring jack-up parts. They can enhance their knowledge through this course to understand jack-up units operations so offshore projects can be executed more smoothly and successfully. The learning objectives are divided in a theoretical and a practical section. The course has a modular setup and can be adjusted to the requirements of each group to focus more on certain topics (e.g. mechanical, electrical, control system). Gulf Marine Services is the first client who booked 3 courses for their personnel last year. Due to positive experiences and feedback from the participants, they intend to book more courses this year.

Ling Chang
Customer Service Engineer



FOCUS ON THE ARCTIC AT ATC COPENHAGEN

In March 2015, the Arctic Technology Conference took place in Copenhagen for the first time in history in Europe. As one of the premier conferences on Arctic technology, the conference was well attended by people from all sectors of the industry. From the conference and the discussions during the conference, it is clear that the necessary long-term focus on the Arctic exists within the industry and that developments are continuing to take place also in this period of lower oil prices.

GustoMSC's participation at the Arctic Technology Conference reflected our continued focus on Arctic developments.

In our booth in the exhibition hall, we had experts present for our floating and jack-up solutions and we contributed to the technical program with two of our experts who have been involved in our Arctic developments since the beginning. Our annual dinner was hosted at a wonderful location in Copenhagen and, as usual, was much appreciated by our guests. All in all, a successful conference and we are looking forward to next year's Arctic Technology Conference in St. John's, Newfoundland!

Alain Wassink
Sales Manager



Courtesy Noble

NOBLE BULLY II WINS GLOBAL FLOATING RIG OF THE YEAR 2014 AWARD

Shell has awarded this year's Global Floating Rig of the Year Award to the Noble Bully II, recognizing it as the best performing floating rig for Shell worldwide in 2014. Noble Bully I won the same award in 2013. The Noble Bully II and its sister Noble Bully I, are designed to offer a low cost and more flexible alternative for drilling in ultra-deep water. The Noble Bully I operates for Shell in the Gulf of Mexico, the Noble Bully II works for Shell off the Brazilian coast.

AGENDA

4 – 7 MAY 2015
OTC 2105 HOUSTON
Stand no. 11307

2 – 4 JUNE 2015
OIL & GAS ASIA 2015 KUALA LUMPUR
Participation in IRO stand

17 – 18 JUNE 2015
IADC WORLD DRILLING 2015 CONF. & EXH. ROME
Stand no. 24

27 – 29 OCTOBER 2015
OTC BRASIL 2015 RIO DE JANEIRO
Stand in Pavilion no. 3 Stand C7

9 – 12 NOVEMBER 2015
ADIPEC ABU DHABI
GustoMSC stand in IRO Holland Pavilion

1 – 3 MARCH 2016
SPE/IADC DRILLING 2016 FT. WORTH, TEXAS
Stand no. 109



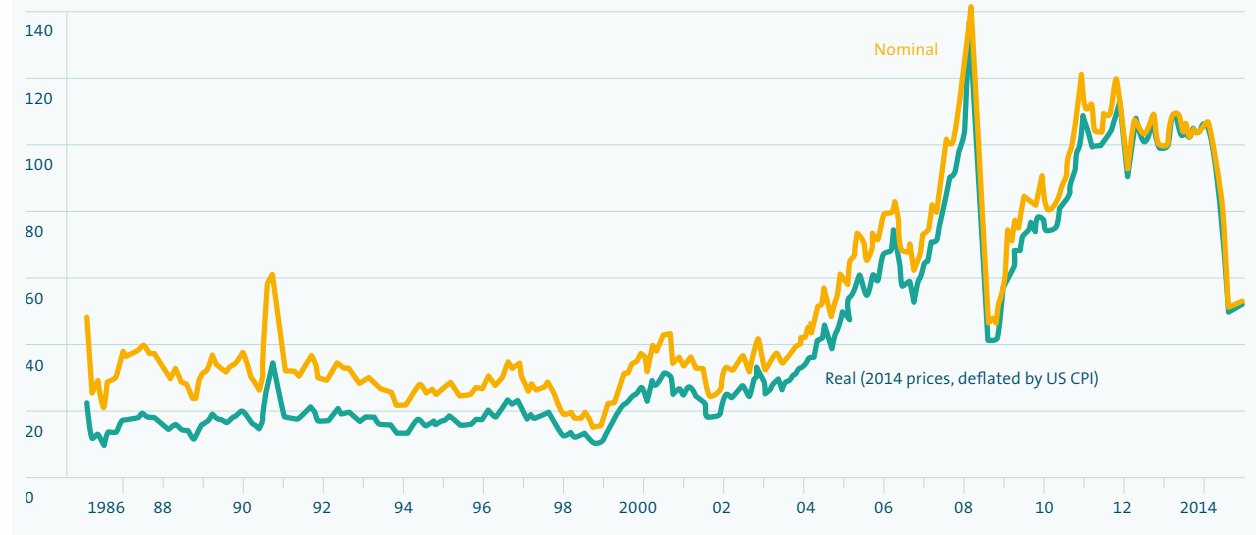
'DURING THE OPEC MEETING IN NOVEMBER 2014, OPEC DECIDED NOT TO INTERFERE IN THE PRICE DROP. THIS HAD NEVER HAPPENED BEFORE.'

Lucia van Geuns
Senior Consultant
Petroleum Geosciences at TNO

LOOKING FORWARD TO THE OIL PRICE

The unprecedented drop in the oil price in the second half of 2014 came after a long period of relative stability on the oil market. Therefore, it is now an important question in the world economy and geopolitics: what direction is the oil price going to take? Can we expect a recovery in the short term? What does the development of the oil price mean for oil-producing countries and for international and national oil companies? Lucia van Geuns, former Senior Fellow at the Clingendael International Energy Programme and currently Senior Consultant Petroleum Geosciences at TNO, is an expert in the field of global energy and geopolitics: 'It looks like we have reached the bottom of the oil price decline. I expect that the price will go up again gradually in the second half of 2015.'

