POLITECNICO DI MILANO

Scuola di Ingegneria dei Sistemi

Corso di Laurea Magistrale in Ingegneria Gestionale

The impact of Shale Oil&Gas Boom on M&M Forging's deep water business

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Corso di Laurea Magistrale in Ingegneria Gestionale

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Acknowledgment

First of all, I would like to dedicate this work to the soul of Andrea Mamé, (the CEO of Mamé group and with Gaia Monchieri were the founders of M&M forgings), who was the victim of fatal accident on 30th of June 2013 in a car race, I hope that everybody in the organization resumes his passion and vision to make M&M Forgings one of the biggest groups in the forge world.

Secondly, I would like to express the deepest appreciation to Professor Giuliano Noci, who gave me the opportunity to work in this high level of industry in which, I gained knowledge in a new sector.

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Abstract

The increasing demand of energy makes the whole world focusing on exploring new resources and increase the efficiency of the already exist ones. In the oil and gas industry, there are two main trends where positive growth is present.

On one hand, due to the lack of new significant discoveries in the traditional onshore oil and gas, the industry started to explore the offshore fields, since the shallow water exploration has already started many years ago, the trend nowadays in the deep and ultra-deep waters, this sector is sending very impressive signs of the massive resources reserved under seabed, thanks to the innovative technology, drilling in water reached depths that they were impossible to think of some decades ago. Therefore, the growth of this sector is hitting all the value chain of offshore oil and gas, starting from the oil production companies, service companies and petroleum trading companies. The attractiveness of this sector increased the competitiveness in the market, in which they are competing in discovering new sources, providing products that could beat the extreme environment of deep-water.

Deep offshore industry is capital intensive, due to the harsh conditions of seabed and the far distances from shores make it very costly, however, the current oil prices support this industry, despite the increasing costs the above $80 per barrel price of oil guarantee feasible deep-water drilling.

On the other hand, the only threat for companies investing in the above mentioned industry comes from the so-called " Shale boom", the uprising unconventional hydrocarbon extraction from shale formation could impact the deep-water players, nevertheless, U.S. shale boom is the trend nowadays, the huge reserves being extracted in America alert the whole world about this trend, as a result the United States is expected to be a net exporter of oil and gas in the near future for the first time in its history, many other countries started to consider shale extraction but all the projects outside the North America are still at their infancy. When looking at the world shale reserves map, it is obvious that 334.6 billion barrels and 7795 trillion cubic of technically recoverable resources will be a very hot topic in the next few years.

Therefore, the purpose of this report is to provide the company on focus (M&M Forgings that produces forged parts used in the ultra-deep water and some products for shale industry as well) with the latest development and to clarify the impact of the shale boom on the ultra-deep water industry, by using marketing analysis and latest updates from the both industries in order to come up with precious and useful information.

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1. Introduction

M&M Forgings as the other companies active in supplying oil industry with forged elements used for the most extremely hard conditions of petroleum operations, try to reach the economy of scale and to better balance their shares in the different markets, while the world market is becoming more divergent and more demanding.

In this context, the report was made to clarify the impact of the market dynamic on M&M Forgings' strategy, in which, analyzing the influence of the Shale boom on the deep-water oil and gas business. Thus, it was necessary to start with following the relevant tracks of the company on the oil and gas value chain, briefing the both shale and deep water industry, illustrating drilling techniques and essential technologies used. And later in the marketing analysis chapter, the market trends are discussed as well, moreover, since the report is focusing on M&M Forging's business, an overview also on forging steel sector and especially the Corrosion Resistance Alloys and their applications in the oil and gas industry.

Although, a company introduction is done in order to describe the M&M Forgings as the company on focus, introducing the history of the firm and its structure, in addition, describing the capacity and the supply chain of the company.

In the analysis chapter, the flow of data started from the Macro level considering the global energy demand, the oil and gas production and supply and the demand forecast, then the analysis undertook the both shale and deep water paths, studying the reserves, the share on the global oil and gas production matrix and demand forecast of the most important tools from M&M Forgings perspective.

Finally, based on each market indicators and forecast, the final conclusion was performed, outlining the latest updated findings, in which, M&M Forgings could better balance its capacity and market strategy towards the upcoming commitments.

1.2 Methodology

In this report a quantitative and qualitative approaches have been conducted, using primary data retrieved from the interview taken on the 17th of April 2013, with Mr. Francesco Piccinini "Global Sales Manager/ Oil and Gas, M&M Forgings", Who has more than 10 experiences in his field, and also using secondary data were gathered from published articles, company annual reports, financial agencies reports, energy consultant agency reports and general oil and gas magazines.

The qualitative and quantities approaches were used to discuss oil and gas marketing analysis, however, the type of the analysis structured in the so-called top down approach, undertaking the oil and gas industry and its future trends in general, while the analysis go more precisely on M&M Forgings business in ultra-deep water and shale oil and gas. This approach allows better understanding of the dynamics and the indicators of each market, and finally to end up with a conclusion in which assesses the company direct its business plans within the two markets.

In that path, the first part will undertake the macro environmental analysis for the oil and gas market by PESTE method, in which all the political/legislation, economic, social, technological and environmental factors express the reflections in ultra- deep water and shale industry. Secondly, it will undertake the demand analysis by studying the world energy matrix trend and will focus on the oil and gas in particular, therefore, the analysis go deeper to investigate the important two industries as far as M&M Forgings, the ultra-deep water and shale oil and gas. Although, offering analysis was very essential, in which was carried out by studying the strength, weakness, opportunities and threats (SWOT Analysis) for each market in order to know what they could relatively offer to the company's business.

Therefore, this report illustrates the company related markets in oil and gas industry in sequence, as mentioned above, the top down approach starting with the increasing energy consumption and the increasing demand for hydrocarbons, then it goes through the oil and gas world reserves and the increasing shares of ultra-deep water in the world oil supply, before evaluating the subsea and shale markets was necessary to understand the shale oil and gas reserves and production. Finally, by considering all the analysis and the indicators using marketing models and techniques the report was ended with some recommendations as results of the study.

1.3. Delimitations

The focus of this research will be on oil and gas industry, since it affects directly the business of M&M Forgings, despite that its core business is forging, the study tried to analyze the main driver for its business which is the subsea and shale, due to the fact that gas is mostly find with oil, forged elements used for either deep-water or Shale are utilized for extraction both oil and gas. However, Natural gas will be undertaken as reserves and production forecast.

In the Macro demand analysis, the segmentation of the globe was considered as (OECD) Organization for Economic Cooperation and Development members and (Non-OECD) none Organization for Economic Cooperation and Development countries in order to better correlate data gathered.

The shale oil and gas industry analysis was focused on the US shale revolution, since the North America In general is leading the industry; United States is the world first mover in terms of economical shale oil and gas production.

2. Industry overview

2.1 Oil and Gas Value Chain:

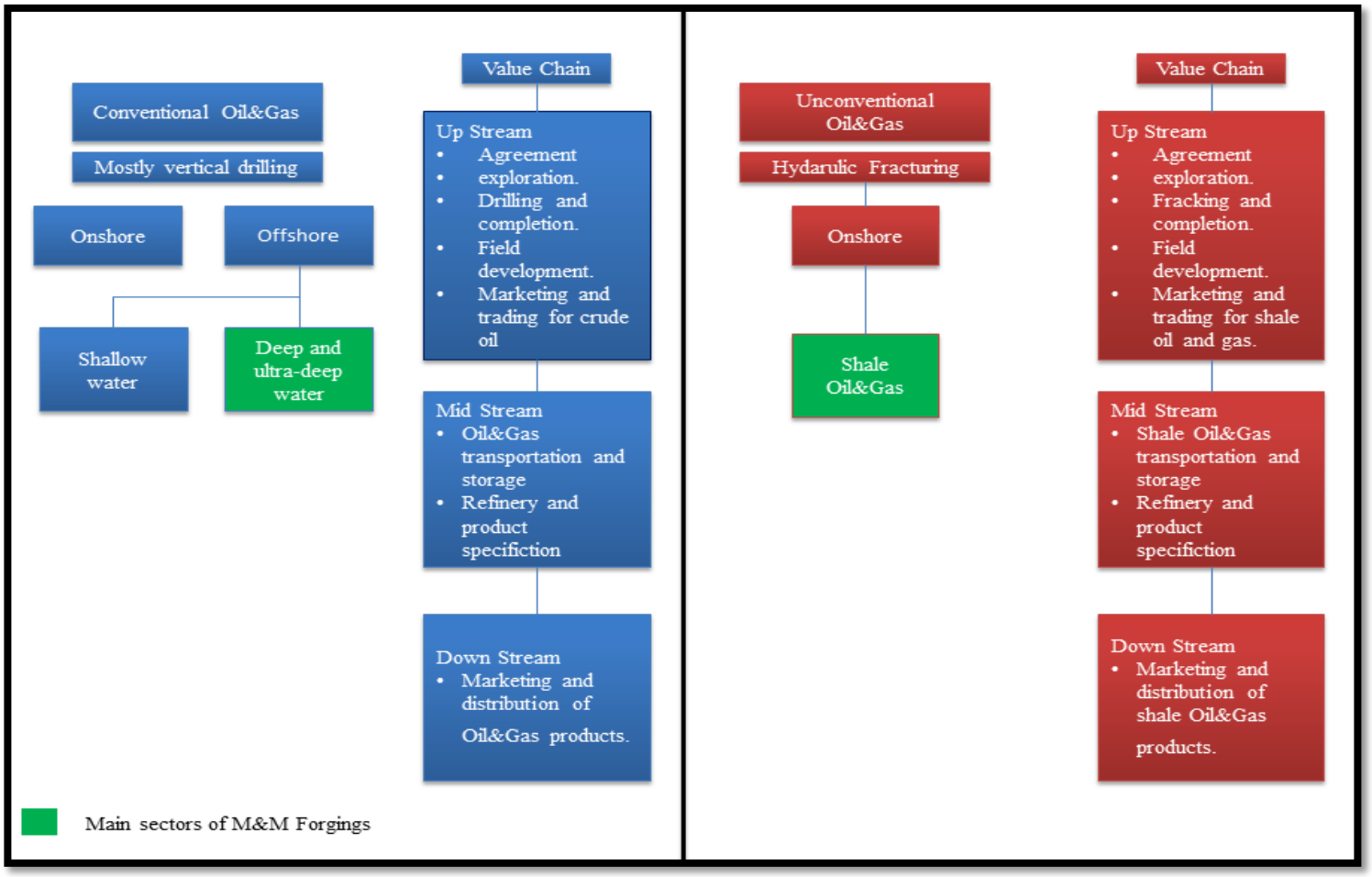


Figure 1, simple structure of oil and gas value chain

The figure above indicates the simplified structure of oil and gas industry. The blue chart shows the conventional oil and gas main sources, in which, all the resources found either onshore or offshore, while, offshore resources are divided into shallow water and deep and ultra-deep water.
The green box represents the first main sector that M&M Forgings supply with critical products.
The chart is accompanied with the value chain figure, in which shows the main three tiers, the upstream, midstream and downstream.
Since the company provides the industry with forged elements needed to perform drilling and precede production by installing subsea systems, therefore, M&M Forgings' core business within the upstream level of the deep and ultra-deep water oil&gas supply chain.
Among the upstream activities the company is acting as a supplier of the main service companies working in drilling, well completion, subsea field development and production.

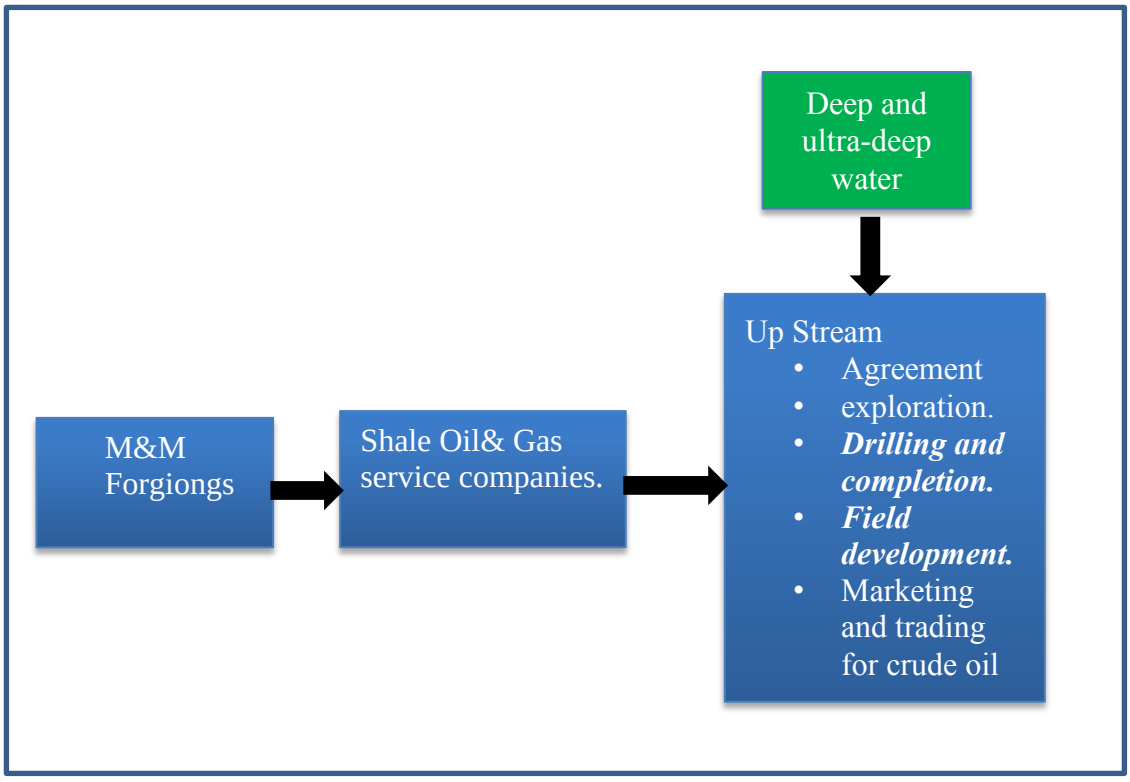


Figure 2, deep and ultra-deep water value chain (upstream focused)

On the other hand, in the unconventional oil and gas track, it's obvious that shale outputs are the result of the horizontal drilling and fracturing shale formations deep into the ground

layers, the massive amounts of technically recoverable shale reserves are considered only onshore due to the technology capabilities.
The second main market in oil and gas industry for M&M Forgings is the shale market, as will be discussed later in this report; the company provides shale service firms with fracking pump motors, used to pump the mixed liquids into the fracks of shale formation to keep releasing the hydrocarbons true the wells.
the value chain chart of the industry is almost the same as the conventional chain, upstream, midstream and downstream levels, consisting of similar activities.

The company is related to part of the service companies' field, the exploration sector is correlated to the fracking pump market due to the amount of testing wells fracked in the exploration phase, moreover, the company's main fracking market potential comes from the excessive amount of new wells need to be drilled continuously for each field to maintain productivity, in which more fracking pumps will be on demand.

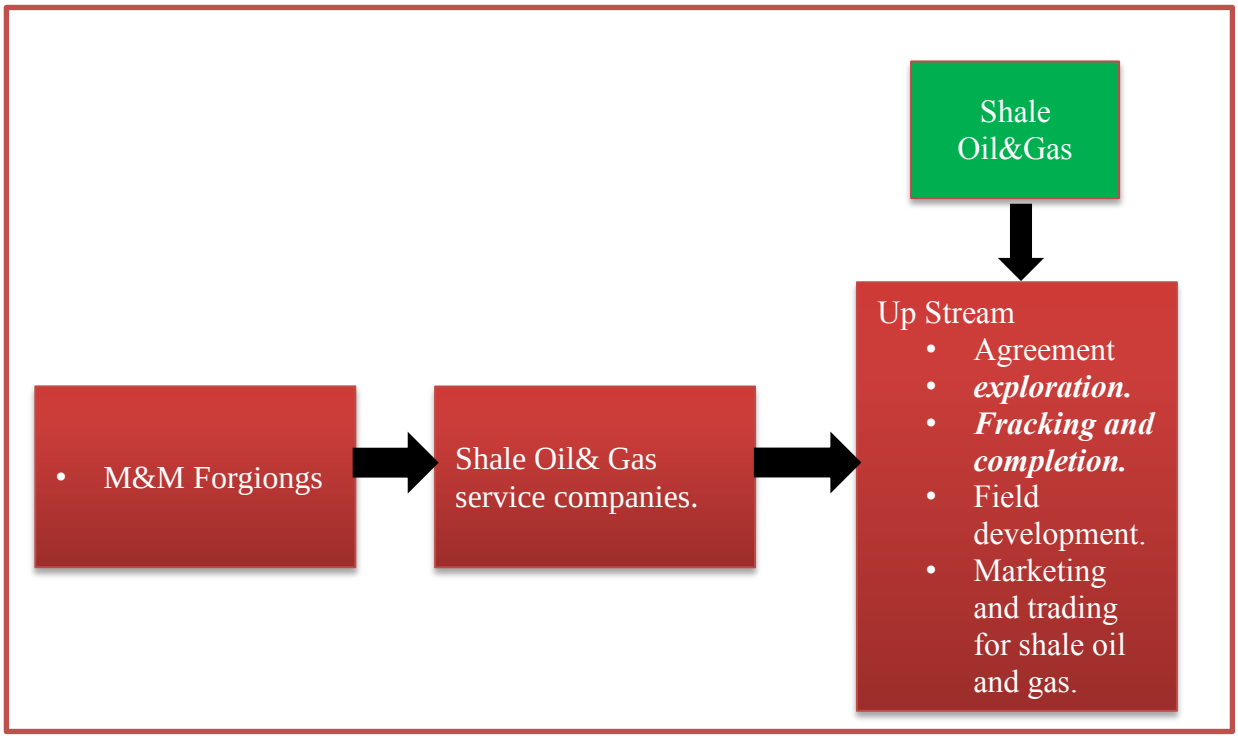


Figure 3, the shale oil and gas value chain (upstream focused)

Since there are two main sectors that M&M Forgings supplies, an overview on the mentioned two industries is carried out below, in order to clarify those sectors and the focus of the company in which it supplies the upstream service players.

2.2. Offshore:

2.2.1 Drilling:

One of the revolutionary achievements of the petroleum industry is the developing technology that opens new frontiers and accesses to energy sources. There is no much difference between the offshore wellbore construction processes and the rotary onshore drilling, the only variation could be drilling rig types and the modified techniques used to operate In complex and harsh environments.