Brent front month (\$ per barrel)



Source: Thomson Reuters Datastream

From 2009 until July 2014, the average oil price was steady near the high level of 110 dollars per barrel. During the nineties, especially towards the end of the century at the time of the Asian financial crisis, the price of oil was very low. As a consequence, expenditure on maintenance was low and only modest investments were being made in oil exploration and production. At the beginning of this century, the oil price started rising from 2000 until 2008 as a result of increasing demand from emerging economies like China and India, and economic growth in the USA and Europe. The price surged as supply could no longer keep up with demand.

What caused the oil price to go down all of a sudden?

'In the first seven years of this century, the international oil market had little spare capacity in the system, which made prices very vulnerable for geopolitical turmoil or natural disasters like hurricane Katrina in the Gulf of Mexico. The financial crisis, which started in 2007 in the USA, was also such an event. It drove the oil price further up, partly due to speculation. When the financial crisis also hit the rest of the world in August 2008, the oil price slumped as demand fell away. At that point in time, the oil price was even lower than it is today. However, it was just for a very short period of time because the OPEC immediately took the decision to cut back on production. They were thus able to force the price up again. Around 2011, the oil price reached the level of 110 dollars per barrel. It remained stable in spite of the increasing unconventional oil ('tight oil') production in the USA. Supply destruction due to unrest in Libya, Nigeria, Iraq or Syria was compensated for by this extra US oil, and Saudi Arabia was able to manage their spare capacity well in order to balance the price at a high level.'

Why didn't OPEC take action as they did in 2008?

'The price drop in the second half of 2014 was caused by a combination of crude oil oversupply and lack of growth in oil demand especially from emerging China. OPEC is a very important player in the oil market: it has around a 40 percent market share, which is the equivalent of 30 million barrels a day. Globally, around 91 million barrels of crude oil a day are being produced. The most influential OPEC member is certainly Saudi Arabia, which produces about 10 million barrels a day. Whereas in 2008 they were able to manage the oil price by cutting back on production, during the OPEC meeting in November 2014 in Vienna,

OPEC decided not to interfere in the price drop. OPEC (read Saudi Arabia) figured that their market share in the current market is more important than trying to bring up the price again. It was a very remarkable decision because this had never happened before.

You have to see this decision in the light of demand and supply. Within OPEC and the Middle East, Iraq produces over 3 million barrels a day; most of their production is exported to Asia. Also Saudi Arabia, Iran and the Emirates export most of their oil to emerging economies in Asia. In the next twenty years, OPEC will be focusing on Asia as the growing consumer market. In the long term, OPEC – read Saudi Arabia – considers it more important to maintain market share than to cut back on production as they have the bulk of the export market. It is a very subtle game that is being played by Saudi Arabia within OPEC and the rest of the world.'

Is it a concerted plan to put pressure on Iran or Russia?

'OPEC says it is all about market share. But if you look at Russia, it produces almost as much oil as Saudi Arabia, about 10 million barrels a day. Normally, Russia benefits from production decisions made by OPEC. Now because of the sudden price drop, Russia is suffering considerably. Almost 50% of their government income is dependent on hard currencies coming from oil exports. Right now, they are experiencing difficulties in their government expenditure in addition to the negative effects of a weak ruble and a strong dollar. And then there is Iran, a country still suffering under a boycott and a reduced oil export because of it, who needs a high oil price to balance their state budget.

Another 'storyline' frequently heard is that Saudi Arabia wants to discourage the production of oil that is technically expensive, for example oil sands, tight oil, or costly deep-water production. If prices are low, these projects will no longer be economically interesting and the production will slow down or stop. As a result, oversupply in the market will be solved and the oil price will go up again. Hence, oil that is expensive to produce, which is not the oil produced by the OPEC, will suffer.'

Oil price needed per barrel to balance budgets



Source: Deutsche Bank and IMF

Which companies are suffering most from the recent low oil prices?

'You have to make a distinction between short, mid and long-term projects. Long-term projects, for example those in the Arctic, will remain fairly unaffected. For example, companies like Shell decided to continue their exploration activities in Alaska. They have already invested billions of dollars and will start drilling in the next season, as they foresee that the oil price will eventually go up again. They are only interested in the oil price at the time that they will actually start producing which will be in 2025 or beyond. They anticipate that on the longer term, the world will still need oil and the oil price will be at such a level that these projects will eventually be economically feasible.

Short-term projects like tight oil in America are characterized by an industrial way of drilling wells. A constant drilling of wells requires a constant flow of capital. Capital inflows can dry up when the returns on investments are insufficient. Many US oil companies can live with an oil price of around 60 dollars, but not all of them. Some companies will scale down or freeze their operations. Eventually, production will be slightly lower. I don't foresee major cutbacks in production, maybe in the second half of this year but only for the smaller American operators. In Canada, the oil sands producers will also suffer. But ultimately, these are long-term projects so they will recover when the oil price goes up again.

Another category of companies that will suffer is the oil & gas service providers, e.g. drilling and offshore services companies. Many international oil companies have announced significant cuts in capital expenditure. The service providers have to be very competitive in order to obtain work. Already many companies had to lay off people because of lower activity levels.'

Who are the stakeholders that would benefit from a high oil price?

'Of course, the international oil companies would benefit because high oil prices are required to sustain investments in long-term production capacity. But also most OPEC countries have an interest in stable high oil prices to balance their books. Some OPEC members require an oil price as high as 120 dollars in order to avoid hard spending choices [see chart of IMF]. Even Saudi Arabia requires an oil price of 104 dollars; however, due to the high oil prices

'A PRICE OF 70 TO 80 DOLLARS IS ACCEPTABLE FOR CERTAIN OPEC MEMBERS.'

Lucia van Geuns
Senior Consultant Petroleum Geosciences at TNO

in the last five years, it has a considerable financial reserve to fall back on. Their main competitors in term of markets are their own OPEC members: Iran and Iraq. Of course, we should not forget the winners of a low oil price: the consuming economies that have to pay far less for fuel. On the other hand, the move to a more sustainable energy economy can be slowed down.'

Have we reached the bottom of the oil price decline?

'Yes, I think we have. It looks like we have reached the bottom of the oil price decline. I expect that the price will go up again gradually in the second half of 2015. Whether the oil price will go up as far as 110 dollars is unlikely. However, if major crises and calamities should occur, this could act as a trigger to boost up the price again. A price of 70 to 80 dollars is acceptable for certain OPEC members, others will still suffer because of the level of their government spending. A stable price of 70 to 80 dollars would be an oil price most stakeholders could live with.'



Lucia van Geuns studied geology at Leiden University in The Netherlands. Van Geuns worked for Shell for over 22 years in various positions and in different countries. She has extensive experience in geoscience, petroleum engineering and economics and planning. In 2003, she started working for the Energy Program of Institute Clingendael, The Netherlands Institute of International Relations. Her research focused on the geopolitics and macroeconomics of international energy markets and energy transition. Van Geuns switched to the energy department of TNO, an applied research organization in The Netherlands, earlier this year. In addition, she is a non-executive director of an energy service company, Core Laboratories, and president of the Royal Geological and Mining Society (KNGMG) of The Netherlands.

500 POB

AJ70 THE ULTIMATE NORTH SEA SOLUTION

For the harsh offshore environment areas, in particular in the North Sea, we see an increasing demand for mobile offshore units which can provide field development, maintenance and decommissioning support services.

Within the North Sea jack-up territory, multiple fields have been developed using drilling jack-ups, with an important role being played by the GustoMSC CJ70 design. New fields are still being developed in the deeper waters of the UK sector and on the Norwegian Continental Shelf. For several platforms, mid-life maintenance or upgrade programs are being considered while other platforms are being prepared for decommissioning and removal.

Operational uptime for mobile offshore units, with accommodation and other related services essential for the progress of the field missions, is of primary importance in controlling safety and execution costs. Therefore an accommodation and maintenance jack-up is the preferred mobile solution as it will outperform the semi-submersible accommodation fleet in a harsh environment.

The CJ70 has been successfully deployed in the North Sea for over 15 years and thus the step to build a dedicated AJ70, a sturdy harsh environment accommodation jack-up, has been taken with confidence. The AJ70 relies on the well-proven jack-up design technology of seven CJ70 units currently in operation and another four under construction. The AJ70 has been further enhanced to make it into an accommodation unit that is able to serve the market with cost-effective operations.

GustoMSC foresees that the AJ70 accommodation jack-up will play an important role in the North Sea for the years to come.



Rutger Baan
Sales Manager

FULLY EQUIPPED
ACCOMMODATION BLOCK UP TO
500 POB

The accommodation areas are arranged on the central deck and around the forward leg. The generic layout has an impressive 500 PoB, all single cabins in accordance with the Norwegian Continental Shelf required standards.

CRANE CAPACITY
UP TO
3,000 T

Two cranes will serve the unit supply logistics but can also provide services to the adjacent platform, while the optional third main crane with a capacity up to 3,000 tons can be fitted to assist with decommissioning activities.

LARGE
VARIABLE LOAD
6,000 T

With a total variable load up to 6,000 tons, the unit has ample capacity to serve its crew and projects in a safe and professional manner.

MAXIMUM
WATER DEPTH
150 M

The AJ70 can operate in harsh environments in a water depth of up to 150 m (492 ft).

UNOBSTRUCTED
DECK AREA
1,500 M²

The main deck has an unobstructed deck space of 1,500 square meters which is orientated in such a manner that it provides direct access to the adjacent platform for a variety of support activities.

ASSOCIATED EQUIPMENT

RACK & PINION SYSTEM

New offshore jack-ups are expected to be relocated more frequently and therefore require appropriate jacking systems. Key factors include: safety, system availability, speeding up relocations, wear reduction and further automation.

GustoMSC first anticipated these developments in 2009, especially for shallow water operations. At that time we introduced the patented high-speed, fully continuous version of our hydraulic cylinder jacking system. Our Variable Speed Drive (VSD) Rack & Pinion Jacking System, introduced in 2006, is the preferred option for deeper water projects, where truss legs are widely used, and is ready for the new challenges. The system has been used on a number of jack-ups which are frequently relocated and we continue to refine the design.

High speed and high quality

Our Rack & Pinion Systems feature case-hardened pinions and high-quality gearboxes for a long, reliable life. Each pinion has its own VSD which provides accurate load sharing and load monitoring, as well as soft-starts and soft-stops. These refinements reduce wear on the drive and brakes as well as fatigue effects. In the past, jack-up platforms were expected to experience only a few dozen rig moves during their life. Our new system allows for

up to thousands of moves – essential for accommodation and construction jack-ups.

Safe, smooth and quick relocations depend on the leg jacking speed, effective automation and a high system availability. We offer jacking speeds up to 0.8 m/min and leg handling speeds up to 1.2 m/min, hence the jacking operation is no longer the governing factor during a rig move. The VSD controlled jacking units are grouped in layers which offer redundancy hence increase safety. The continuously variable speed drive also means that the power demand can be lowered should the rig power supply be limited. Careful design and fault tree analysis results in a 99.9% availability of the drives and control system during operational life. The highly automated control system provides the jacking operator with full information on the central control panel about the motor temperatures, loads and status of numerous system parameters.

Load monitoring

The loads on the legs and pinions during jacking can be accurately monitored by measuring the motor currents. To supplement these dynamic measurements we recently introduced two static load measurement systems. These are designed for fixed jacking systems which lack flexible shock pads with load sensors. Static load measurement are particularly useful when operating four-leg rigs which are widely used for construction applications, but three-leg rigs can also benefit from them. These static load measurement systems enable operators to monitor the ballast preloading process and heavy loads during severe storms. Full-scale factory tests of the new systems have been completed successfully and on-board tests are progressing well. The systems are currently being fitted to six jack-up rigs, of three different designs.

Arjen van der Spek
Consultant



RACK & PINION JACKING COURSES

Siemens Netherlands is a key supplier to GustoMSC for their Rack & Pinion Jacking Systems, responsible for motors, drives, brakes and automation. Siemens Netherlands and GustoMSC share an exclusive long-term partnership for these jacking systems, in which they combine the experience and knowledge of both companies. Peter van Dijk, sales manager at Siemens Netherlands: 'This partnership enables us both to share knowledge in order to achieve operational excellence. Together, we have reached the quality of design as it exists today. Due to this shared knowledge during commissioning and start-up, these jacking systems are among the best available and flawless systems in the world.'