In the 20th century drilling in offshore begun, thanks to the use of fixed shallow water platforms, in the 1947 the first offshore well drilled away from shore. Since then, production from offshore sources kept developing and taking higher contribution of total world oil supply, about 35% of the U.S. crude oil production is flowing from offshore fields.

Offshore drilling high costs are function in the water depth and the complexity of wells, thus, the drilling is performed only for the approved significant reserves to be economically justified.

The continues improving and developing of offshore drilling techniques has unlocked new reserves , such as; complex and horizontal drilling, ultra- High Temperature, High Pressure, and extreme extended-reach drilling, in which they positively influence the world energy supply.

In 1975 the first deep-water well drilled in more than 1000 feet depth, lately, in 1986 also in the Gulf Of Mexico a 5000 feet ultra-deep water is drilled, recently, new records of water depth keep showing up, the 10194 feet depth off the eastern cost of India was a record in 2011. The expensive oil prices have made investing in such depths viable.

The other important sector of offshore upstream value chain is Completion. A well completion is asset of actions undertaken in order to convert a borehole into an operational system for governing the flow of hydrocarbons out of the well. Subsea completion stands for; a system of pipes, connections and valves that are based on seabed and operate to gather hydrocarbons released from completed wells and lead them to storage and processing systems either offshore or onshore.

The deeper offshore drilling goes the highly skilled labor and the more complicated drilling rigs are needed, basically, big oil companies do not own drilling rigs, mostly they are outsourced by drilling contractors, this service include a skilled manpower supply as well in order to operate and supervise the equipment, outsourcing drilling has made the industry wide opened also for the mid-size corporations to undertake considerable deep water projects.

2.2.1.1. Common types of drilling rigs:

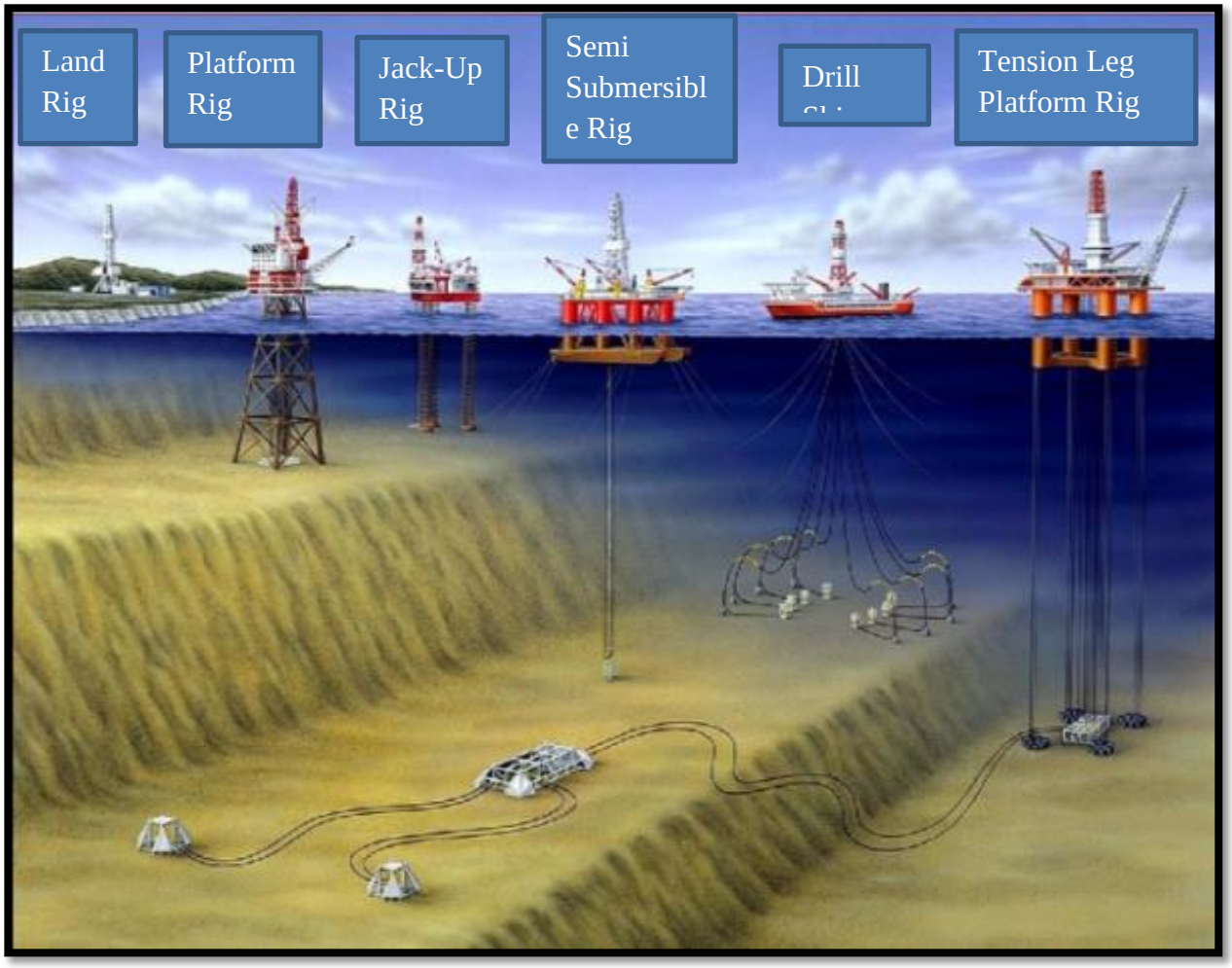


Figure 4, different drilling rig types

There are two main categories of drilling rigs, one type is the transferrable rigs that can be moved from place to another, allowing for drilling in different locations, and the other category is the fixed-location platform.

1- **Mobile Offshore Drilling Unit (MODU):** drilling rigs which are operating exclusively to drill offshore, moreover, they can be floating either while drilling or when they are being moved from location to another, those mobile drilling rigs fall into two main types:

- **Bottom-Supported drilling rigs:** Barges and Jack-Ups.
- **Floating drill rigs:** Submersible, Semi-Submersible and Drill Ships.

2- **Platform Rigs:** drilling rigs which are assembled on a production platform, and they might be installed for short term or long term.

Subsea completion is essential where no direct vertical channel in which production flows up to fixed structure, subsea well contains a production tree that is connected with the flow line and floating or shore based facility.
Subsea completions can be used in both deep and shallow water under any circumstances of High pressure and high temperature.

West Cameron 192 was the first subsea well installed in 1961 in the Gulf of Mexico, afterwards, several installations were followed, but the significant move trend was in 1993 with the introduction of the horizontal tree, in which has allowed to access a wellbore without interrupting the tree and the flowlines, service line s or control umbilical.

The evolution of subsea systems never stopped, drilling kept going deeper in water, and developments had to overcome the extreme conditions faced of high pressure and temperatures.

The next important milestone was the introduction of the advanced All-Electric tree in 2007. The improvements on the upper and lower completions continued to challenge pressure and temperature scores, therefore, a significant advancement was observed by considering the one-trip installation of multiple-zone systems, this technology has reduced the operational cost.

Production tree: there are two main types of production trees, either the traditional vertical tree or the horizontal trees; however, they are characterized by their mode of operation (electric or hydraulic) and by the intensity of penetrations in which the tree has to control subsurface equipment and hydrocarbon flow.

Upper Completion: it is consistent of a production tube based system from the tree to the subsurface safety valve (SSSV), and another tube based system from the SSSV down to the production packer installed in the casing.

There different types of SSSV's vary by their method of installation, in which they can be installed with the completion in the case of normal wells, or they can be installed on wire-line in an already prepared profile inside the tubing system.
The production packer variety depend on its method of retrieval, permanent packers must be drilled out of the wellbore, while retrievable ones can be recovered.
Mostly, all parts of the completions system are available in HPHT characteristics if needed.

Lower Completion: this part of completion is made of a gravel-pack packer, sand control screens and a lower sump packer, connected all together by production tubing.
The packer is installed on the screens and it helps in fitting the lower completion inside production casing. While the sand controls screens and the gravel packs connected vary with the types of productive interval placement.
Screens come in different figures; including wire mesh, wire wrapped and pre-packed screens.

2.2.1.2. Drilling process:

2.2.1.2.1. Well construction:

Drilling process starts by digging a large diameter hole and casing it with a large diameter rod, the drilling keeps going progressively with smaller holes as the downhole pressure increases, corresponding to the smaller holes being drilled smaller diameter casing rods are installing, drilling from Jack-up rigs and from permanent stations a pipe is connected tightly to the seabed in order to perform circulation of the drilling fluid and to remove cuttings.
Moreover, the Blow Out Preventers (BOP), are installed beyond the drilling rig, along with risers the BOP's are fitted to wellhead system down at seabed, the wellhead system Is connected to the first string casing that passes through a large diameter pipe that helps in performing the jetting or drilling action, drilling without risers is usually considered during the first string of casing, thus, with fluid and cuttings discharged to the seafloor. Either by a mechanical motor located at the surface or by a mud motor at seabed the drill bit is rotated, in the subsurface formation the drilling is performed by a high pressure fluid (mud) pumped inside the drill string to spin downward and to lift drilling cuts upward through the casing conduct, once the drilling fluid and cuttings arrive to the drilling rig, automatically, the fluid is separated by vibrating shale shakers and chemically treated to be reused in further drilling operations, a proper recycling for drilling fluid is very important, since it is responsible of reducing waste and exploiting the maximum of the already used fluid.
The evaluation and the design of each depth interval is undertaken in the planning stage, while re-evaluation and modification during the wellbore construction process
The anticipated subsurface pressure, the actual wellbore conditions, equipment limitations and other factors influence many processes such as; the length of each interval, the drilling assembly, drilling fluid density, casing, quantity and quality of cement used.
For example Fig (5) shows how the number and diameters of casing strings are distributed throughout a standard deep-water well found in the Gulf of Mexico.

(the NPC North American Resource Development Study, 2011)

Figure 5, projected view of deep-water well drilling

To calculate the needed string specification it is essential to consider and evaluate different issues, such as, the interval for the subsurface rock stress and pore pressure, well diameter at total depth, the strength of casing and finally the type of completion wanted.

Well control is achieved by fixing some barriers that prevent unwanted elements of formation fluid from entering a wellbore, a drilling fluid with a higher density can be the best to use as a barrier, and thus its hydrostatic pressure will do the job.
As the depth increases, fractures may occur on the exposed formation when a heavy drilling fluid is used, thus, leakage of the liquid may appear from the well to the underground formation.
The following points represent the main steps of deep-water well construction, showing the process of drilling and preparing it for subsea system installation.

1- **Circulation system:**

Mud tanks hold large amounts of drilling fluid in which it flows with high pressure through the drill string, where the drilling fluid is circulated downhole to provide hydraulic power cleaning up from cuttings and to power equipment as well.
The separation process of the used drilling fluid is undertaken at the surface to filter it from drill cuttings by vibrating shale shakers, and then, in the recycling process of the used fluid after, separation is proceeded in order to achieve the standard properties of drilling fluid.
Drill cuttings can be discharged to the ocean water, it depends on the regulatory regime of the state.

2- **Formation logging:**

In order to achieve productive geological formations there are some techniques can be considered such as; mud logging which is the most simple one and well logging which is more sophisticated, this technology depends on a special electronic tools are run either on a wireline or in a drill string, in result, specific key rock properties are identified. Moreover, using specialized drilling tools or wireline logs allow measuring formation pressure and obtaining core samples.

3- **Completion:**

Once offshore well is drilled a completion process must be undertaken, in which, tubing and other equipment are installed or fitted tightly to a wellbore in order to guarantee decent flow of hydrocarbons, completion process may undertakes installing a slotted liner or perforated adjacent to the field formations, and then installing packers and tubing.

4- **Riser-less drilling:**

Seawater and sweeps are used to jet or drill the casing before the well is drilled, and before the installation of risers, to obtain effective well design the first casing should be positioned deep enough to provide better robustness against the increasing formation pressure as the drill goes deeper.
In the riser-less drilling, weighted drilling fluids used to operate in depths where the formation has the required strength, this technique is very essential for ultra-deep water applications, on the other hand, it discharges vast amounts of muds liquid at the seabed, in the last 10 years, riser-less drilling with weighted mud can be undertaken with return fluid system that makes circulation through the rig,
This type of systems allow a dual-gradient pressure pretty similar to the deep-water natural pressure value, the system has been applied to different offshore wells, thee only concern is the weak supply of required equipment and well control applications.

2.2.2. Subsea Production Systems

2.2.2.1. Production tree (Christmas trees)

Christmas tree is an assembly of valves, used in petroleum extraction. They are used in much different kind of wells like: Oil, gas, water injection, gas injection wells.
Basically, subsea Christmas trees are similar to those used for onshore (dry trees), it works as primary tool for controlling the flow of the produced fluid, thanks to the embedded series of valves and control equipment that forming the tree, in the beginning of the subsea era, Christmas trees were critically dependent on diver assistance in terms of installation and op
A Christmas tree is an assembly of valves, used in petroleum extraction. They are used in much different kind of wells like: Oil, gas, water injection, gas injection wells etc.
There is both surface and subsea trees.
The purpose of the Christmas tree is to isolate the well from the physical conditions of the seabed environment. Nowadays, by using hydraulic techniques industry trend is going for remotely operated connectors, valves and chokes, they are installed simply by drilling rigs and a guidelines system for deep-waters.

(DeepWik,i the well service authority)

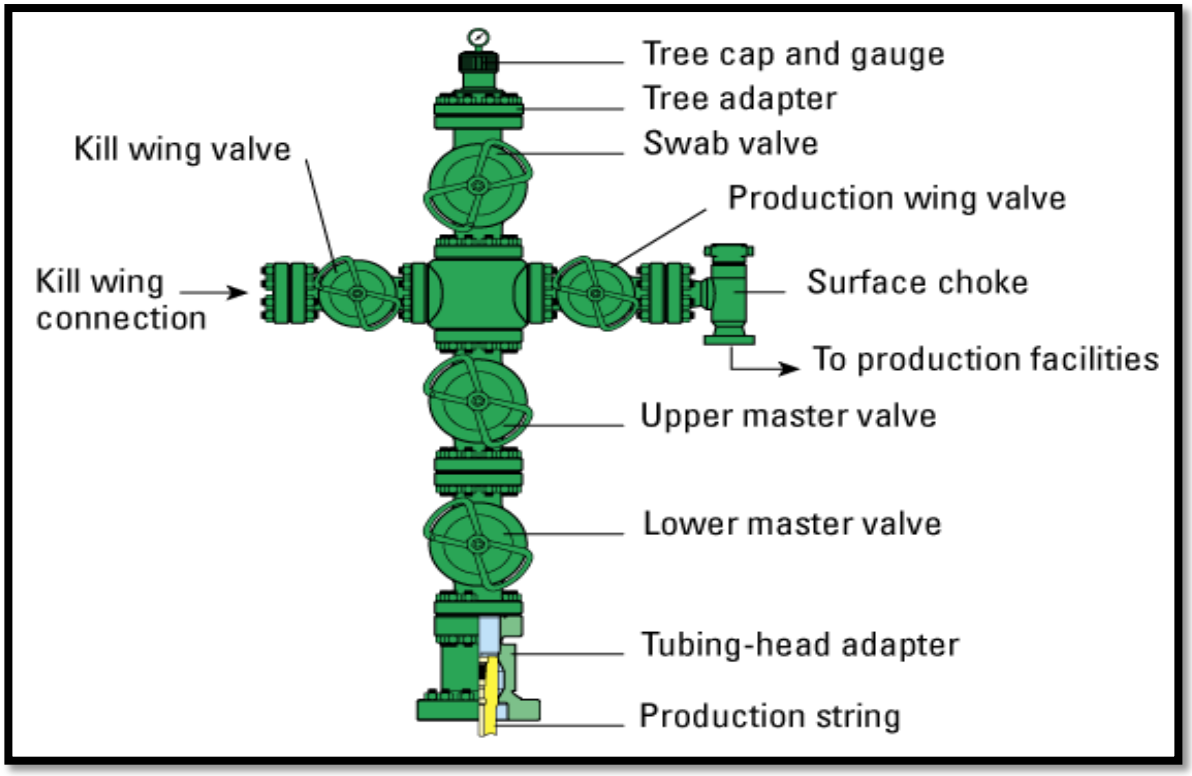


Figure 6, Christmas tree

Since the main purpose of Christmas trees is to provide control of fluid flow in and out of the well and to isolate the well from the atmosphere as well, it contains many valves with different functions as the following:

1. Swab Valve: wireline and coil tubing in well intervention.
2. Kill wing: it is used for fluid injection.
3. Flow wing: it helps in directing the flow of the hydrocarbons throw production facilities.

4. Upper master: hydraulic master valve.
5. Lower master: manual master valve.

2.2.2.2 .Subsea Manifolds.

A structured valves and pipes with controlling components working as a one device (Manifold), its duty to mix or divert the produced fluid and also to control the injection fluids through their path.

Subsea Manifold helps in reducing the number of flowlines and injection lines between wells and platform, thus, reduces costs.

2.2.2.3. Subsea boosting and processing.

The new trend in subsea applications is the multi-phase booster and fluid separator. The main idea of the multi-phase booster is to provide the produced fluid with high pressure enough to send it directly to a long distance platform or maybe to an onshore platform, thus, there will be no need to store the output to a surface platform in huge tanks, moreover, the other application is the separation technology, it performs water separation at seabed and re-inject it underground for disposal, thus, reduces cost of transporting water to surface, the both technologies were developed in the past but never applied in real projects, until lately when some operators have started implementations of such promising technology.

2.2.2.4. Subsea Control System

For best subsea production system, tight control must be applied on its components, thus, it is very important also to have indicators from those components such as, downhole/wellhead pressure, temperatures and flow rate readings, currently; hydraulic and electric methods are used for subsea control. One of the most common methods used is the lector-hydraulic multiplexed system.

2.2.2.5. Blowout Preventer (BOP)

The blowout preventer is a huge valve specialized in sealing and controlling wells and it is installed as a safety valve used in case of blowouts, the BOP is designed to operate in extreme conditions and to cope with high pressure and wild flow, Basically, it helps in preventing tools, drilling fluid and produced fluid from being leaked out of the wellhead, subsea BOPs are located exactly at the top of the wellhead (wellbore) and they are connected to drilling rigs by the so-called drilling risers.