GustoMSC Rack & Pinion Jacking Courses are available to provide access to its operations, minimizing downtime and optimizing the ease of operation. The program offers the ability to train your employees on the Automation and Electrical scope of a VSJS Jacking System by simulating faults to explore root cause analysis and fault finding techniques.

If you are interested in the Rack & Pinion Jacking Course, please contact Ling Chan at ling.chan@gustomsc.com

INTEGRATION WITH OPERATION SUPPORT SOFTWARE

Our Operation Support Software (OSS) includes a Weight Management module for the daily load sheet calculations, based on the tank levels and deck loads. The software can also be used to forecast the effects of heavy lifts by rig cranes, jacking loads and ballast preloading and then to monitor the actual loads on the legs when these operations are carried out. OSS is now integrated with the jacking control system and X-Y skidding control system. This means that leg positions, leg loads and cantilever positions can be monitored in real time and compared with the expected values. Our customers can now verify their calculations and receive valuable information for the next rig move or critical crane operation.



Rack & Pinion Jacking course by GustoMSC and Siemens

INTERVIEW

NEW ACCOMMODATION SEMI-SUBMERSIBLES FOR PROSAFE

Prosafe, owner and operator of semi-submersible accommodation units, is presently building two semi-submersible accommodation vessels based on the OCEAN500 design of GustoMSC. These vessels are the most advanced and flexible semi-submersible accommodation units for worldwide operations – excluding Norway – and will be ready for operation in 2016. Gerrit-Jan Schepman, sales manager at GustoMSC, interviewed James MacGregor, Chief Technical Officer of Prosafe, on the development and customization of the OCEAN500 project.



James MacGregor joined Prosafe in 2012 as the Director of Engineering. He graduated from the University of Glasgow in Naval Architecture & Ocean Engineering in 1985. James has 27 years of experience in the shipbuilding and offshore industry. Prior to joining Prosafe, he worked most recently as a New Build Manager for SBM Offshore in Singapore and as a New Build Vessel Project Manager for Subsea 7 in Aberdeen. Earlier in his career, James worked as a Technical Director at Harland & Wolff Shipbuilding and with Amerada Hess.

What are the major regions for Prosafe units in general and the OCEAN500 units in particular?

'The North Sea and Mexico have been and are the major regions for our company. In more recent years, Brazil is also emerging as a key region for accommodation services. Other newcomers are Australia, Southeast Asia and the US Gulf of Mexico. The way the market looks now, the most likely regions for the two Ocean500 vessels are probably the UK and Brazil. In the longer term, there should also be potential for work elsewhere.'

Regarding the decision of the Mexican Ministry of Energy to introduce more possibilities for international companies to develop offshore fields, do you see any interesting opportunities for your company in the near future?

'The accommodation support business is fairly late-cyclical. The first point in time in an oil field's lifetime where we could be involved is in the hook-up and commissioning phase. As such, we are not likely to see any near-term impact from the Mexican energy reform. However, in the longer term, it could be positive if more fields are being developed.'

In view of the current market developments, do you regard Brazil as one of the potential expanding markets for service companies?

'In Brazil, accommodation support vessels are mostly used for safety and maintenance purposes at producing fields. All the vessels servicing the Brazilian market are currently operating in the Campos basin. In the longer term, it is likely that there will also be demand from other areas. Accordingly, the outlook for further growth in Brazil remains positive, despite higher, near-term uncertainty resulting from recent developments in the global oil market.'

What do you see as the main drivers for operators to select an accommodation unit?

'The operations of Prosafe are mostly related to maintenance and modification of installations on fields already in production, hook-up and commissioning of new fields, tie-backs to existing infrastructure



OCEAN500 under construction at COSCO Qidong shipyard

and decommissioning. In harsh environments such as the North Sea, semi-submersible accommodation vessels are the preferred accommodation solution. In benign waters such as the West Africa region, other types of accommodation vessels such as ship-shaped vessels and barges, are utilized for accommodation.

When operating a conventional semi-submersible, like Prosafe's four new builds, the actual direction of wind and currents is less problematic from a station keeping and deck motion stability point of view. The vessel will almost have the same performance regardless of its heading relative to the weather. Semi-submersibles with a more rectangular aspect ratio will have a somewhat larger exposure to side-on wind and currents. A ship-shaped monohull will have an even larger exposure area to side-on weather.

A conventional semi-submersible design may have a larger exposure area when the wind impacts at the bow, but it will normally tolerate more wind from a 90-degree angle than a rectangular aspect ratio semi-submersible and a monohull. As such, a conventional semi-submersible typically offers the greatest flexibility in terms of positioning relative to production facilities as it is less dependent on the direction of wind and currents. This is very important in areas with floating production facilities, such as weathervaning FPSOs combined with high currents, such as in Brazil.'

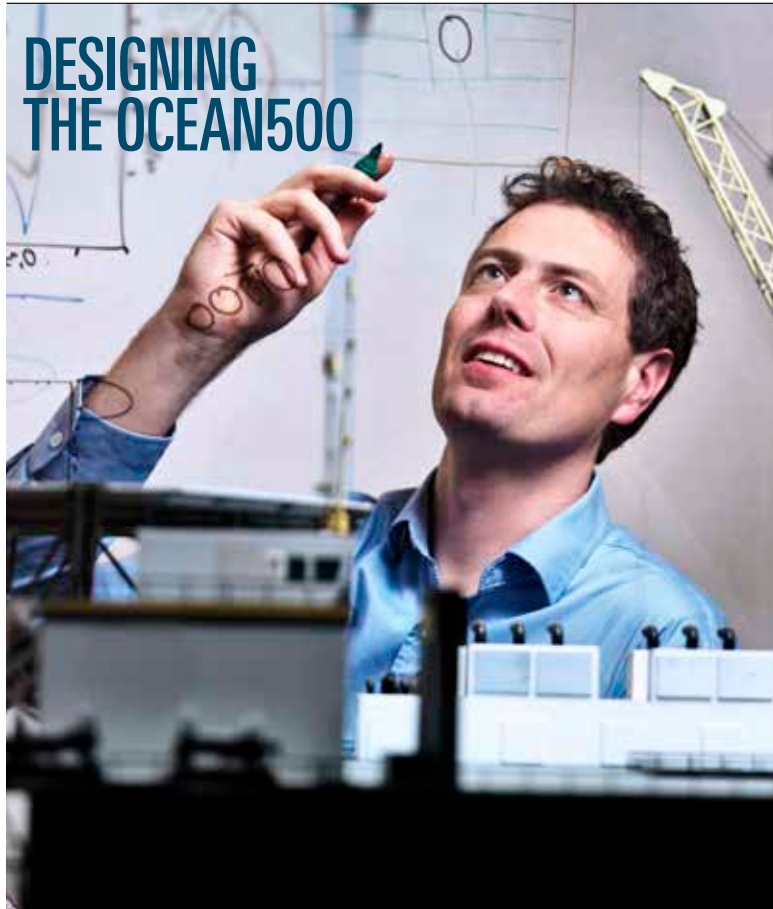
In 2013, Prosafe signed a contract with COSCO for the construction of the two OCEAN500 accommodation vessels. What was your main reason to select COSCO as the ship building yard?

'In order to reduce the risk, Prosafe was only willing to consider shipyards that already had experience with semi-

'WE WERE VERY PLEASED THAT A MORE PROVEN AND LARGER ALL-WEATHER DESIGN, THE OCEAN500, WAS FEASIBLE WITHIN OUR ECONOMIC TARGETS.'

James MacGregor
Director of Engineering Prosafe

DESIGNING THE OCEAN500



The GustoMSC design team, led by Jelmer de Weerd as project manager, realized the OCEAN500 accommodation unit with a large operability in mind at competitive building costs.

'To achieve the highest uptime for the unit, being the time the unit is connected to the fixed platform by its gangway, the following aspects have been given great care: optimizing the motions, excellent DP performance, gangway position and the large maximum stroke of the telescopic gangway. Furthermore, the OCEAN500 concept was intended to be cost efficient by its construction principle of flat panel shipbuilding practice and flexible layout. The final design of the OCEAN500 proves to be a unit suitable for operations worldwide. The Norwegian Continental Shelf was excluded because of the very stringent requirements, which would have significantly influenced the building costs. During the basic design phase, the GustoMSC project team and COSCO worked together to achieve the above-mentioned principles. The recent completion of the first OCEAN500 for Cotemar confirmed the success of this cooperation as the basic design weight estimation of GustoMSC and weight control of COSCO were spot-on, resulting in a semi-submersible able to easily achieve its contract Variable Deck Load (VDL) capacity.'

submersible construction, preferably together with the vessel designer being employed for the project. In fact, there are not many shipyards that have this experience, and even fewer with DP accommodation unit experience. The COSCO – GustoMSC combination represented a lower risk project, based on COSCO's experience with GustoMSC on many projects, and recently with the OCEAN500 semi-submersible design. Of course, COSCO also offered a competitive price and demonstrated good technical competence together with GustoMSC, so this gave us confidence.

Originally, Prosafe had tendered a new smaller design for moderate environments to several shipyards, but the price and the project risk were considered to be excessive. We were very pleased when it turned out that a more proven and larger all-weather design, the OCEAN500, was feasible within our economic targets.'

Could you please elaborate on how you have organized the building supervision team to manage the shipyard? Is there a difference in the building supervision team between the Singapore yard and the Chinese yard?

'We keep the project team small and simple and we ensure that the team members are highly technically competent. The aim is to empower the site team to be able to make quick decisions, which is necessary for the shipyard to make good progress. The small team size requires strong interdisciplinary and interpersonal communication skills. This enables better knowledge sharing and avoids the 'silo' mentality that can develop in larger teams.

The main difference between our teams at the Singapore yard and at the COSCO yard is that the Singapore team has to deal with the NORSOK and PSA aspects of a Norwegian offshore project. This introduces much more uncertainty and makes decision-making more difficult and the risk of changes is also higher. In addition, extensive documentation of all aspects of the project (including

workforce involvement) is necessary for an offshore project destined for Norway. The Singapore team had to invest much more in these aspects.'

Could you describe the relationship with GustoMSC during the basic design, detailed design and construction of the units?

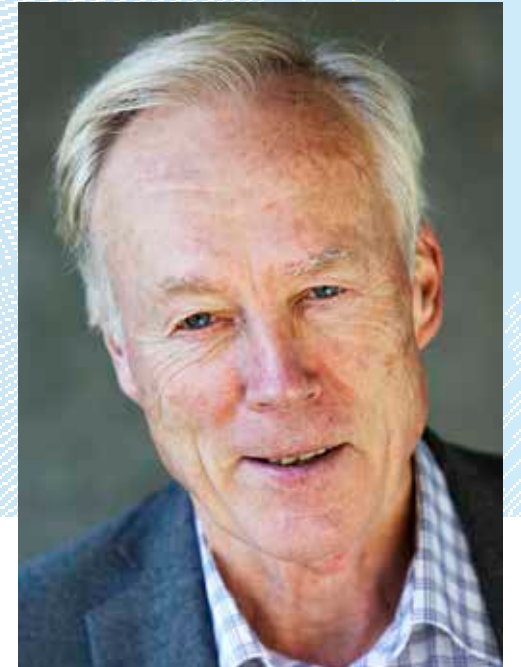
'All companies co-operated very well in the development of the project. COSCO and GustoMSC worked very quickly to develop the design and determine the price prior to contract, and after concluding the contract they have continued to work together very constructively and effectively.

We received the first GA of an OCEAN500 accommodation unit design on June 7th 2013. Several revisions and developments of the GA were carried out very quickly together with GustoMSC to allow COSCO to make a quote. We have good confidence in the technical performance of the unit and our confidence increased even more after the positive results obtained by GustoMSC/COSCO on the first OCEAN500 project in terms of weight prediction, control and speed and propulsion.'