There are two main types of BOPs:

- The Ram Blowout Preventer: it is almost a gate valve with a pair of steel rams, in which they extend toward the wellbore center in order to block the flow or to unblock back the wellbore and allow flow.

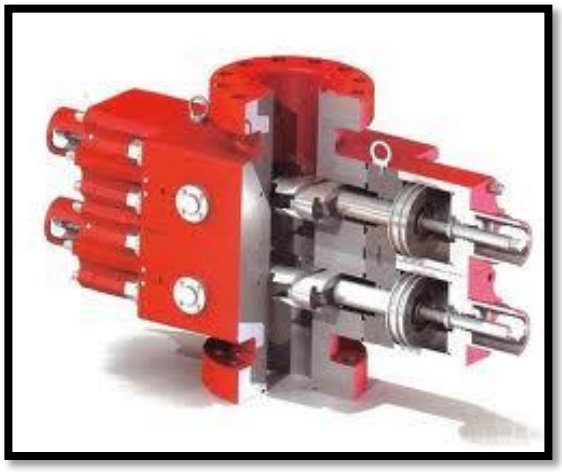


Figure 7, the Ram BOP, (DeepWik,i the well service authority)

- The Annular Blowout Preventer:
  This type can close around a cylindrical or non-cylindrical object, a drill pipe has the ability to be moved vertically while keeping pressure below, in which, annular preventer controls the hydraulic closing pressure.

Figure 8, The Annular BOP, (DeepWik,i the well service authority)

2.3. Unconventional resources (Shale Oil and Gas)

Unconventional formations are organic rich, fine grained, sedimentary shale and other rocks. Shale is the source and the storage of oil and gas exactly like conventional hydrocarbon sources. Unconventional resources were described by The Society of Petroleum Engineers as petroleum accumulations that are pervasive throughout a large area, in which they are not highly affected by water pressure; they are also called “tight formations”. On the other hand, conventional oil and gas are found in permeable sandstones and carbonate reservoirs.

Because of the low permeability that unconventional oil and gas resources have make their ability to flow very low, this low permeability means that hydrocarbons remain in rock formations unless natural or artificial fractures appeared. Moreover, these types of unconventional reservoirs contain huge quantities of hydrocarbons embedded in rock matrix due to the limited pathways that allow outflow, hydraulic fracturing is considered to make fractures or to connect between already existing fractures therefore ensuring pathways through which those hydrocarbons flow to wellbore.

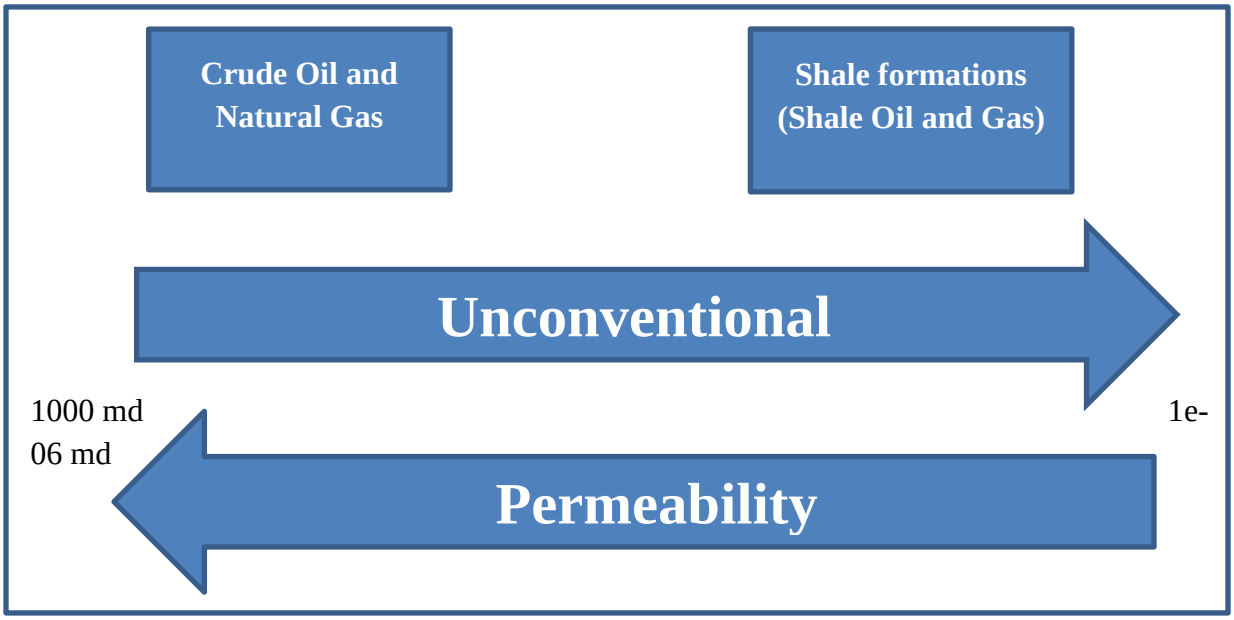


Figure 9, types of oil and gas as function of permeability, (Schlumberger, 2011) (Schlumberger, 2011)

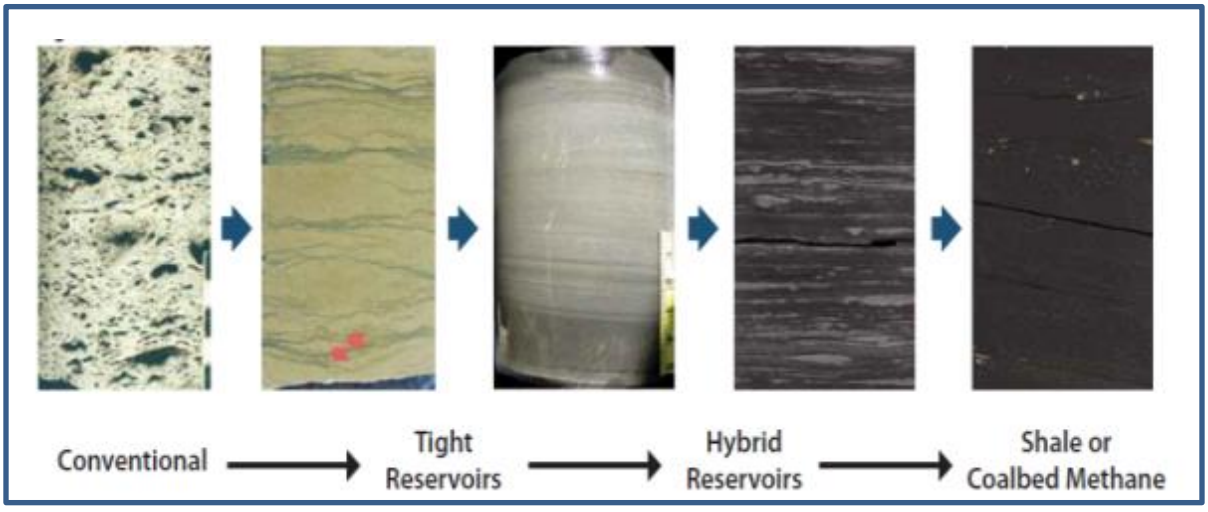


Figure 10, the different formations of hydrocarbon rich rocks, (Schlumberger, 2011)

In the figure above, a description of how is the relation between rock formations and permeability of these formations, in which the easiness of hydrocarbons flow, depends on.

2.3.1. Well Construction:

The basic rule of successful hydraulic fracturing is to ensure during drilling that groundwater is perfectly isolated in completion and production stages, also, damaging rock formations should be kept at minimum level in order to maintain flow.

Thus, selection and application of casing and cement plays significant role in order to achieve successful well construction, therefore, there are three stages to isolate the wellbore from the surrounding penetrated rocks.

1- At the first stage, and after the basic hole of the well has been drilled to the base of the unconsolidated laying formation, a casing profile is inserted into the hole and cemented in place, thus, barriers are made in which they prevent fluids from leaking to unconsolidated sands, while preventing these sans and ground materials from falling into the wellbore, then, the well is drilled till a specific depth, in which provides the mechanical strength for better future drilling or reservoir stimulation.
2- Secondly, one more steel casing is cemented inside the wellbore to prevent any interval of aquifers from the wellbore; the cement is allowed to set prior to continuation of drilling.
3- In the final stage, the well is drilled to its final depth; additional casing can be inserted based on the expected reservoir and well condition and also the stimulation technique to be used, when the target depth is reached, a production casing string is installed through the borehole. The figure below illustrates projected section of unconventional well construction.

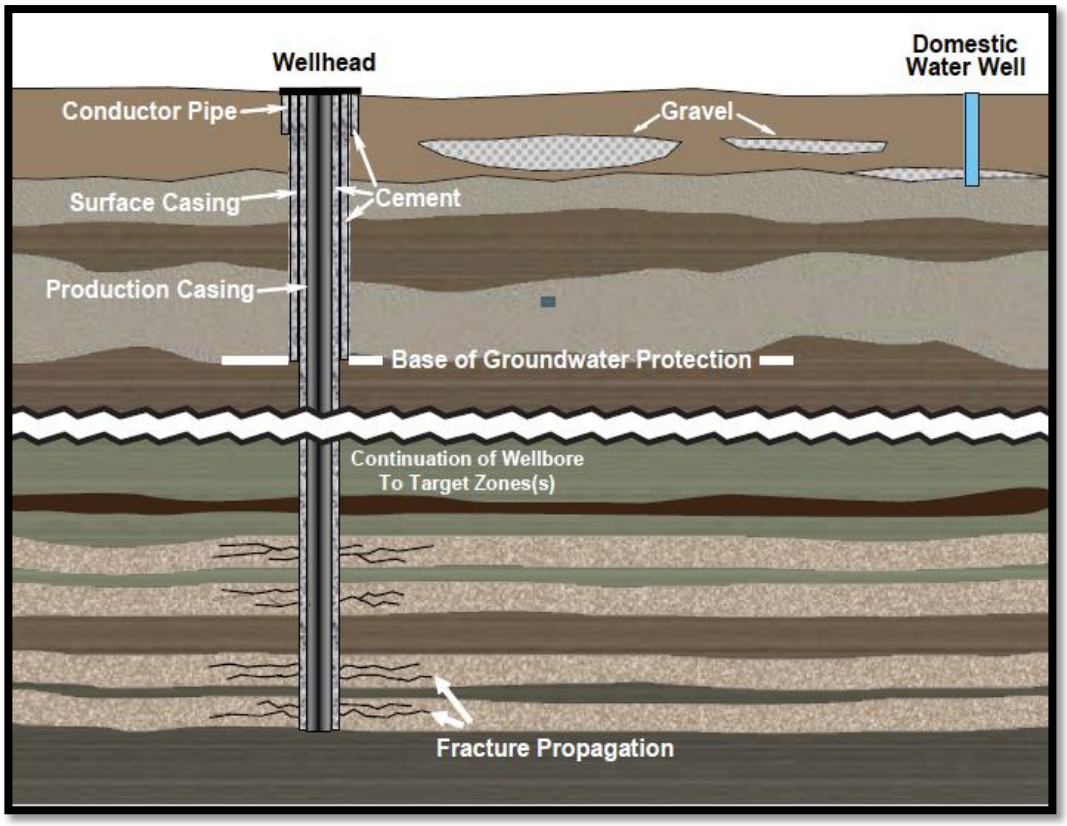


Figure 11, unconventional well , (Canadian Society for Unconventional Gas)

2.3.2. Hydraulic fracturing:

Most of oil and gas reservoirs are extended in their horizontal dimensions than their vertical dimensions, as shown in figure (12), thus, drilling horizontally through the shale formation could expose more area to the wellbore than in the vertical drilling case, however, whether the well was horizontal (A) or vertical (B), the same fracturing process will be undertaken.

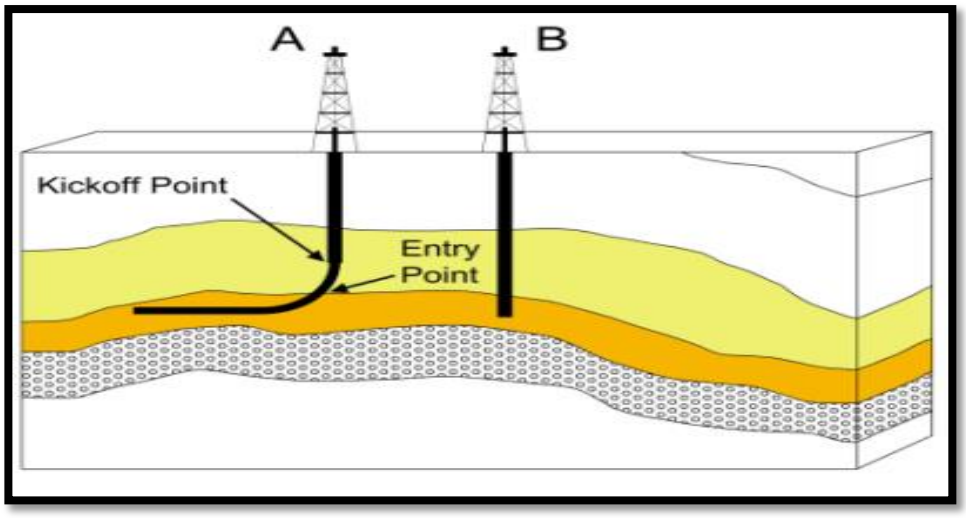


Figure 12, unconventional horizontal well (A) and unconventional vertical well (B)

The fracturing process can be divided into six stages starting from the bottom end of the wellbore and finishes up at the well surface:

1- **Perforating the casing:**
A perforating gun is inserted in the well and lowered through the horizontal portion or the end part of the well, then, an electrical signal is sent to this gun to make a small explosion, in which tiny hole made by the gun in the shale formation, these holes have two duties, one is to allow fracturing fluid to pass through and fill the holes in order to fracture the formation and create pathways, and also to provide an access for the hydrocarbons to the wellbore.

2- **Shale fracturing:**
The fracturing fluid which contains 99% water sands and less than 1% chemicals, is pumped by a huge pump at the surface down into the wellbore, in which this fluid enter the perforated holes and extra crack them, the sand will remain in the formation propping open the shale to guarantee pathways for the hydrocarbons embedded.

3- **Repeat in stages:**
In a systematic and structured way the process is repeated in different levels, experts record discuss and analyze each stage in order to better exploit the reservoir and for maximum output.

4- **Fracturing fluid removal:**
After the fractures were made in formations, the fracture fluid is recovered back from each well to big tanks found on the surface to be recycled and treated for future use.

5- **Flaring:**

Following the last quantities of fracturing fluid coming out of the well the gas will start to immigrate up throw the wellbore, thus a flare is set to make sure that gas is burnt.

6- **Collecting the hydrocarbons:**

After safely removing the fracturing fluid from the formation, the sand will remain in fractures to keep oil or gas flowing out of their rock formations throughout those pathways.

2.3.3. Fracking pumps:

The key success of hydraulic fracturing is the pump equipment used to inject the drilling fluid down the wellbore, with a pressure of 15,000 psi and flow rates more than 100 barrels per minute of the mixture of water and chemicals are injected by Reciprocating plunger pumps. Fracturing pumps were developing throughout the life of hydraulic fracturing increasing size, pressure and horsepower, in order to meet the increasing demand.

Until the beginning of 2000's fracturing pumps come in two types, triplex and quintuplex and the range of horsepower capacity from 1,300 to 2,000 bhp. Those pumps have been used for vertical wells in order to operate stimulation with some fractures, pressure required was almost 10, 0000 psi, pump design kept developing over the last decades until the early 2000s, in which, the dramatic shift in unconventional service market, thanks to the shale boom of U.S. the harsh pumping environment of shale drilling requires stronger pumps capable at operating in 9,000 psi and pumping sessions for more than 8 hours. For example, in Barnett Shale during the shale drilling boom between 2006 and 2008 service companies were pumping almost all hours in everyday, therefore, increased stress and bearing on the pump power kit including the fluid cylinder.

Due to the above mentioned shift in fracking market, some companies have started to come up with new modifications and advanced technology to the already existing pumps, one example was the modified quintuplex model, with more robust fully welded parts, greater wrist pin bearing surface area, stronger steel construction and increased rod load capacity compared to previous pump designs, this type of modified pumps was called "Supper Duty", those supper duty pumps provide higher flow rate and higher durability, therefore improved fracturing operation.

Another massive shift in fracking market, the shale boom in the North America continued impressing the world in the last couple of years by the vast reserves of unconventional resources being explored and technically approved, thus, pump manufacturers found themselves in a rush to provide better designs and characteristics of fracking pumps, since the new discovered basins require " monster pumps " that can beat the challenging conditions of drilling especially with the technique of horizontal drilling, this technique was developed to increase production rates therefore reducing the high cost of drilling and

completion. For instance, the Haynesville shale is being fracked with 13,500 psi in which fracking pumps operate 6 to 8 hours shift, fracking might operate for several days, under these tough conditions 50 percent of spare capacity must be available onsite in case of failure, the evolution of fracking pumps got even further, thus, some of the existing pumps at that moment got totally redesigned in terms of power frame allowing higher rod load and reducing the weight at the same time, more development was applied in terms of forged elements by ordering enhanced forging steel alloys to produce those parts, these pump design improvements have made the fracking pumps working comfortably at 2,400 psi, the cylindrical spacing, crankshaft stroke and all the geometry around expandable components was far from change in order to maintain the current ease of maintenance processes.

in summary, oil and gas forging industry plays big role in developing fracking pumps and upgrade them to operate in the most challenging and harsh environments ever.

2.4. Forging:

The share of oil and gas production from deep and ultra-deep water has increased along with the new trend of shale oil and gas, as a result, the service sector has become more critical to the growth of oil and gas industry in general, high temperature, high pressure and the high carbon dioxide levels, all these extreme conditions require improved equipment and high performance materials to reach the planned level of oil and gas productivity, therefore, oil and gas component manufacturers have become more focused on the Corrosion Resistance Alloys (CRAs), in the way they increased their forging capacity and variety.

the demand of the special alloy steel, stainless steel and Nickel alloys for upstream players in the oil and gas value chain have increased substantially and this growth is expected to continue developing,

2.4.1. Types and selection of CRAs:

CRAs are typically introduced as stainless steel and Nickel alloy, moreover, special alloy steels are considered in the oil and gas industry as well, and however, alloy steels and stainless steels account for approximately 95% of the total tonnage while Nickel alloys come with approximately 5%, while the total contribution of the CRAs is 25% of the total value. (Steel Market Intelligence, Austria and Quest Offshore Resources, Houston, Texas, USA, June, 2013)

The demand of CRAs is critically correlated with basin conditions, each as its importance are correspondingly listed below;

1- Corrosiveness (Hydrogen Sulphide, Carbon Dioxide, Chloride).
2- Temperature.
3- Pressure.