Gerrit-Jan Schepman
Sales Manager

COLUMN SAFETY AND RELIABILITY OF MOBILE OFFSHORE UNITS



Unfortunately, significant improvements in Mobile Offshore Unit (MOU) safety have largely been driven by serious accidents. Four key accidents have guided the development of current MOU safety regulations:

The capsizing of the semi-submersible Alexander Kielland (1980, Norwegian waters, 123 fatalities) caused by a leg failure due to fatigue and the sinking of the Ocean Ranger (1982, Canadian waters, 85 fatalities). The latter accident was due to malfunctioning of the ballast water control system when waves broke a window of the control room and filled it with water. These events led to national regulations which were later incorporated in the 1989 IMO MODU Code.

The Piper Alpha accident (1988, UK waters, 165 fatalities) where a gas leak led to an explosion. The unit lacked explosion safety features such as effective separation and firewalls. This was a turning point for UK offshore safety legislation, leading to a review of safety-critical aspects. Safety cases (risk assessments and compliance demonstrations) were introduced and this approach is now being adopted internationally.

The Deepwater Horizon Macondo well accident (2010, US waters, 11 fatalities) caused by a blowout, leading to the release of close to 5 bbls oil into the ocean. This resulted in new requirements for well control, BOPs, and safety and environmental management systems (SEMs).

These accidents resulted in a reconsideration of the prescriptive regulatory approach used at the time. Instead, a risk-based approach was adopted. However, this means that

owners and manufacturers now have to prove that their solutions meet the functional safety requirements. This can be more difficult than proving compliance with prescribed standards. A pragmatic approach would be to use prescriptive international standards as a basis and add risk-based methods to identify and deal with unique aspects of a project. This may require the qualification of unproven technologies and special operational factors (e.g. difficult environments and challenging reservoirs).

In the 1990s the offshore industry started using barrier management and bow tie assessments. These can provide valuable information about fault tolerance and a thorough understanding of the safety measures by relevant personnel. Information gained from these risk-based approaches can then be used to define standards for widely encountered risks.

Human factors

Several accidents have demonstrated that despite technical precautions, accidents can still happen due to human factors – the Deepwater Horizon accident provided a stark reminder of that. Consequently the International Association of Drilling Contractors (IADC) and International Association of Oil & Gas Producers (IOGP) have issued recommendations for improved training about nontechnical issues related to well control. This covers subjects such as communications, feedback, team work, situational awareness, decision making, problem solving, and managing stress and fatigue.

Looking ahead

It is essential that both rig crews and support personnel are aware of the risks associated with MOU operations. Awareness always increases after an accident but tends to wear off over time and when new personnel are appointed (lack of institutional memory). In future, operations will be undertaken at even more remote sites, in more and more challenging environments, and with more difficult fields. MOU owners can only operate successfully if they optimise the uptime and safety of their installations. Some are now adopting more advanced maintenance methods and undertaking maintenance continuously, without interrupting operations. In essence they are treating their MOUs as factories rather than ships which occasionally call at ports.

The current market is difficult and operators have to keep costs under tight control. Fortunately, it seems that most are still retaining their focus on safety and effective maintenance. As older MOUs may be uncompetitive when the market improves, some owners are now scrapping them and replacing them by new rigs.

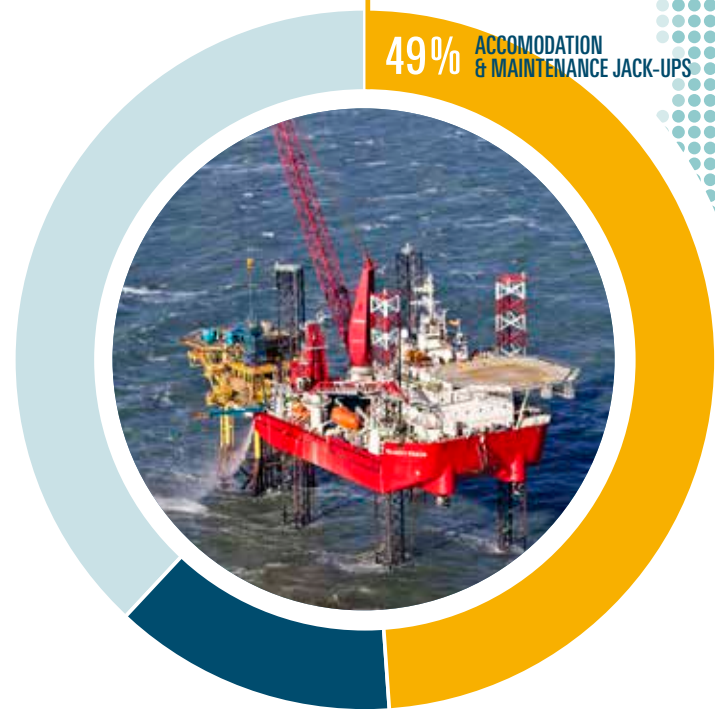
Dr. Carl Arne Carlsen

Senior vice president DNV, received the SNAME Blakely Smith medal for outstanding accomplishment in ocean engineering in 2013 and the OTC Individual Achievement Award in 2014.

RECOGNIZED MARKET LEADER

IN THE ACCOMMODATION & MAINTENANCE MARKET

GustoMSC market share
51 accommodation and maintenance units delivered since 1975, 13 currently under construction.



**AJ46
CROSSWAY
EAGLE**
Owner: CBI-MMEER
Position: Dalian Shipyard



**DSS20-NS
FLOATEL
SUPERIOR**
Owner: Floatel International
Position: Keppel FELS



**NG-2500X
GMS
ENDURANCE**
Owner: Gulf Marine Services
Position: North Sea

Accommodation and maintenance units

- Accommodation Jack-up (AJ series)
- Accommodation Semi-submersible (OCEAN series and DSS series)
- Installation and maintenance Jack-up (NG series and SEA series)
- Under construction
- At work

NG-5500X

VERSATILE SOLUTION

As a market leader for the design of jack-ups, GustoMSC is well acquainted with the challenges that the offshore industry faces.

In this article, we take a closer look at these challenges and we consider GustoMSC's new offering, the NG-5500X design.



A UNIT THAT CAN TRULY OPERATE IN THE OFFSHORE WIND AND OIL & GAS MARKETS CREATES A MORE SOLID BASE FOR INVESTMENT.

If you ask an experienced offshore professional to list some of the key challenges for a jack-up operating in a harsh environment, without a doubt stability and balance will appear on the top of the list, and not without reason. The key principle of a jack-up is to provide a safe and stable platform under all circumstances within the design envelope. However, even a solid and stable platform is still not necessarily an efficient jack-up. Only those jack-ups which meet the principle criteria of providing a safe, stable and solid working platform and which are also well-balanced with respect to all of their main design parameters can be qualified as efficient jack-ups. The typical main parameters are water depth, environment (wind, wave and current) and the variable load (how much can be carried on deck).

For example, it is easy to see why a large crane is required if heavy components need to be installed. In order to prevent a platform from capsizing when slewing with a heavy load over the side, sufficiently wide leg spacing is required. Wider leg spacing means that the hull needs to be wider. A wider hull is heavier. A heavier hull needs a heavier jacking system and legs, which in turn lead to heavier integration and so forth.

This is the typical trap you can fall into when safely combining all maximum requirements. Instead, balancing the leg spacing (and width of the hull) with the crane and operational environment and ensuring a proper survival environment in the most efficient manner, will result in a truly efficient jack-up; a solid and reliable platform meeting all requirements at the minimum cost. Although this may sound trivial, in practice it is not. Ideally, it requires owners and operators to look ahead for some years and establish a future-proof, well-balanced set of requirements prior to acquiring a new unit. In general, this proves to be rather difficult. But how can an operator or owner determine what is well-balanced in terms of design input? Only being able to judge the end result

(on price and performance) is not sufficient to provide a solid basis for a well-informed investment decision in the early stages of development.

As a consequence, GustoMSC is often confronted with the challenge of coming up with new ideas or concepts or suggesting a reasonable and realistic combination of parameters, while not being the end operator and/or owner. As a market leader for the design of jack-ups (propelled and non-propelled), GustoMSC has demonstrated that it is able to rise to that challenge.

True multi-purpose unit

The most recent new development in the NG series of self-propelled jack-ups is the NG-5500X, a true multi-purpose unit. For Oil & Gas services, the gap between the operational area of the very successful NG-2500X series (eight in operation and five under construction) and deeper water drilling rigs such as the CJ series, is significant. On this basis, GustoMSC identified the potential for a unit in the mid-range, being able to serve the southern North Sea including the southern Danish fields, without the need for a full-blown deep-water unit. Furthermore, GustoMSC, along with several contractors in the market, recognized the need for deeper water installation and service jack-ups for the offshore wind industry. The Offshore Wind installation market is experiencing difficulties at this moment and the Oil & Gas market is also suffering due to the drop in the oil price. This means that firm investments for new units in both markets are under pressure. However, a unit that can truly operate in the Offshore Wind and Oil & Gas market creates a more solid base for investment.

Well-balanced overall dimensions

The new NG-5500X design covers the identified market needs in a well-proportioned, balanced way:

Well-balanced overall dimensions (leg spacing, water depth, hull sizing), accommodation, free deck area, variable load (market specific), environment, propulsion and maneuvering characteristics.

The NG-5500X is independent, self-propelled and features dynamic positioning (DP-2). This is common for the higher-end Offshore Wind units. For Oil & Gas support and maintenance, self-propelled jack-ups are less common. However, based on the success of the self-propelled NG-2500X design, the propulsion and DP characteristics of the NG-5500X are a logical extension of the same philosophy on autonomous operations and being multi-functional.

The NG-5500X is suitable for either Offshore Wind or Oil & Gas works up to 55 meters water depth (65 meters in summer conditions). This covers the majority of deep-water wind projects and Oil & Gas support and maintenance work in the southern North Sea including the southern Danish sector. For benign areas like the Arabian Gulf, this unit is able to operate in water depths of up to 80 meters.

For the Offshore Wind market, the unit can be outfitted with an 800-ton crane around the leg. For the Oil & Gas market, the unit can also be outfitted with the GustoMSC X-Y Cantilever for well service or light drilling. **Typical accommodation** of around 100 PoB in single and double cabins.

By efficient balancing of requirements, the target investment is kept well below the typical 180 to 250 million USD for the high-end installation units for Offshore Wind. Therefore, this unit is expected to operate at attractive day rates.

Based on proven technology: using the existing and proven NG-5500C hull accompanied by our proven, electrical VFD-driven rack and pinion jacking system on truss legs and relying on our in-house methods to ensure proper integration.



Table 1: Main particulars

HULL	
Length main deck	87.5 m
Width	42 m
Depth	8 m
LEGS	
Number	4
Type	triangular truss-type, X-brace structure
Size	6.5 m
Length overall	Approx. 107 m

JACKING SYSTEM

Type	GustoMSC floating, opposed rack & pinion
Drive	electric, variable speed
Number of pinions	3 x 24
Jacking capacity per pinion	200 t
Preload capacity per pinion	345 t
Jacking speed, hull lifting	0.16 - 0.8 m/min (steplless)
Jacking speed, leg handling	0.16 - 1.6 m/min (steplless)

POWER AND PROPULSION*

Dynamic positioning	DP-2
Transit speed	8 knots
Diesel-electric, installed power	Approx. 12.5 MW

* Customization of the deckhouse and accommodation has a direct influence on wind areas, and thus on wind induced resistance during transit and wind loading during dynamic positioning. Therefore, customer specific values are likely to vary to some extent.

Table 2: Environmental data for survival conditions and variable load

	O & G ALL YEAR	O & G SUMMER	WIND ALL YEAR
Indicative variable load*	2,200 t	2,200 t	4,200 t
Leg length	107 m	107 m	107 m
Max. water depth	55 m	65 m	55 m
Airgap to SWL	20 m	18 m	15 m
Max. wave height	18.5 m	17.5 m	16 m
Associated wave period	14 s	14 s	14 s
Wind speed	40 m/s	35 m/s	35 m/s
Surface current	1.2 m/s	1.2 m/s	1.2 m/s
Leg penetration	3 m	3 m	3 m

* The horizontal centre of gravity of the elevated weight shall be located within 0.1 m of hull centerline and between 0.1 m aft and 0.1 m forward to the centre of the leg pattern. The variable load is indicative only and depends amongst others on the customer specific customizations such as accommodation size and outfitting, extra DP requirements etc.