Thus, corrosion experts determine the expected corrosion rate per year and then they multiplied it by the design life, if the corrosion was estimated at levels exceeding certain point either CRAs are considered or the high wall thickness carbon steel, in addition the use of such alloys can be also as cladding or welding overlay.

CRAs might need high capital investment in the beginning, while they are the cheaper sector along the lifecycle since less maintenance and chemical inhibitors needed; the following figure illustrates the steel matrix for oil and gas projects corresponding to the main selection parameters of metal alloys.

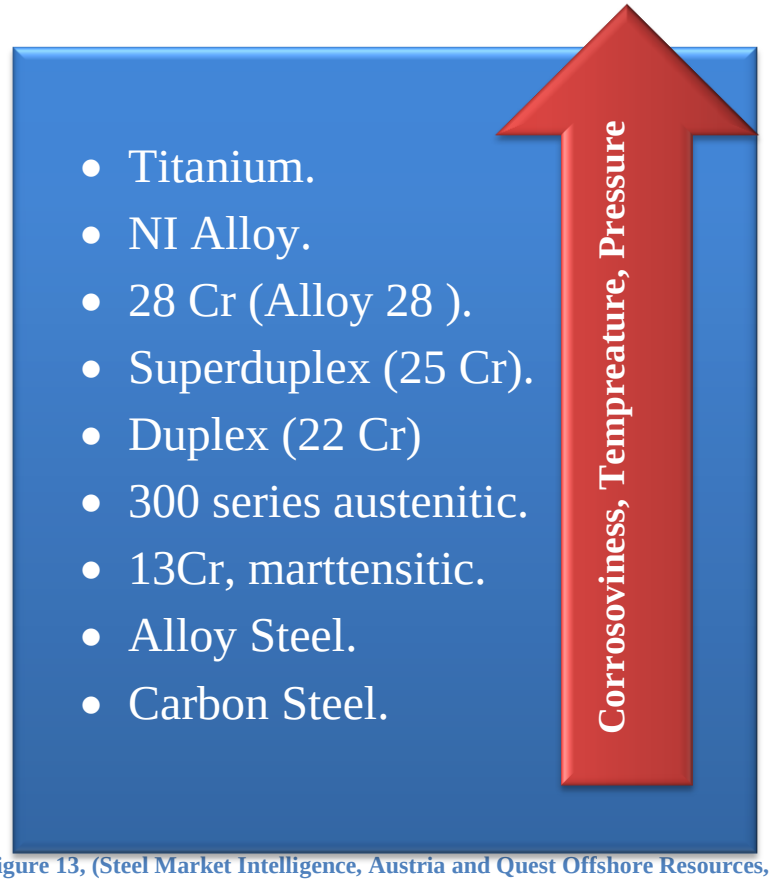


Figure 13, (Steel Market Intelligence, Austria and Quest Offshore Resources, Houston, Texas, USA, June, 2013)

Basically, Carbon and alloy steels are the lowest cost material in the list thus, they are used whenever the operating condition is less wild, while a much as the environment becomes harsher higher grade materials should be considered though,

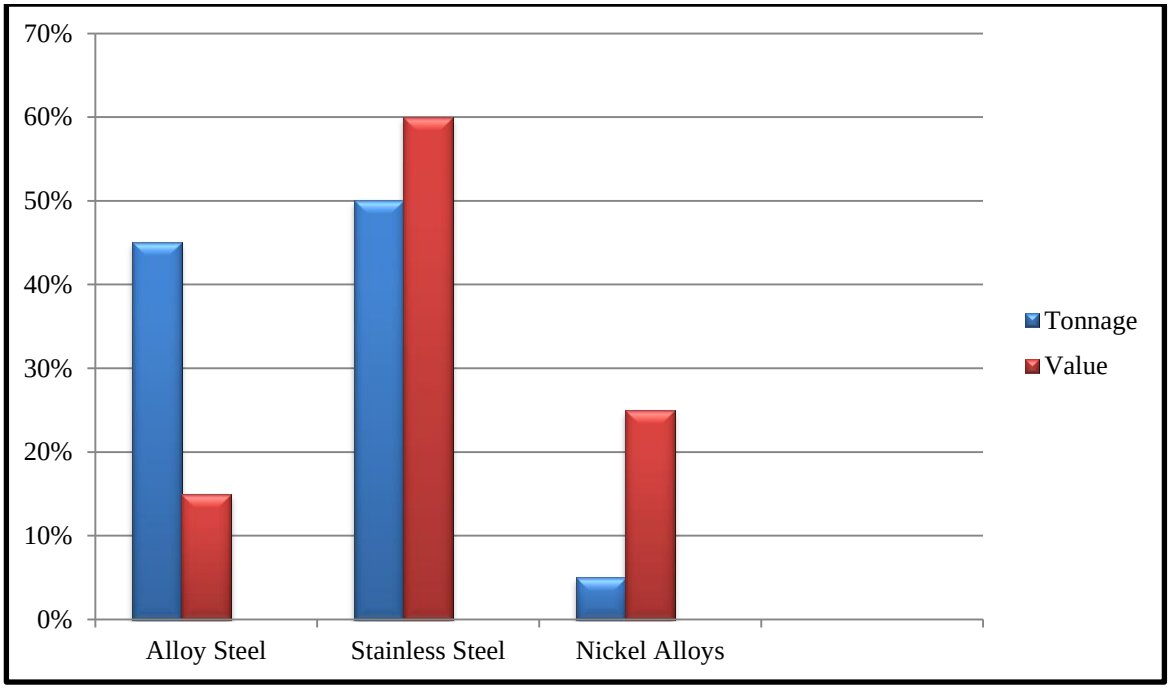


Figure 14, metal used in the oil and gas industry, (Steel Market Intelligence, Austria and Quest Offshore Resources, Houston, Texas, USA, June, 2013).

For more specific details, the following table lists steel alloys with different grades:

Alloy	Grades
Steel Alloy	4145H, 4130, 4140, 4330, 8630, F22
Martensitic	13Cr, Super 13Cr, 410, 420, F6NM
Austenitic	316, 304, 321, 317L, Nitronic 50/60, 904L, 254SMO (6Mo)
Duplex	2205, 2507, LDX2101
PH Grades	17-4, 15-5, 13-8
Ni Alloys	825, 625, 718, 925, Alloy 28
Non Magnetic	special chromium manganese austenitic grades

Table 1, the most widely used steel grades in the oil and gas industry, (Steel Market Intelligence, Austria and Quest Offshore Resources, Houston, Texas, USA, June, 2013).

CRAs are used in producing different shapes of products, including 3D-forgings, and many other applications, the following table describe the most common application and parts forged by CRAs.

2.4.2. Application for CRAs in the oil and gas industry:

The table below indicates the forged applications used in oil and gas industry with steel type, notice that the unmarked elements are either carbon steel based or castings.

classification 1	Classification 2	Classification 3	Steel Type		
			Alloy Steel	Stainless Steel	Nickel Alloy
Drill String	Kelly		x		
	Heavy Weight Drill Pipe	Integral Heavy Weight Drill Pipe		x	
		Welded Heavy Weight Drill Pipe - Body	x		
		Welded Heavy Weight Drill Pipe - Joint	x		
	Bottom Hole Assembly	Drill Collar	x		
		Non-Magnetic Drill Collar		x	x
		MWD & LWD		x	x
		Connections and Subs	x	x	
		Stabilizer & Rotary Reamer	x	x	x
		Mud Motor/Downhole Motor - Stator	x	x	x

		Mud Motor/Downhole Motor - Rotor	x		
		Drill Bit	x		
Blowout Preventers	Ram Type BOP	Body	x		
		Flange & Bonnet	x		
		Ram	x		
		Operating Cylinder	x		
		Piston	x		
		Weld Overlay			x
	Annular Type BOP	Body	x		
		Weld Overlay			x
Wellheads	Conventional Surface Wellhead	Tubing Head Adapter	x	x	
		Tubing Hanger	x	x	x
		Tubing Head	x	x	
		Casing Hanger	x	x	x
		Casing Spool	x	x	
		Casing Head	x	x	
		Seal/Pack-Off	x	x	
		Weld Overlay			x
	Subsea Wellheads	Conductor	x		

		Housing			
		High Pressure Housing	x		
		Casing Hanger	x	x	x
		Annulus Seal Assembly	x	x	
		Wear Bushing	x	x	
		Weld Overlay			x
Downhole Tools	Flow Control	Sliding Sleeve	x	x	x
		Landing Nipple	x	x	x
		Polished Bore Receptacle	x	x	x
		Others	x	x	x
	Safety Systems		x	x	x
	Packers		x	x	x
	Liner Hangers		x	x	x
	Sand Control	Screen	x	x	x
		Gravel Pack	x	x	x
Subsea Equipment	Subsea Tree	Tubing Hanger	x	x	x
		Master Valve	x		x
		Wing Valve	x	x	
		Other Tree Valves	x	x	
		Production Choke	x	x	

		Weld Overlay			x
	Subsea Manifold	Manifold Block	x	x	
		Weld Overlay			x
Risers	Drilling Riser	High Pressure Drilling Riser	x		
	Production Riser	Steel Catenary Riser	x		x
	Riser Joints	Flex Joints	x		
		Stress Joints	x		x
Subsea Connectors	Bolted Flange	Flange	x	x	x
		Seal Ring	x	x	x
	Clamp Connector	Hub	x	x	x
		Clamp	x	x	
		Lead Screw			x
		Seal Ring	x	x	x
	Collet Connector	Body	x		
		Seal Ring	x		
	Dog & Window Connector	Body	x		
		Gasket		x	x
		Body	x		
	Tubular Connector	Tubular Connector			
	Stab Connector	Body		x	x
		Seal			x

	Weld Overlay				x
Subsea Control Units	Subsea Sensors			x	x
FPSO	Swivel Stack	Turret Svivel Core	x	x	x
		Swivel Rings		x	
Pumps	Horizontal Split Case Pump	Casing		x	
		Casing			
		Shaft	x	x	x
	Deep well Vertical Lineshaft Pump	Volute Casing			
		Impeller			
		Shaft	x	x	
		Pipe Stack		x	
	Electric Submersible Pump	Housing	x	x	
		Shaft		x	x
		Stage			
	Helico-Axial Pump	Housing			
		Motor Rotor	x		x
		Shaft		x	
		Stage			
	Progressive Cavity Pump	Drive Train		x	x
		Housing / Stator	x	x	x
		Rotor	x	x	x

	Twin Screw Pump	Housing			
		Twin Screws	x	x	
	Reciprocating Pump	Housing			
		Plunger		x	x
	Fracking Pump	Housing			
		Crankshaft	x		
		Fluid End	x	x	
		Plunger	x		
Compressors	Screw Compressor	Body			
		Twin Screws		x	x
	Reciprocating Compressor	Housing			
		Crankshaft	x		
		Cylinder	x	x	x
		Rod	x		
Valves	Gate Valve	Body	x	x	x
		Bonnet	x	x	
		Gate/Wedge	x	x	x
		Seat Ring	x	x	x
		Stem	x	x	x
	Globe Valve	Body	x	x	
		Bonnet	x	x	

		Plug/Disc	x	x	
		Seat		x	
		Stem	x	x	
	Ball Valve	Body	x	x	x
		Ball	x	x	x
		Seat Ring		x	
		Stem	x	x	x
		Trunnion	x	x	
	Check Valve	Body	x	x	x
		Bonnet	x	x	x
		Disk	x	x	x
		Seat	x	x	x
	Butterfly Valve	Body	x	x	
		Disc	x	x	x
		Shaft		x	x
		Seat		x	x
	Choke Valve	Body	x	x	x
		Bonnet	x	x	x
		Flow Bean		x	
		Seat		x	x
		Stem		x	
	Actuator	Case/Cylinder			
		Piston		x	

		Spring	x		
		Stem	x	x	

Table 2, list of oil and gas forged applications, (Steel Market Intelligence GmbH and Quest Offshore Resources, Inc., 2013)

Special alloy steels are used for wide range of applications especially in those facing harsh conditions such as ultra-deep water and shale oil and gas, the CRAs as shown in table () are used in forging; drill string components, tubing and casing, downhole completion equipment, wellheads, blowout preventers, subsea Christmas trees, manifolds, riser system, flowlines, jumpers, umbilical, valves, pumps, topside processing equipment, pumps and etc.

For example, 13 Cr superduplex or Nickel alloy grades are used with cold working to produce Seamless tubes for tubing and casing. Instead of solid CRA flowlines, pipelines and steel catenary risers, welded clad pipes are preferred due to their low cost compared to the first mentioned parts.

Large size forgings are required by BOPs and Christmas tree manufacturers, they are usually made of alloy steel (F22, 8630, 4130), while Nickel alloy weld overlay (grade 625) is applied on all humidity or water exposed surfaces to prevent corrosion, on the other hand, smaller forgings for valves bodies are made from duplex grades.

2.4.3. Cladding

Basically, in many metal applications, it is common to consider at the beginning whether carbon or alloy steels would be suitable, thanks to the relatively low cost and the variety of mechanical properties that the above mentioned types have, however, in the harsh environments, the CRAs are necessary to extend service life and to improve strength compared to the basic steel, those CRAs would increase cost per ton for each part produced, thus, Cladding technology is went up to the surface in order to provide the option of cost impact reduction.

In cladding CRAs are applied as a barrier layer on the surface of a carbon or alloy steel, this would be the solution of cost reduction rather than making the whole application with the expensive CRAs.

This barrier layer is bonded to the normal steel with fully metallurgical contact, while a differentiation is made between the cladding layer and the metal surface by hot dipping or plating.

With CRAs products, welding operations must be carried carefully in order to not damage their properties; therefore, welding methods with low heat input are recommended.

However, clad products have been considered in oil and gas industry as anti-corrosion, cladding applications became a reasonable alternative of carbon steel and solid CRAs in certain conditions, in case of high corrosion rate or in projects last for too long in which corrosion is present at some point. In such cases, the choice of cladding may appear as the economically best solution

3. Company introduction

Forgiatura Mamé:

In 1905 Frogiatura Mamé was founded, more than 100 years of experience made the company among the leaders Italian forging companies and has always been in a competitive position in the global market of the oil and gas forgings sector.

Forge Monchieri:

The year 1970 had witnessed the birth of Forge Monchieri, the energy sector is the company specialty, and its supply covers Europe, Asia and America.

M&M Forgings:

The two abovementioned companies have agreed to start up a strategic alliance to face future challenges with more potential and to aggressively compete in such huge and risky markets.

Merging the two capacities and the variety of products has given the motivation to adopt such a movement, if we consider the giant 120 tons pieces that Monchieri can produce and the small and medium range of forged elements along with the finishing processes that Mamé could represent a perfect combination and comprehensiveness to aggressively attack different markets and the most risky ones with more confidence.

- M&M Forgings is keeping the trend of the high cost and quality ratio of the Italian forging industry.
- One of the most important steps forward has been made is the unifying of three important departments, as shown in figure (15), sales and purchasing departments, Marketing and R&D department, in order to achieve the best coordination and the internal integration, therefore rigid alliance.

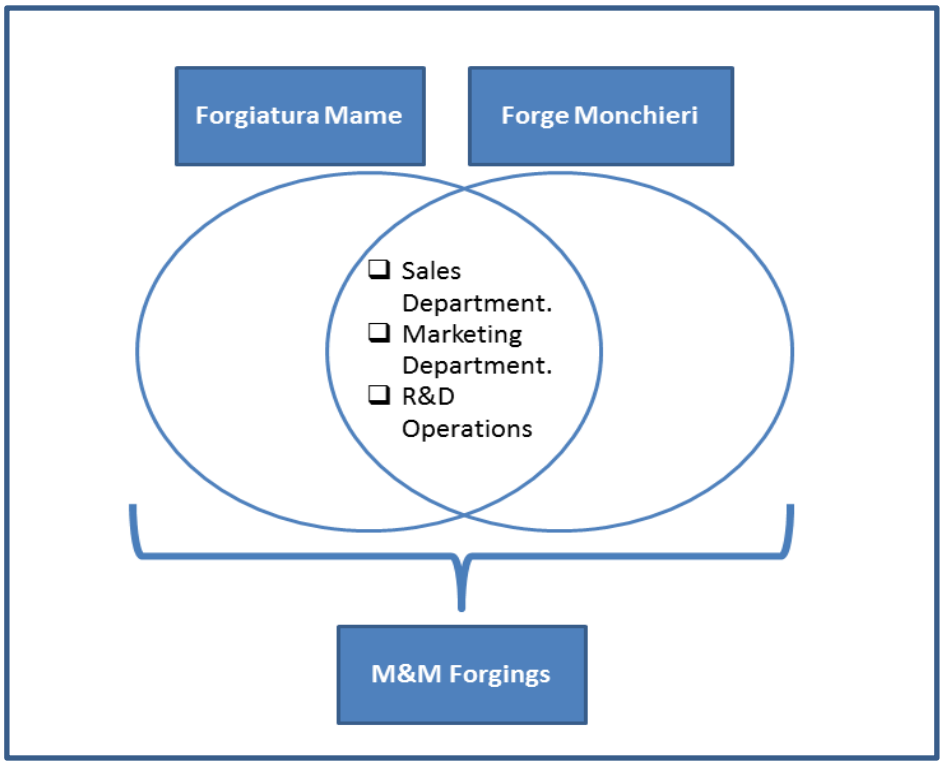


Figure 15, the alliance outlines

Therefore, the merged departments represent a mixture of both companies experience in the corresponding issues, forming an integrated network that leads M&M Forgings for new era.

The following figure illustrates the M&M Forging's Oil and Gas sales department, given that all the offers and contracts have to be analyzed by the six aspects before making any decision.

Figure 16, Oil and Gas sales department structure

3.1 M&M Forgings Value:

To produce high quality products is not a competitive advantage anymore, due to the extreme competition it became a standard in order survive in the market, thus, M&M forgings had to sophisticate its service by offering extra features such as;

- Product customization → rough conditions
  → Pre-cladding conditions
- Customer involvement during the processing phase.
- Short lead time, thanks to relatively short lead time of ordering raw material from ASO the Italian steel supplier located in Brescia which is few kilometers away from M&M Forgings' workshops.
- A combined capacity of 100,000 metric tons/year, such capacity assures more leverage in terms of dealing with row materials suppliers and to achieve the economy of scale.