Immediate market response

The main particulars of the NG-5500X are listed in table 1. The variable load and environmental envelope are provided in table 2. Considering the multi-purpose nature of the NG-5500X, efficiently targeting the deeper water Offshore Wind and medium range service potential for Oil & Gas, the NG-5500X is a valuable addition to the successful GustoMSC NG series, offering its customers high value for money. This is further substantiated by an immediate market response after the introduction, with an order for an NG-5500X design by GeoSea (announced in January 2015) and strong interest from both the Oil & Gas and Offshore Wind markets.

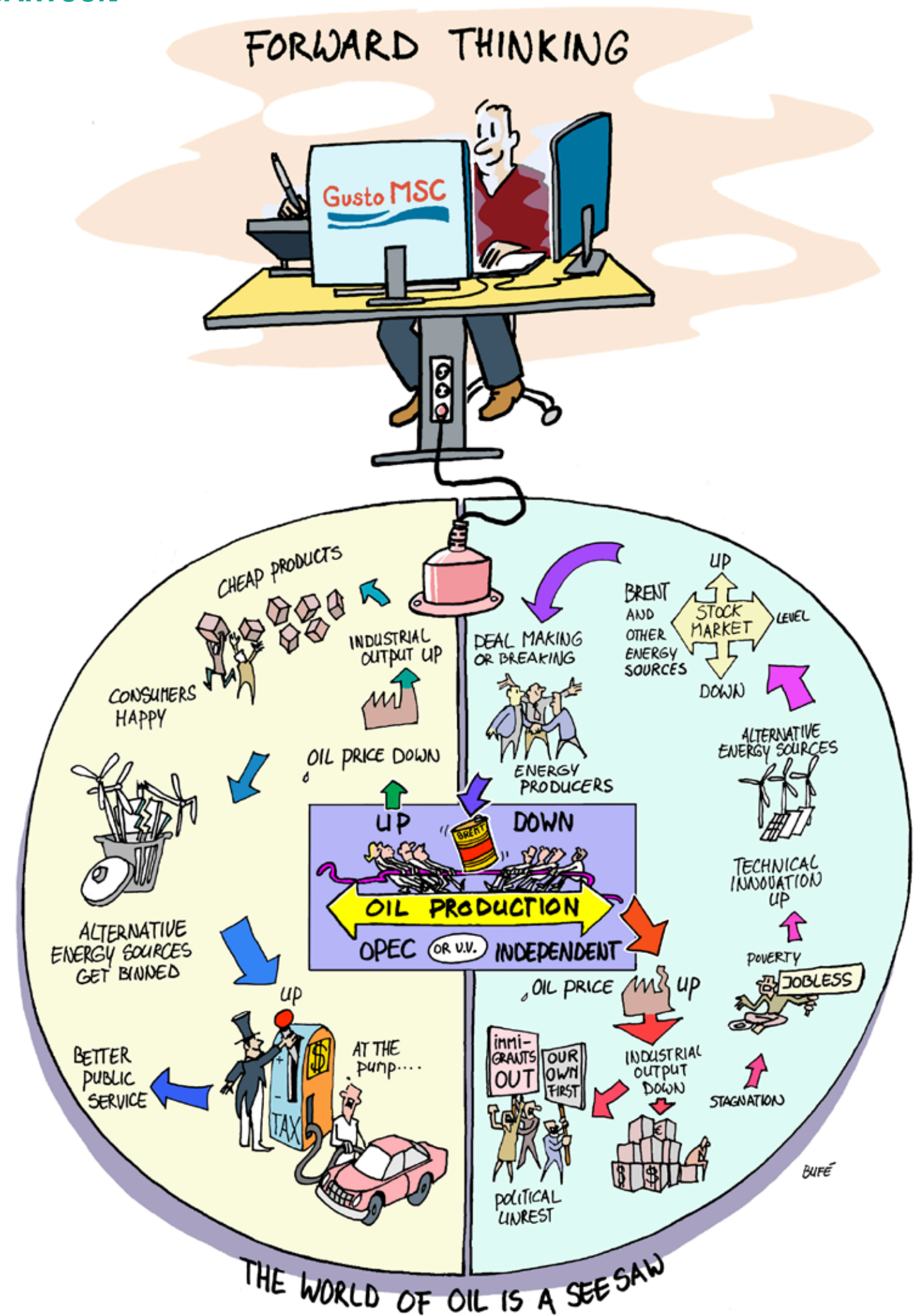


Thomas Lerchenmüller
Senior Engineer



Andries Hofman
Project Manager

CARTOON



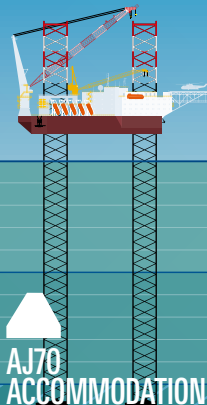
THE PIONEERS OF OFFSHORE ENGINEERING



NG-2500X
MULTI-PURPOSE
JACK-UP
**PROVEN
& ROBUST DESIGN
DP-2 CLASS**



CJ54
CANTILEVER
DRILLING JACK-UP
**NEXT STEP IN
WORLDWIDE
DRILLING
OPERATIONS**



AJ70
ACCOMMODATION
JACK-UP
**COST-EFFECTIVE
SOLUTION IN
HARSH
ENVIRONMENTS
500 POB**



OCEAN500
ACCOMMODATION
SEMI-SUBMERSIBLE
**SAFE WORKING
& LIVING
ENVIRONMENT
750 POB**

GustoMSC

GustoMSC is an independent, world renowned and leading design and engineering company, thanks to the vast knowledge and expertise of our dedicated professionals and our close relationships with the most influential players in the offshore market. We serve the offshore industry by providing best in class solutions for mobile offshore units.

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