3.2 The Supply Chain

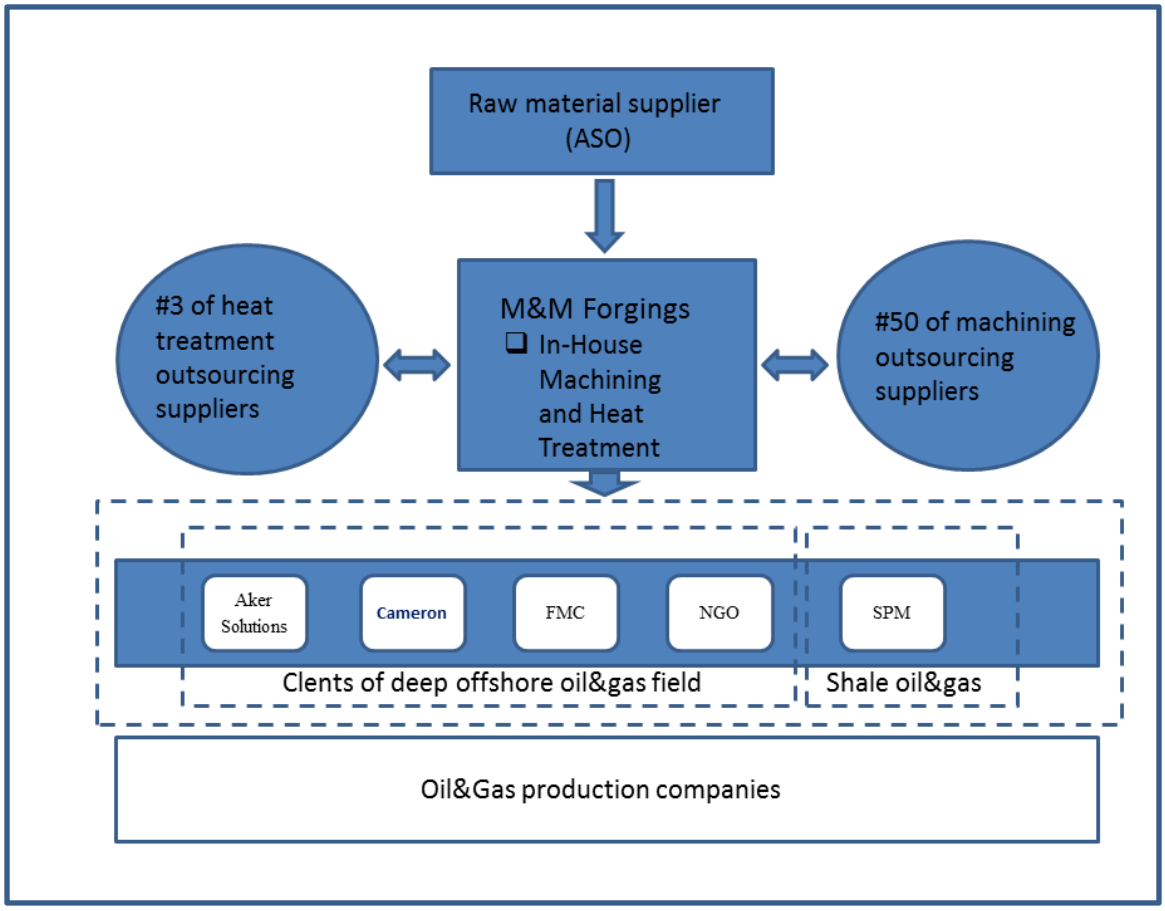


Figure 17, M&M Forgings supply chain

The figure above gives a rough idea about the supply chain flow starting from the row material supplier ending with the final customers.

The row material supplier: ASO is Italian steel trader that offers high quality metal sheets and blocks, its location gives advantage of short lead time, row material has crucial impact on the overall cost of each product with average weight of 40% to 50%.

M&M Forgings has invested in improving its output by focusing on machining and heat treatment in house that allows better control of production, Moreover, it has kept good connections with outsourcing considering about 50 providers for Machining and 3 for Heat treatment to be able to cope with orders jam, while recently, the latest investment was the introduction of the new semi-automatic heat treatment plant able to process up to 3,000 tons per month, this plant containing two muffle furnaces with overall length of 20 meters, a special crane to manage handing process in all movements and two tanks of heat treatment which can be connected to each other through four mobile platforms, while each tank has a capacity of 100 tons every three hours.

M&M Forging business is wide spread in the global market by covering the Ultra deep water service companies such as; Chevron, Cameron, Aker Solutions, FMC and NGO. and covering also the Shale Oil&Gas market by supplying a significant player such as Weir SPM.

3.3. Purchase Process

In most case, the manufacturing strategy of the company is "Make to Order" or "Engineer to Order" and the cost of buying raw materials from the supplier reaches 50% of the total cost, Therefore, it's absolutely significant to get some installments of the value of the project to buy the material needed in advanced, in this case gathering a stock reduces the risk of unexpected issues by fixing the price along the project's lifetime. On the other hand, full integration with the supplier offers the required quantities at the right time with no need of in-house stock.

3.4. Selling Process

There are some crucial points before describing the buying process itself:

- The company's profile is wide distributed among the most important companies working in the target market.
- Sight visits by sales department manager to those companies in order to know what type of products they make thus; they can better explain the parts or service M&M Forgings can offer.
- The decision has to be evaluated by the six phases of the sales department (logistics, quality, technical, shipping, purchasing and estimating)

The selling process flows as described below:

- Receiving a project description with quotation request from the client.
- Analyzing the project in terms of capability and feasibility.
- Manufacturing plan (to determine the needed resources and their allocation), M&M Forgings has developed a new software that can simulate the forging and the heat treatment processes before starting production to ensure that the output will satisfy the customer specifications.
- Supply plan (acquiring a quotation of the needed resources and the lead time from suppliers).
- Preparing the offer.

- Negotiating.
- Agreement.

In fact, the process is not as simple as it looks, a very tough competition has to be considered, the quotation request was already sent to the competitors at the same time as well, recently, a €23 million project was on table among the biggest players in the market to supply Aker Solutions with forged elements to be used in the deep offshore, the competition dropped down to 12 companies then it has been confined between M&M Forgings and its rival before the first mentioned has won the tender, thanks to the professional and comprehensive quotation submitted.

The definition of the both markets, the shale and the deep offshore oil and gas in M&M Forging's point of view

	Shale Oil&Gas	**Deep Offshore Oil&Gas**
products	Engines of Fracking Pumps.	Christmas tree parts (spool body, AWB, and PWB) and pieces such as; Valve bodies, Blow Out Preventers BOPS, STRESS JOINTS, Risers, Wellheads, and Pinions for jackup drilling rigs.
clients	Weir SPM	Cameron, Aker Solutions, NGO, FMC and GE Oil&Gas
projects	Supplying SPM with engines of the Fracking pumps used in different projects around the world for Shale Oil&Gas.	Gorgon off Western Australia; Ichthys (Inpex); BP Norge's Skarv, and other BP projects offshore Angola and in the Gulf of Mexico (Mad Dog); Kizomba A&B and Total's CLOV, Dalia, Girassol, and Pazflor developments offshore Angola; Balder Phase III, Goliat, Kristin, Troll, Vigdis, and Visund offshore Norway; RasGas off Qatar; and Chevron's Big Foot and Jack/St Malo in the Gulf of Mexico
advantages	Standard products and less	Huge market, high demand

	complicated to produce, growing market.	and profitability is considered high compared to Shale Oil&Gas if we talk about 10% to 30% margin.
Disadvantages	the environmental issues increase the risk of adopting new projects by the developed countries. The profitably relatively low in which doesn't exceed 5% margin and the company has not witnessed any new orders and even its customers do not tend to buy.	More complicated to produce due to the critical implementation conditions and to the different characteristics ordered by customer (for example Aker Solutions has recently ordered Spool Bodies to be adjusted to survive in very extreme conditions)
Future	Ambiguous due to the environmental issues	Promising market One extra feature that the company is ready to invest in is to offer cladding processing to its customers available under request.

M&M Forgings is trying to work in parallel on both sectors Ultra Deep Water and Shale oil&gas, each sector has its own ; opportunities, threats, products and market, the following table underlines an overview of these two different markets.

4.0 Marketing Analysis.

4.1. Macro Environment – PESTEL Analysis

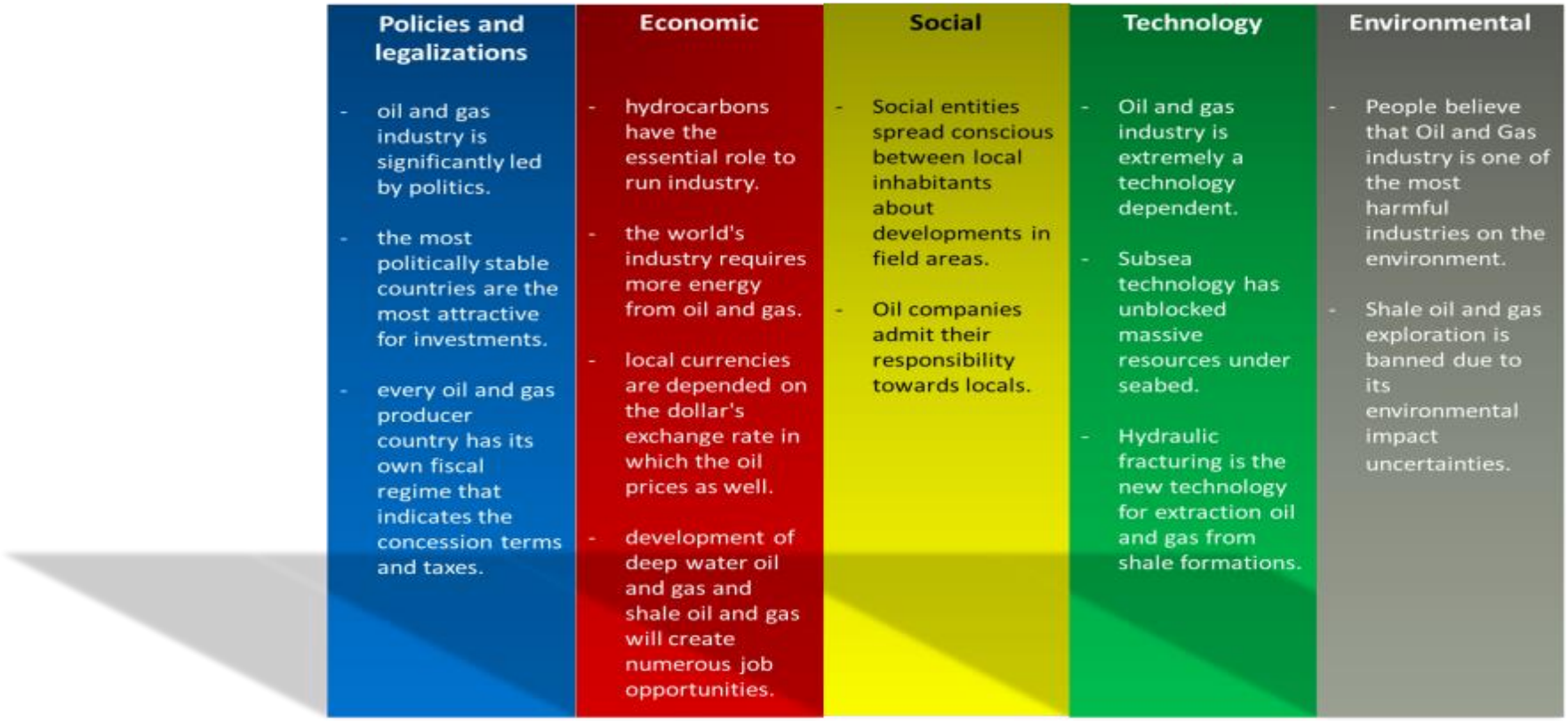


Figure 18, PESTE Analysis

The initial step of the strategic analysis at Macro level is to asses and clarify the Definition and qualification of the master market (deep offshore and shale Oil&Gas market) that directly controls the Oil&Gas forged parts market, analyzing the external environment, that directly or indirectly influences the above mentioned markets by PESTEL Analysis, taking into account the most important aspects; Political, Economic, Social, Technology and Environment.

4.1.1. Political aspect

The petroleum industry is significantly led by the world political regimen which draws the plan of relations among the hydrocarbons exporters and importers and the regulations and the legislations controlling the markets.

For example, the British government continues support to its BP projects in terms of security and logistic issues in Iraq, in addition, this type of support is fundamental within the world leading countries to ensure the needed energy supply even from the most unstable and ambiguous regions.

There is a powerful correlation between the political point of view and the legislation path, in which, flexibility of fiscal regime conditions from state to another is simply achieved when it comes to certain projects or partners in terms of taxation and contract conditions.

For better understanding, some examples of political intervention and new regulations are shown pointing at the two main industries on focus.

The BP oil spell in the Gulf of Mexico has significantly influenced the Oil and Gas industry in general and the regulatory regime in particular.

after the disaster, the industry has witnessed a dramatically increase of the insurance rates for companies working in the sector, for instance, the rigs operating in shallow water had induced to 25% by June 2010 (Reuters , 2010), furthermore, the inflation had increased the

insurance premiums for deep-water operations to 25% and for deep-water drilling to almost 100% (The Guardian, September 20, 2010).

As a result, this would lead the mid to small size companies to be eliminated from the Gulf, since being self-insured requires a missive cash resource.

Therefore, the US government has made a revolution in the regulatory system by restructuring the federal regulatory agency which is the responsible body of monitoring and assessing the offshore drilling, also, it has established the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), the previously named, The Mineral Management Service. The new office structure based on two divisions, one issues drilling leases and the other regulates the drilling processes. thus, companies aimed at drilling in the deep-water has to meet the BOEMRE conditions by showing the availability of the appropriate means to overcome the worst case scenario, the office will consider a random oil rig inspections and a periodically control on certain indicators such as pressure readings.

Drilling Safety Rule and Workplace Safety Rule are set of standards issued by the BOEMRE in order to improve the safety in the industry.

Another example, is the Shale Oil and Gas fracking regulations, a moratorium on hydraulic fracking is considered in many countries around the world. For example, France, Netherlands and Bulgaria are banning the fracking technology due to its ambiguous effect on the environment; on the other hand, many other countries are either on the way to adopt the technology and start producing such as Germany and Lithuania or have already kicked off drilling.

USA and Canada are the leaders of this sector as they had already started producing, the other countries, thanks to the economic pressure and the growing demand of energy; they had to approve fracking under some restrictions to minimize its risk on the environment.

4.1.2. Economical Aspect

Oil and Gas industry in general is tightly connected with the world economy and it is the most sensitive one among the other industries to world economic fluctuations and vice versa. Energy demand grows accordingly with economy, in growing economies all the

sectors witness positive indicators and will ask for more energy to continue developing, thus, construction will critically need energy and oil products, industry will require more energy as a result of expansion. On the other hand, availability of Oil and Gas in the market with reasonable prices is very crucial; any increase will negatively affect peoples' pockets.

Oil demand is expected to keep increasing for the next decades, especially in countries like China and India who are experiencing high GDP growth, Moreover, the value of the Dollar, the currency in which Oil and Gas are traded has to be taken into account, for example when the dollar value shrinks the oil price goes up in order to compensate in a certain way the lost difference according to the exchange rate of the oil producers local currencies. Therefore, Oil and Gas stakeholders' benefits depend on the stability of the dollar and the economy of the United States in general.

From different perspective, either Ultra-deep water and Shale Oil and Gas's new projects will create several thousands of job opportunities, not exclusively for oil and gas sectors but also for the other fields such as; transportation, construction, heavy industry and chemicals.

4.1.3. Social aspect:

One significant party of the industry stakeholders, is the society, represented in the social entities that concern about the beliefs, lifestyle and world in general, these forces have gained power and legitimacy day by day and year by year, people became more aware about the hot topics regarding their life as a result of the globalization, global warming, pollution and corruption are being observed.

Apart of the united states where the landowner has the right to utilize the mineral resources his land reserves, a feeling of depression and exploitation rose up towards the industry in the rest of the world, normal people witnessing no positive changes in their lives nor in their societies as a result of organizational corruption and greediness, therefore, the majority of oil companies have set plans based on avoiding such conflicts, by running sustainable human development programs in the areas they operate, showing their interest of improving the surrounding, starting up camps to explain their steps towards green housing, furthermore, they are also involved in funding social activities and organizations

supporting youths, developing the local manpower and charge up their skills. Such programs and plans have already started, for example; British Petroleum one of the biggest oil companies in the world, announced in its annual report the contribution to local communities in terms of education and human resource development (training and developing the local resources) and supporting the local market. While Petrobras has almost the same strategy, it admits that the industry depletes the natural resources which are heritage for every single citizen, thus, the company tries to invest in different social, cultural and environmental projects the have direct impact on satisfying the public.

These issues concern all levels of Oil and Gas supply chain, including exploring, drilling, service, logistic, equipment producers and all the other sectors of this leading industry.

4.1.4. Technological aspect

Oil and Gas industry is extremely dependent on technology, drilling the rocks and extract the hydrocarbons that are used in every day's life in different images is achieved, because of the developing technology and the innovative ideas that experts come up with, the advanced technology means have made what was considered in the past as impossible to achieve a normal process, technology helped in better exploiting the mineral resources and to improve the outcome of the existed wells, it has also led companies to go further than digging onshore by opening the doors to explore seabed starting from shallow water and by the up streaming technology drillers reached the so called ultra-deep water, nowadays, Shell the Dutch oil company announces the project of digging the deepest offshore oil well in the Gulf of Mexico, thanks to the latest technology they have achieved. The oil will travel 3000 meters to reach the ocean surface, the mentioned depth some years ago was "a joke", leading Oil and Gas companies around the world aggressively compete among each other through their research and development departments to go deeper and deeper, challenging the extreme geophysical conditions of high temperature, pressure and other factors. Moreover, these challenges spread all the way through the Oil and Gas value chain, involving other brains and resources to beat the above mentioned challenges, producing the means able to overcome those conditions at reasonable cost.

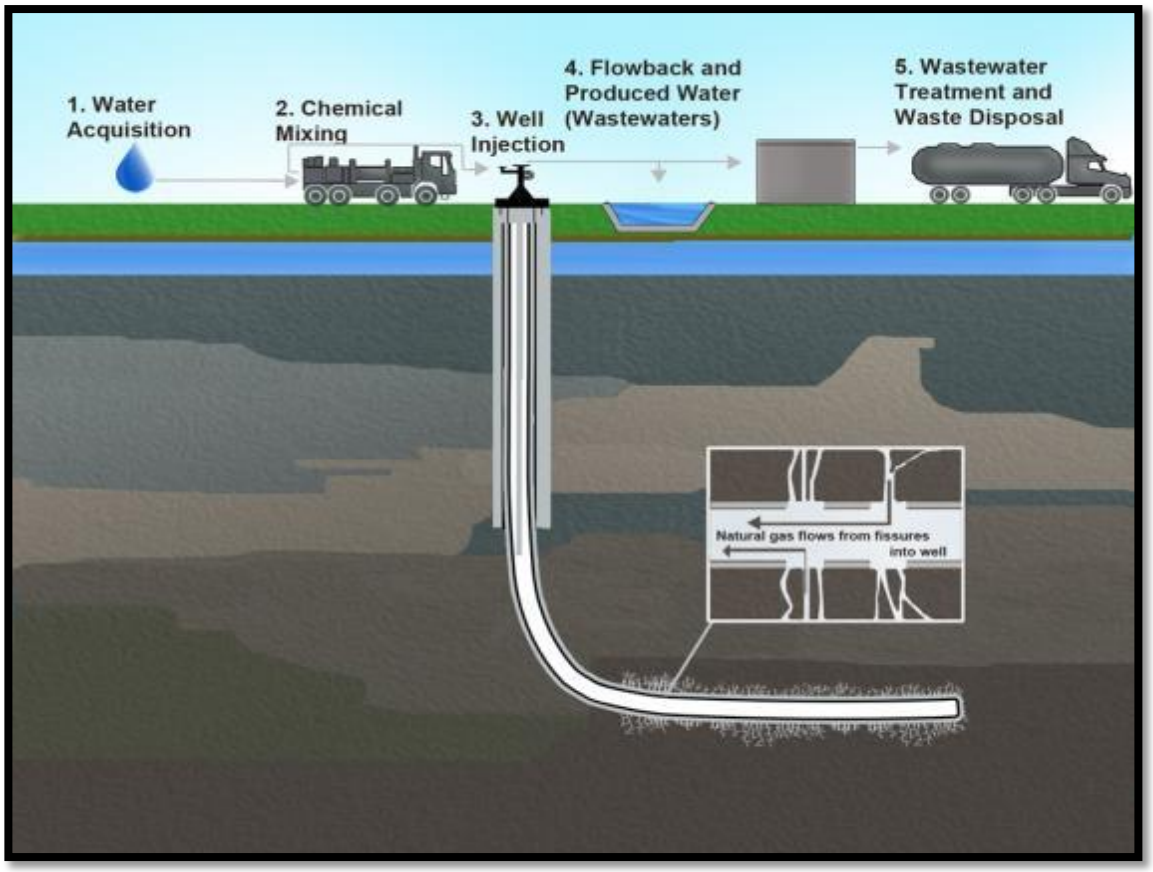
On the other hand, the technology has opened the way to benefit from the unconventional Oil and Gas as well, using Fracking (a technique used to make fractures in the rock that contain oil and gas and extract it) which is extremely technology driven, such technology have introduced new regions as hydrocarbon producers and also expanded the world's hydrocarbons capacity.

In summary, the increasing demand of energy as a result of growing economies, technology is the reliance of reaching as soon as possible the sustainable mineral resource usage that meets the growing need of power for the human race.

4.1.5. Environment aspect

People believe that Oil and Gas industry is one of the most harmful industries on the environment, companies are highly affected of this issue by taking the whole direct responsibility of the pollution appears in the field areas, and indirectly responsible of the global environmental issues, starting from the chemicals used in the Shale oil and gas, these chemicals are enough to kill the nature in the area forever and the land cannot be utilized afterwards.

Extracting the Oil and Gas from the shale plays is complicated, fracking requires huge volumes of water mixed with sand and chemicals to the deep rock formations, the impact on the environment is critical in the short and the long range, the following graph illustrates the general picture of fracking and its relation with nature life.



(United States Environmental Protection Agency, 2013). Figure 19

As indicated in graph (19), fracking requires a massive amount of water which compromises the water resources of the area by time, approximately 1-8 million Gallons of water needed to complete a fracking job, taking into account that only in the USA more than 1 million well have been drilled.

The above mentioned quantity of water of each well has to be mixed with more than 40000 Gallons of chemicals and sands to be injected in to the rock layers with high pressure to extract the hydrocarbons, these chemicals are considered toxic ones including (URANIU, MMERCURY, ETHYLENE GLYCOL, METHANOL, HYDROCHLORIC and ACIDFORMALDEHYDE) , and the threat is what if these chemicals reached the drinking water resources due to poor casing of the well or due to another reason. The process risks also poisoning the surface water from the discharge of the used water. Moreover, fracking the rock layers results a movement in these layers which could cause earthquakes, as what happened in the UK near to Blackpoll.

On the other hand, people believe that the negative impact on environment can be reduced to the minimum levels by issuing the rules and the regulations to control the types of chemical used as the European Union does, Moreover, the chemicals and water mix can be reused to drill more than one well in order to minimize the dependence on the toxic substances.

In result, the final product either Shale Gas or Oil tended to be less harmful in terms of greenhouse emissions compared to Coal based energy.

Oil spills, another dangerous issue hits the environment, tanker ships accidents and subsea blowouts (Vaduz ExonMobile and BP Gulf of Mexico) are the main reasons of Oil spills, its harmful effects start by destroying the marine life, killing fish and the other small organisms that are necessary for the global food supply, the threat becomes more critical when the floating spill reaches the shore, the affected area will be dramatically in crises, birds, animals, plants and human beings would suffer, simply, the whole area will be out of life standards for long time.

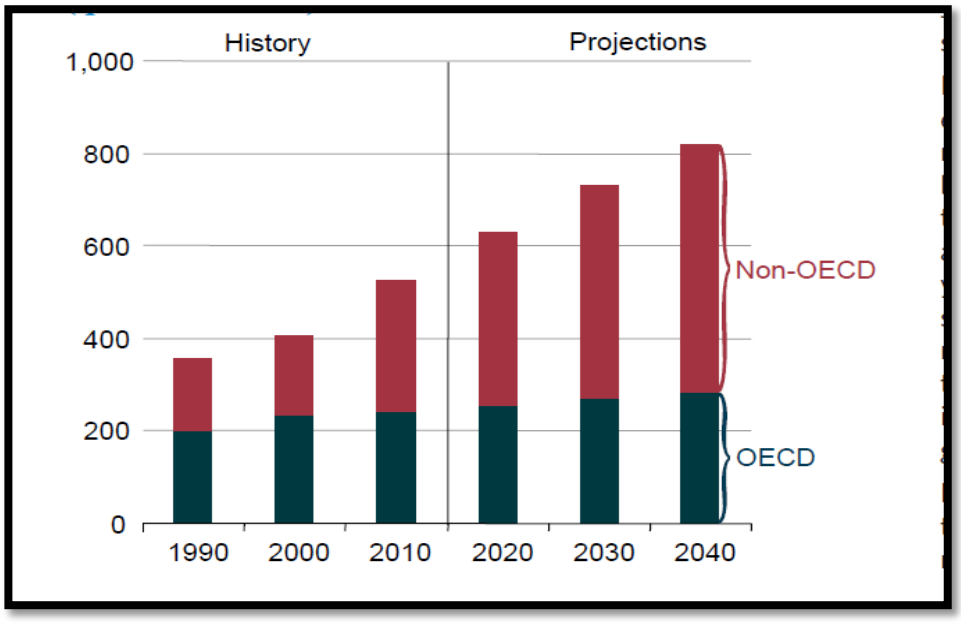
Therefore, as described in the political issues, many countries have adjusted their regulations to extract oil and gas from the seabed, increased insurance prices and higher standards required might support the environment in case of disasters, Moreover, oil companies already started to focus on the environment assessment, more campaigns are made to introduce their new technologies to eliminate the probability of having such disasters.

4.2. Demand Analysis:

4.2.1. Energy trend:

The IEO2013 illustrates the energy trend in the coming years and how the consumption is dramatically increasing due to different factors such as population and industry development.

The world will witness an increase of energy consumption from 524 quadrillion Btu in 2010 to 630 quadrillion Btu in 2020, a 56% expansion of energy consumption that hits the counters to 820 quadrillion Btu in 30 years, the developing nations outside the Organization for Economic Cooperation and Development (non- OECD) will count the 85% of the increase in the global energy demand in the next 30 years, thanks to their expanding population and growing economies. While the indicators from the OECD nations showing the contrast.



(U.S. Energy Information Adminstration , 2013). Table 3, Global energy consumption from 1990 until 2040.

The world economic crises hardly affected the European economies, while USA is recovering very slowly compared to the past recessions; also the short and long-term debt

issues are rising up the uncertainties of the future growth. Japan is still trying to recover from the third recession in the last three years. On the other hand, positive signs coming from the non-OCED countries especially from the Asian side, China and India were seen among the fastest growing economies in the past 20 years giving readings in 2010 of 10.4% and 6.4% growth per year respectively. This growth has not been dramatically reduced during the world economic crises as their rivals in the OECD.

Region	2010	2015	2020	2025	2030	2035	2040	Avg annual percentage change 2010-2040
OECD	242	244	266	283	288	278	286	0.6
Americas	120	121	126	130	133	137	144	0.6
Europe	82	82	85	89	91	93	95	0.5
Asia	40	41	43	44	45	46	46	0.5
Non-OECD	282	328	376	418	480	601	636	2.2
Europe/ Eurasia	47	50	53	57	61	65	67	1.2
Asia	159	194	230	262	290	317	337	2.5
Middle East	28	33	37	39	43	46	49	1.9
Africa	19	20	22	24	27	31	35	2.1
Central and South America	29	31	33	35	39	42	47	1.6
World	624	672	630	680	728	777	820	1.5

(U.S. Energy Information Adminstration , 2013). Table 4

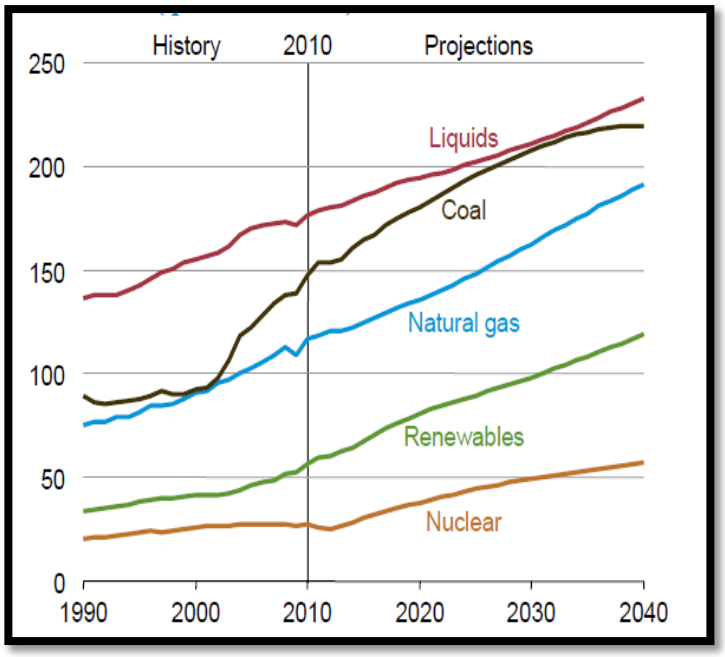
Recently, China became the biggest energy consumer in the world and it is predicted to reach more than the double of the United States energy consumption by 2040, at the same

time spam, middle east will need 76% more energy, Africa will also have increased demand of 85% rising from the expansion of population and growing economies which still depend on geopolitical stability, 62% of increased demand is expected for the non-OCED central and south American regions, while the weakest growth will show up in Europe and Eurasian regions by 42%.

4.2.1.1. The world energy matrix:

Due to the increasing demand of energy in the coming 30 years all the energy sources will be utilized as much as possible, oil prices are expected to reach high values compared to the historical range, the slowest growing source of energy is petroleum and liquid fuels with 0.9% from 2010 to 2040, while the total energy demand increases by 1.5% per year as shown in figure (22). With 2.5% growth rate Nuclear power and renewables are the fastest growing sources; this rapid growth is led by some factors such as: the expected high oil prices, the environmental issues and the concerns about the world's increasing demand of energy.

Hydrocarbons and coal are satisfying three-fourths of world energy needs. The graph below shows the trend of the world's energy matrix throughout the projected period from 2010 to 2040.



(U.S. Energy Information Adminstration , 2013). Table 5.

Petroleum and the other liquid fuels will keep their position as the largest source of energy, but decline will appear on their share in the matrix from 34% in 2010 to 28% in 2040, the drop in the matrix share is a result of the increasing oil prices, which forces many energy dependent sectors move to cheaper source.

In the 2020, natural gas consumption is 132 trillion cubic feet rising with an average of 1.7% per year reaching 185 trillion cubic feet in 2040. Thanks to the Shale Boom of the United States and the massive shale formations in Canada, and elsewhere as well.

Natural gas is traded with cheaper prices than oil and coal, which results in the increasing demand for the coming thirty years, the power electricity generation and the industrial sectors account 77 percent of the net increase of the world's energy consumption.

4.2.1.2. Oil production:

The world oil supply depends on different variables such as: exploration and discoveries of new reserves, oil prices, technology and innovation in the oil supply chain and also the impact of OPEC decision.

The sources of production growth needed to satisfy the increasing global oil demand are changing over time, in 2040 the total world liquids production is expected to be 115 million barrels per day with 28.3 million barrels above the 2010 production level.
The diversification of the liquids and their weights in the oil supply matrix(heavy oil, tight oil and shale oil) depends on the innovative ideas and the leading technology which open for us new reserves and more efficient to extract, new ways of imaging the ground layers such as 3-D seismic, furthermore, the horizontal drilling and fracturing techniques open new spaces for well drilling field, the development in the deep-water technology is taking us deeper and deeper in the bottom of oceans, providing perfect control on the flow, thanks to the advanced tools, such as floating vessels for production, storage and offloading (FPSO), seabed tools (Christmas trees, BOP and ,,,,,,etc.) and risers as well.

Global oil production is increasing rapidly from the Americas, thanks to the flow of oil sands in Canada, tight oil of the United States and the ultra-deep-water projects in Brazil. On the other hand, this production growth is faced from the other side by the increasing cost of extraction and exploration, the annual spending on the industry is tripled in the past ten years to reach $550 billion in 2011.

Despite all the positive indicators of production growth in the Americas, OPEC is still critical in the global market since its members contribution is 13.8 million barrels per day to the global petroleum supply from 2010 to 2040, the other part of the world oil supply is done by the Non-OPEC members with 11.5 million barrels per day and the nonpetroleum sources stand on 3 million barrels.
A strong increase in production of natural gas liquid fuels led by the growing shale gas production and the increasing natural gas production from Asia and the Middle East. Increased liquid production from the Americas has a huge impact on the world’s liquid trade, output from Brazil and Canada is heavy oil, thus, the new American refineries based in the gulf coast operate were designed to deal with such complex liquid, while the imports of sweet light oil from the middle East and Africa will decline.

4.2.1.3. Oil supply:

OPEC:

The period from 2010 to 2040 will witness an incremental investment in order to provide up to 43 percent of the total global supply of liquids, Middle East countries making the 68 percent of total OPEC production in 2010 rises 12 million barrels per day in 2040. Saudi Arabia, Iraq and Iran have big share of the world overall oil reserves and they are easy to produce.

West African OPEC production is boosted up to 5.9 million barrels per day 2040; Nigeria and Angola are expanding their offshore capacity by investing in new projects, while the onshore fields need more support.

North African OPEC producers Libya and Algeria experience slower growth than their western counterparts, adding only a combined 0.2 million barrels per day of liquids production from 2010 to 2040.

In 2040 the south American OPEC which includes Venezuela and Ecuador produce 3.3 million barrel per day with 0.4 yearly growth, the two countries reserve considerable amount of extra-heavy oil in the Orinoco belt which requires major investments to make it available in the global market.

(U.S. Energy Information Adminstration , 2013)

Non-OPEC

The developing offshore resources of Brazil influence its production to reach 5 million barrels per day, thus, these numbers are relatively connected to high oil prices and technology available to operate the ultra-deep water efficiently, the massive oil reserves in the deep water of Brazil are estimated to be 28 billion barrels in January 2013, some deep offshore projects are still at their infancy, such as: Papa Terra and Sapinhoa which have

started the current year. 64 companies are showing their interest of the 11 bids resumed by the government for exploration in its offshore.

Canada, a production growth of 1.8 percent per year is making the Canadian production growing twice faster as United States 0.8% per year production growth.

Canada has three major production sources, bitumen from oil sands of Alberta, crude oil from the Western Canada Sedimentary Basin (WCSB) and the Atlantic Ocean offshore fields. In 2011 the half of Canadian oil production came from oil sands.

The unproved technically resources of tight oil in the Unite state are expected to be around 58 billion barrels which is considered pivotal for the world tight oil production. Bakken, Eagle Ford, Woodford, Austin Chalk, Spraberry, Niobrara, Avalon, Bone Springs and Monterey plays are responsible of 26 billion barrels of tight oil production in the coming 30 years. On the other hand, crude oil production from the Gulf of Mexico's deep and ultra-deep water is growing steadily due to the advanced technology and resources operating in the region, while the low US production is present in the 0.2 million barrels per day of GTL in 2040 .

In summary, the United States petroleum production in the coming thirty years will be fluctuating in the range of 11.5 million barrels per day, peaking at 12.8 in 2020 and settling at 11.7 million barrels per day in 2040.

Mexico and Chile oil production will experience two periods, one is with a staidly decline through 2025 to combined capacity of 1.8 million barrels per day due to the diminishing main source, and the other period is the recovery session thanks to the improvement of the sector investments, However, the total production in 2040 will fix at 2.1 million barrels per day which is still below the 2010 output of 3 million barrels per day.

Another important part of earth on the world oil map is the Eurasia region, Kazakhstan has the Kashagan field which has been considered as the largest discovery in the past 30 years outside the Middle East, $28 billion dollars were spent in 2010 by the join operating

company, North Caspian Operating Company (NCOC), to develop the field that. The lately mentioned oilfield with the other Caspian field are estimated to boost the production growth with a 3 percent per year, in which Kazakhstan production of oil in 2040 will 3.9 million barrels per day.

Russia, shows an increase of 0.5 percent of oil production growth every year from 2010 to 2040, the mature fields in the west of Siberia showing a decline of production, in which the industry started to shift gradually to the eastern part of the country, one other reason for this movement is to shorten the distance to the predicted increasing demand of the Asian market in China, India, Korea and Japan. In Addition, massive reserves of tight oil were proved in west Siberia, 75 billion barrels of technically recoverable shale oil is buried in Bazhenov shale formation. Recently, Dutch Shell and Gazprom have signed an agreement to improve and develop Bazhenov resources for a long term efficient production.

Moreover, Azerbaijan and Turkmenistan are showing some incline of liquids production over the next thirty years, this growth is estimated to be excluded for the liquefied natural gas.

The North Sea continental shelf holds substantial reserves of oil, and it is considered as the largest source in OECD Europe. Denmark, Germany, Netherlands, United Kingdom and Norway have the legitimacy to give Licenses for exploration and production due to an agreement signed by them. A decline in the production was obviously seen since the last peak of 6.3 million barrels per day in 1996 has reduced the production to 3.6 million barrels per day in 2010, with a drop of 1.6 percent per year the north sea production of oil will be 2.2 million barrels per day in 2040, the United Kingdom experience the highest decline of oil production due to infrastructure issues and the depleting of major sources, on the other hand, Norway shows some positive indicator of production capacity, thanks to the advanced technology and the huge investment available.

Non-OPEC Asia

China, an increase of 0.8 percent per year makes its production of oil to 5.6 million barrels per day in 2040, a big share of this increase is related to the significant investment by the

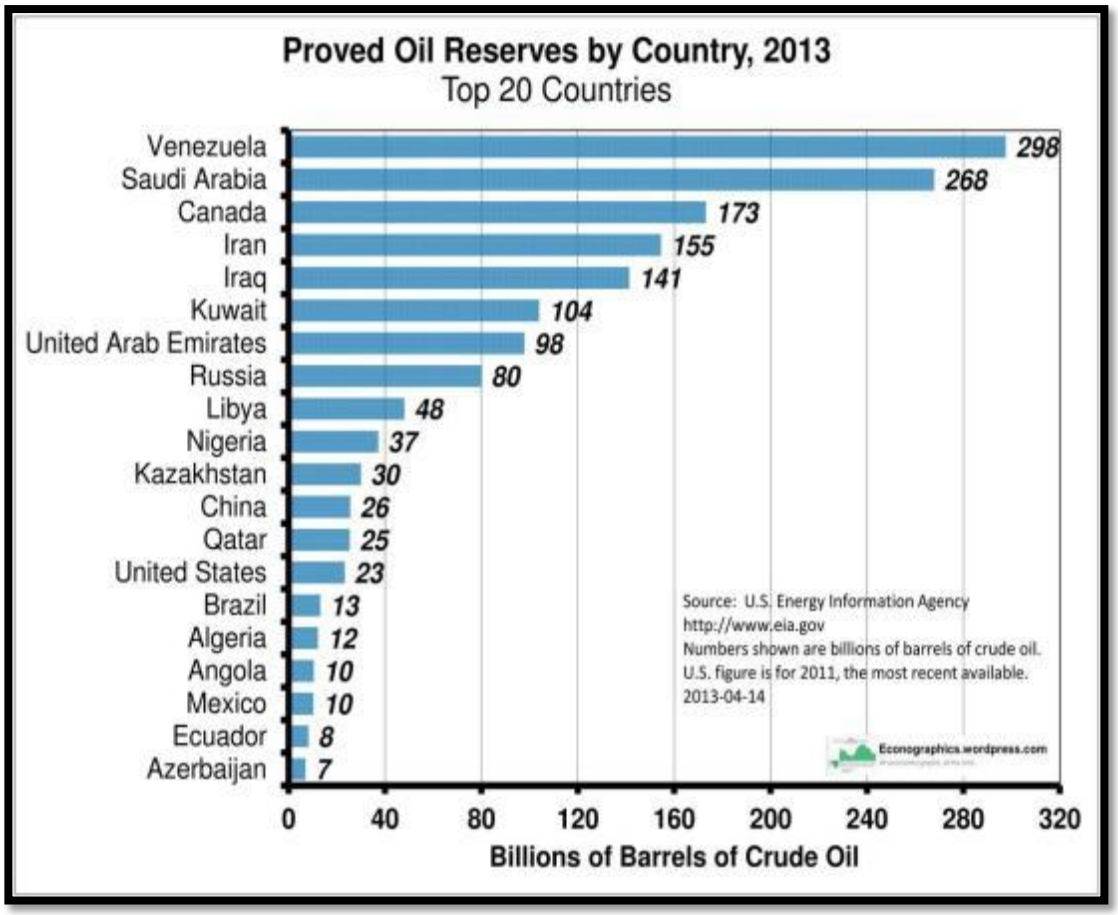
national oil companies CNPC and CNOOC in the deep-water offshore basin of Pearl River, the development of some Onshore fields by Changging and Tarim has also positively influenced the production growth throughout the next 30 years.

On the other hand, Vietnam, Indonesia, and Thailand, experience decline of 0.7 percent per year through 2040 due the diminishing sources and shortage of new considerable discoveries.

4.2.2. Oil reserves

The first of January 2013, Oil&Gas Journal, reports that the estimated technically approved resources of oil is 1638 billion barrels, 120 million barrels higher than the same estimation from 2012, the Middle East contains almost the half of the world reserves, Canadian oil sands and Russian basins are sharing the 80% of global oil reserves with other six OPEC members.

The biggest increase of the proved reserves came from Venezuela, from 2012 to 2013 its reserves increased by 86 million barrels, and the Journal also reported an increase of 20 billion barrels from Russia.



(U.S. Energy Information Adminstration , 2013). Figure 20

4.2.3. Natural gas production:

The increasing global consumption of natural gas has encouraged the world to search for more gas sources in order to increase production levels, more than 70 trillion cubic feet are needed to support the current supply for the next 30 years.

An increase of 2 percent per year coming from the Non- OECD countries, in which the production grows from 70 trillion cubic feet in 2010 to 126 trillion cubic feet in 2040, on the other hand, the OECD countries output of gas is increasing by only 1.3 percent per year, in which the production becomes 61 trillion cubic feet in 2040.

The shale gas production grows in the both the OECD and the no OECD countries from 16 to 41 trillion cubic feet, and from less than 1 to 20 trillion cubic feet respectively through 2040.

(U.S. Energy Information Adminstration , 2013)

The shale gas production still has some certainties about the future trend, since its availability is function of other factors, such as: the resources of water used in fracturing and the feasibility of extraction in some cases.

Region	2010	2015	2020	2025	2030	2035	2040	Production growth rate from 2010 to 2040
OECD								
United States	21.2	23.9	26.5	26.4	29.7	31.3	33.1	1.5
Canada	5.4	5	5.4	5.9	6.4	7	7.6	1.1
Europe	10.4	9	8.1	8	8.6	9.2	9.9	-0.2
Australia/ New Zealand	1.9	2.7	3.8	4.9	5.6	6.2	6.7	4.3
Rest of OECD	2.1	1.7	1.8	1.9	2.3	3.0	3.8	2.1
TOTAL OECD	41.0	42.3	45.6	49.1	52.5	56.7	61.2	1.3
Non-OECD								
Russia	20.9	21.6	23.6	26.3	29.4	32.1	33.3	1.6
Europe and Central Asia	5.8	7.4	8.4	9.3	10.3	11.4	12.3	2.6
Iran	5.2	6.4	7.5	8.5	9.4	10.1	10.6	2.4
Qatar	3.4	6.0	6.9	7.3	7.6	7.9	8.3	3.0
Rest of	7.3	7.7	8.4	9.5	10.5	11.4	12.6	1.8

Middle East								
North Africa	5.8	5.7	6.2	6.2	6.4	6.8	7.4	0.8
Rest of Africa	1.6	2.3	3.1	4.0	4.8	5.6	6.3	4.8
China	3.3	3.8	4.2	5.2	6.7	8.5	10.1	3.8
Rest of Asia	11.5	11.1	11.4	11.8	12.5	13.5	14.4	0.8
Central and South America	5.4	6.4	7.4	7.9	8.5	9.5	10.4	2.2
Total non-OECD	70.2	78.5	87.1	96.0	106.2	116.8	125.6	2.0
Total world	111.1	120.8	132.7	145.1	158.7	173.5	186.8	1.7

(U.S. Energy Information Adminstration , 2013), Table 6. World natural gas production by region and country, 2010-2040 (trillion cubic feet)

4.2.4. Natural gas reserves:

In the past 20 years the world total reserves of natural gas increased by 39 percent to 6793 trillion cubic feet, Qatar has made a significant increase from 509 to 910 trillion cubic feet in 2004, in which has influenced the growth if non OECD countries with an average 2.8 percent per year from 2003 to 2008,

19 trillion cubic feet is the increase in this year from OECD countries, in which is seen as 15 trillion cubic feet from OECD Asia and 7 trillion cubic feet from OECD Americas, while a decline is recorded from OECD Europe of 3 trillion cubic feet.

The non OECD countries keep their reserves increasing with 27 trillion cubic feet from 2012 to 2013, this incline came from the 56 trillion cubic feet from Middle East, China and Europe and Eurasia non OECD countries, however, an offset was observed due to the decrease of 33 trillion cubic feet in the Indonesian proved reserves.

The biggest change in the estimation of proved natural gas reserves was from iran, an increase of 19 trillion cubic feet made its reserves induce from 1168 trillion cubic feet in 2012 to 1187 trillion cubic feet in 2013. The second largest increase was from China, in which 17 trillion cubic feet of natural gas were discovered in the 2013 making the proved reserves 124 trillion cubic feet. Moreover, Russia has remained as the largest world source of proved natural gas with 1688 trillion cubic feet.

Regardless of the high consumption rate of natural gas in the last 15 years, the world total reserves to consumption ratio is estimated at 63.6 years. (The considered reserves are only the technically and economically feasible reserves).

COUNTRY	**NATURAL GAS RESERVES (trillion cubic feet)**
World	6793
Russia	1688
Iran	1187
Qatar	890
Saudi Arabia	288
United Sates	273
Turkmenistan	265
United Arab Emirates	215
Venezuela	195
Nigeria	182
Algeria	159
China	124
Iraq	112
Indonesia	108

Kazakhstan	85
Malaysia	83
Egypt	77
Norway	73
Canada	68
Uzbekistan	65
Kuwait	63
Rest of world	593

(U.S. Energy Information Adminstration , 2013). Table 7 Global natural gas reserves.

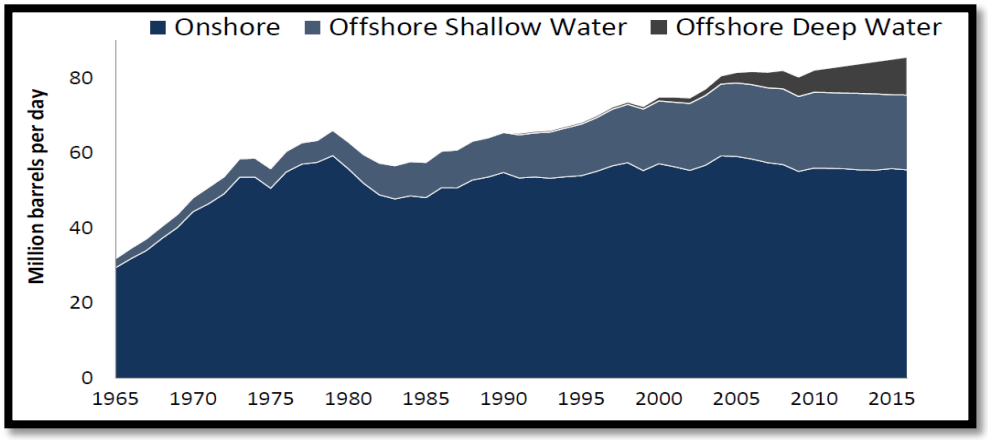
4.3. The deep offshore oil&gas:

As far as M&Mforgings concerned, the first market will be analyzed is the deep offshore oil&gas:

4.3.1. Subsea Market drivers

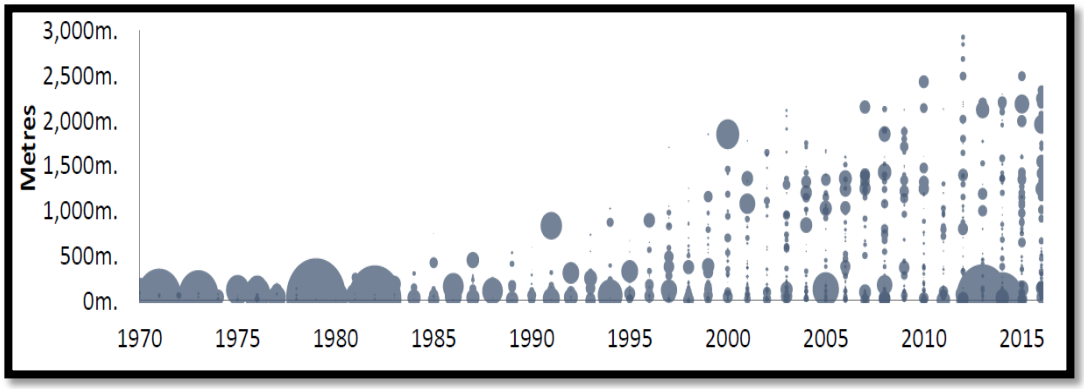
The two main issues of the subsea oil and gas industry are depth of water and distance from shore.

Going deeper:



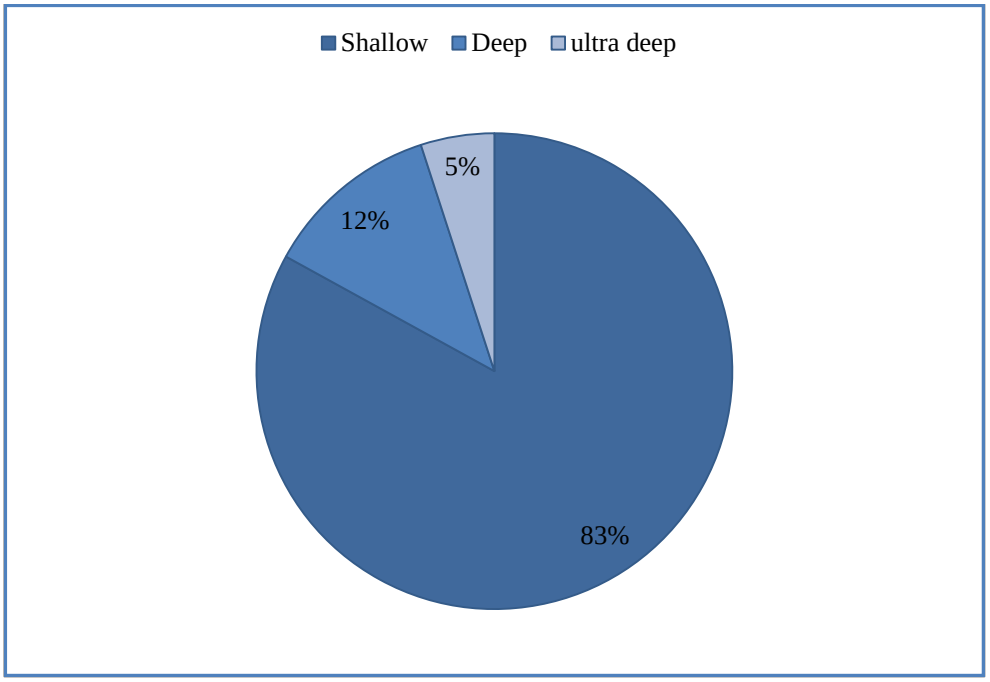
(Infield Systems, 2013), Figure 21, crude oil production matrix.

Year by year the share of Offshore deep water is increasing, starting from the 60's when onshore reserves where still growing rapidly the world had started searching for oil in the shallow water near to coasts, due to the relatively low cost of onshore oil and gas production the offshore was not as attractive as nowadays, onshore reserves are started to decline in some regions, in which many oil companies started to exploit offshore sources, starting from the shallow water and lately the deep water and ultra-deep as well, thanks to the developing technology that removed the barriers of remote locations and harsh climates, therefore increasing the world's oil production coming from seabed to 30% of total oil production in the globe.



(John Ferentinos – Infield Systems, 2013). Figure 22, Fields On-Stream Year by Reserve Size and Water Depth.

The figure above shows how the trend of offshore oil and gas production is moving from shallow water below 500 meter in the beginning of 70's towards deeper sources, as the time passes the technology develops, therefore, in the recent years, several wells have been drilled on depth that was considered impossible to reach 20 years ago, we are talking here about 2000 to 3000 meters beyond the surface. Moreover, the graph shows how the production is moving from the diminishing shallow water source and utilizing the new discoveries of deep and ultra-deep water oil and gas.



(Anna Karra – Associate Consultant, 2013). Figure 23, oil fields, 2008-2017 (2,372 fields)

The above pie chart indicates the changing shares of offshore production in a time span of 20 years, it's shown that since year 2000, many substantial deep and ultra-deep water sources were discovered, in which, boosting up their shares in the total offshore oil and gas production from 8% , 2% in 1998 to 12%, 5% by 2017, respectively.

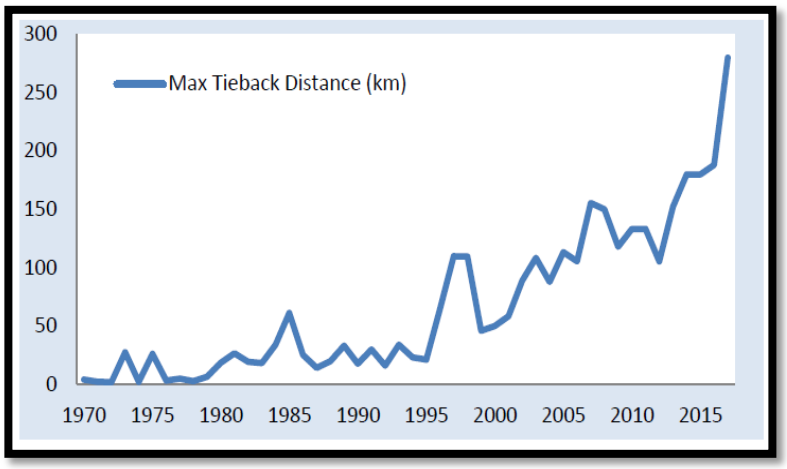
These new discoveries are concentrated in certain regions, the table below underlines the most important regions of new discoveries in both deep and ultra-deep oil and gas fields.

IMORTANT OIL FIELDS	**SIGNIFICANT GAS PLAYS**
pre-salt Brazil	East Africa
the US GULF OF MEXICO	Australia
West Africa	Israel
Malaysia	India

(Anna Karra – Associate Consultant, 2013). Table 8

Going Further:

Nevertheless, the other significant subsea market driver is the distance from the shore, chasing the valuable sources in deeper water requires longer tiebacks, therefore, oil companies started to develop new technologies to overcome the harsh environmental issues in order to reach remote distances from the shore, the graph below shows the maximum tieback lengths achieved from the early beginning of offshore production to 2015.



(Anna Karra – Associate Consultant, 2013). Figure 24, Maximum Tieback Distance (km), 1970-2017.

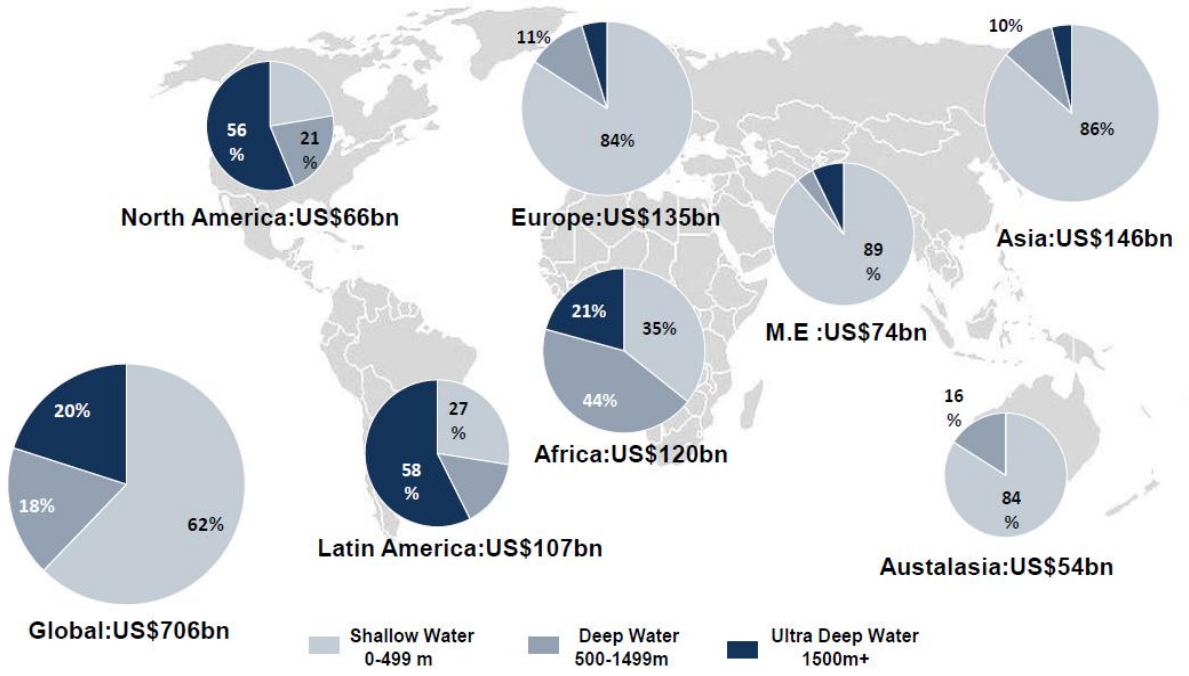
The table below lists the major projects of platform installations far from shore.

Company	Region	Distance	Year
Shell	MC Mensa in US Gulf of Mexico, Ultra-deep subsea tieback to fixed platform	110km	1997
Statoil	Snøhvit/Albatross (Melkoya Island) in Norway, Shallow	156km	2007

	subsea tieback to shore		
Chevron	et al Gorgon area fields in Australia, Deep subsea tiebacks to shore	188km	2016
Woodside	Browse Basin CCS in Australia, Subsea CO2 injection from shore	280km	2017
Husky	SeaRose FPSO, Canada	350km	Operating since 2005

(Anna Karra – Associate Consultant, 2013). Table 9

- The map of world's offshore capital expenditure CAPEX (subsea, pipeline, platform and control line) between 2012 and 2018.



(John Ferentinos – Infield Systems, 2013). Figure 25, Offshore Capex 2012-2018

Comparison between the shallow and deep water in terms of capital expenditures (CAPEX), showing that Shallow Water CAPEX $ 437.72 billion from 2012 to 2018 and the Deep Water CAPEX $268.2 billion for the same period, although, the expenditures per project are much higher for deep water, the table below shows the concentration of the Shallow and Deep-water projects, pointing out the main operators and their shares and also the manufacturers of the subsea means.

Table 10, the main key markets and the corresponding operators in the Shallow Water activity.

Key Markets	Operator	Subsea tool supplier
Europe **Norway** **The United Kingdom**	Statoil Independents	FMC & Aker Solutions (FA) GE & Cameron
Africa **West Of Africa**	Eni Chevron Sinopec	GE
80% of Asian Pacific (APAC) **Australia** **China** **Indonesia**	Chevron Apache CNOOC	Cameron (Australia) Others

(Anna Karra – Associate Consultant, 2013)

Table 11, the main key markets and the corresponding operators in the deep-water activity. .

Key Markets	Operator	Subsea tool supplier
North America	Shell BP Anadarko Chevron ExxonMobil	63% FMC 28% Cameron 4% Drill-Quip
South America **mainly Brazil**	Petrobras	FMC Cameron Aker Solutions GE&Drill-Quip, mainly for dry solutions
Africa **Egypt** **West Africa**	National oil companies (NOC's)	FMC Cameron
Asia Pacific **Malaysia** **India**	Murphy & Shell (Malaysia) Reliance & ONGC (India)	45% Aker Solutions FMC Cameron GE

(Anna Karra – Associate Consultant, 2013)

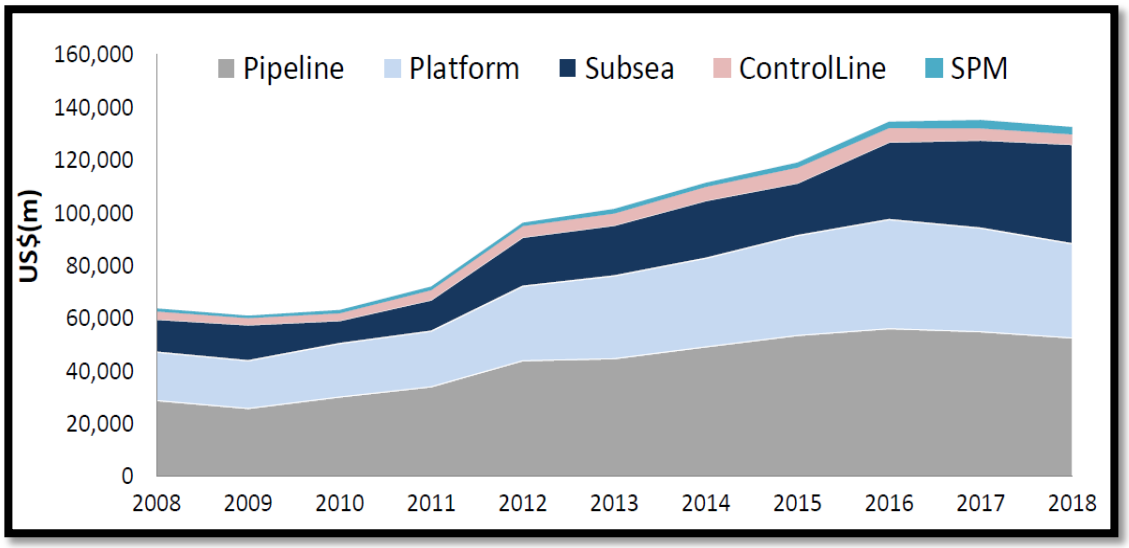
In the South East of Asia, subsea market sends positive since, a forecast has been made by Infield Systems, giving an estimation of US$18 Billion investments on subsea technology between 2013 and 2017, Malaysia and Indonesia will count US$7 Billion and US$5.6 Billion, as capital expenditure for each country respectively. In particular, Malaysia is seen as the leader of Asian Subsea market, with operator spend almost US$3.7 billion over the next five years with about 109 unites will be online on the same period. With 65 subsea completions and US$2 billion operator spend, Indonesia is expected to see a dramatic

increase in the subsea operations between 2015 and 2017, Eni is foreseen to anticipate the subsea growth by investing in installation of subsea infrastructure on its deepwater Jangkrik, Aster and Tulip/Tulip East fields, Cheveron also is contributing to ultra-deep water investment in Gehem and Gendalo fields.

The balance between the domestic rising demand and capitalizing on soaring import demand from China is a key factor of subsea development in the region, while the focus will keep on the deep and ultra-deep water projects.

4.3.2. Offshore CAPEX distribution:

For deeper drilling and harder conditions of pressure and temperature, subsea tool spending is growing faster than any other class in offshore system, with 14% growth rate, the increasing spending on subsea market has encouraged many manufacturers to increase their capacity in order to meet the needs of this market. See figure (31)



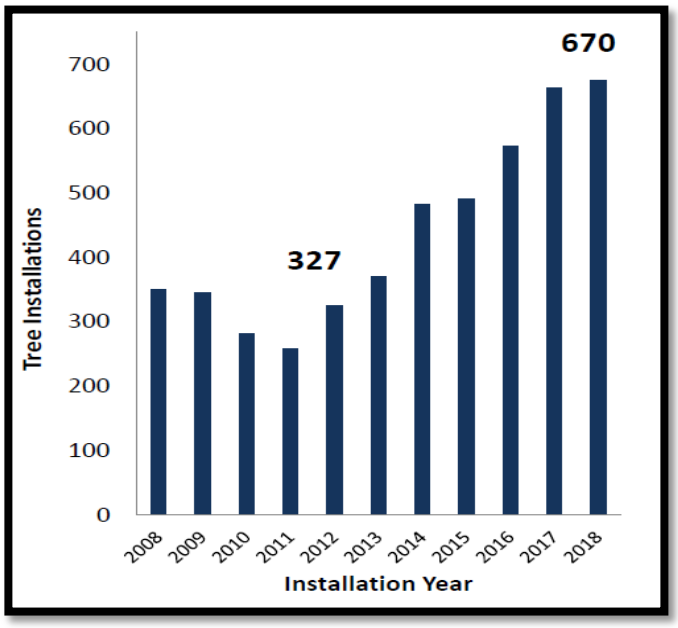
(John Ferentinos – Infield Systems, 2013). Figure 26, Global Capex by Infrastructure

4.3.3 Market trends of subsea systems:

In order to better understand the subsea system's market, two indicators are considered, the dynamic of subsea Christmas Trees and Drilling Rigs, in which they represent a market segment of the company on focus (M&M Forgings), either Christmas trees or drilling rigs are based on forged framework to overcome the challenges of ultra-deep water as mentioned previously in this report, number of projects, installations, capacity and demand forecast are to be carried out to come up with an outlook of this industry.

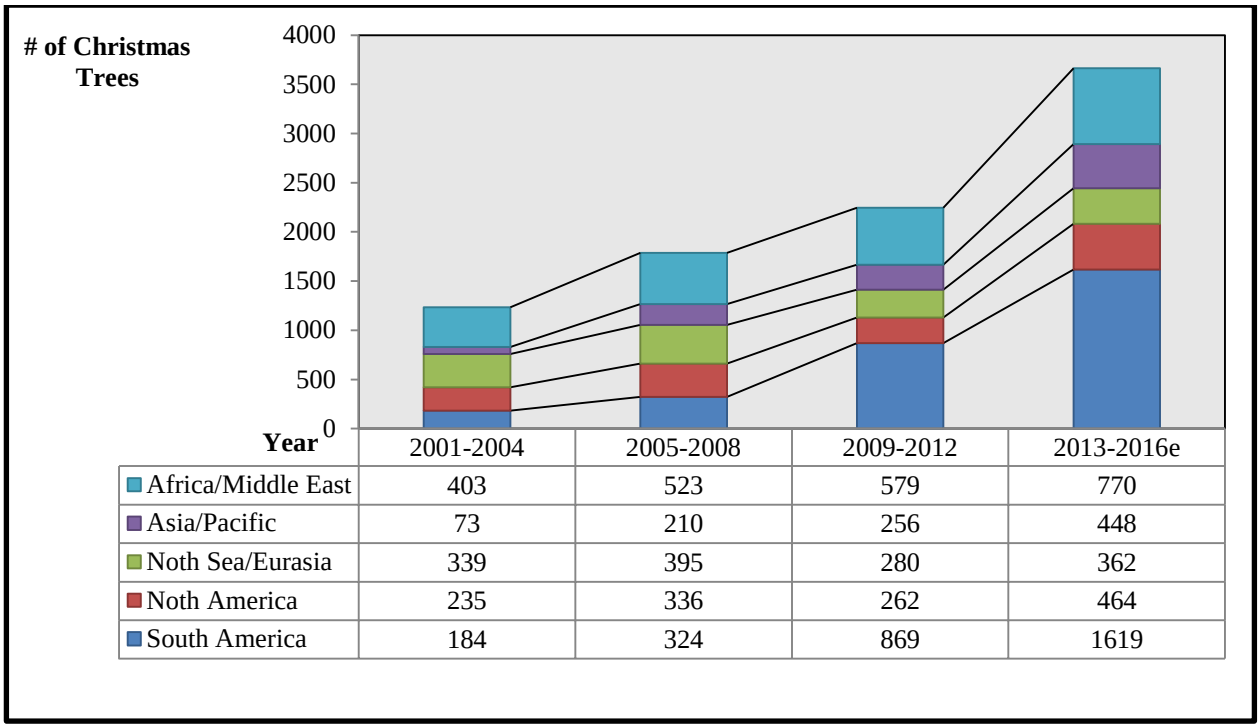
4.3.3.1Christmas tree installation forecast:

The figure below indicates the trees are planned to be installed through 2018, due to the growing industry and the inclining numbers of projects, the figure shows that year 2011 has witnessed the turnover point, number of trees being installed every year is increasing steadily, while in the last year 327 Christmas trees were installed, this number is expected to be doubled in 2017 and 2018.



(John Ferentinos – Infield Systems, 2013). Figure 27. Subsea Tree Installations

4.3.3.2 Christmas Trees demand



	2001-2004	2005-2008	2009-2012	2013-2016e
Africa/Middle East	403	523	579	770
Asia/Pacific	73	210	256	448
Noth Sea/Eurasia	339	395	280	362
Noth America	235	336	262	464
South America	184	324	869	1619

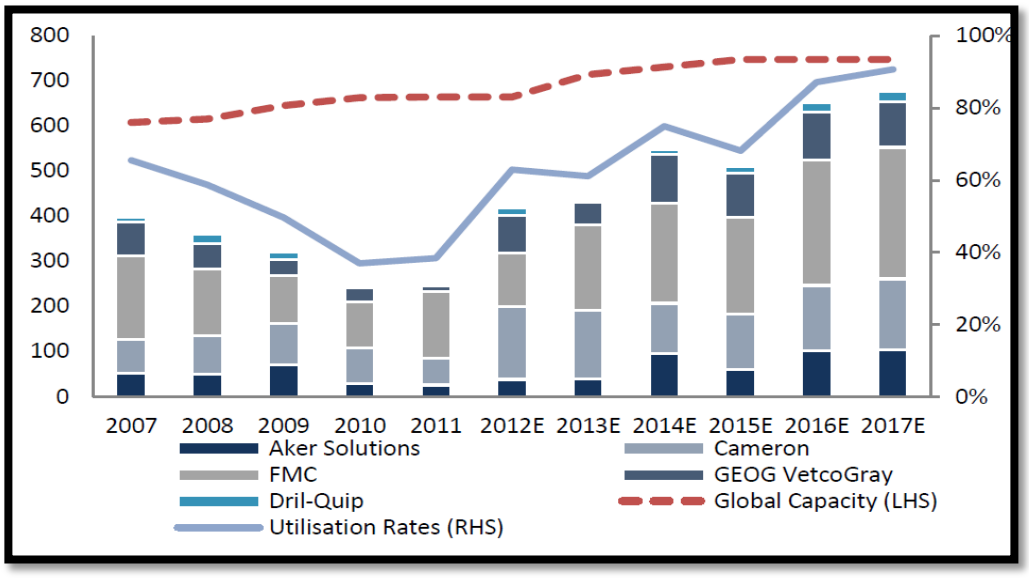
(Quest Offshore, 2011). Figure 28, Demand for subsea trees.

It is indicated that Christmas tree's industry is growing steadily since 2001, with 45% growth rate the industry increased to 1788 for 2005-2008, in the period 2009-2012 the growth rate had lost potential due to the Gulf of Mexico oil spell, however, 25% of growth mostly related to the expansion of South America offshore, it's shown that North America reduced the amount of Christmas trees to the attractive market near to Brazilian coast, making the offset of the decrease in North America and North Sea operations.

Through year 2016, the market will keep its trend, and it will score 63% growth rate, which makes the manufacturers of subsea systems on fire, the growth will dramatically foster the market of South America by almost 100% counting 1619 Christmas trees compared to 2009-2012 level of only 869, the growth will affect all the regions. The significant growth will affect the other regions but with less numbers, Africa and Middle East come second,

thanks to the new offshore discoveries in the western and eastern coast of Africa, in which Africa and Middle East combined demand 770 trees in the mentioned period.

4.3.3.3.Christmas tree world supply:



(Global Subsea Outlook , 2013). Figure 29, Subsea Tree Orders by Operator Group.

The world average demand of Christmas tress is slightly less than the overall capacity, however, due to the increasing subsea operations, the demand will exceed the availability of the product, in which higher prices will be applied by the manufacturers along with increasing capacity to the maximum, moreover, new players are expected to enter the market, thus, existing players are tending to focus on several factors which are foreseen as main issues to maintain competition, better quality, better prices, less production cost (mass production) and lead times.

FMC: The biggest share is related to FMC which has almost 30 % in 2012 and they expect to increase their market share to reach 40% by 2017

Cameron: a fluctuated trend is observed from its market share behavior, starting from 2011 exactly after the world economic crises, the Gulf of Mexico oil spell and the new

discoveries of ultra-deep-water in South America, Cameron had increased its share to the double from 20% in 2011 to 40% in 2012, this increase is expected to fall back again to 20% in 2014, the goal of Cameron would be achieving the 25% by 2017.

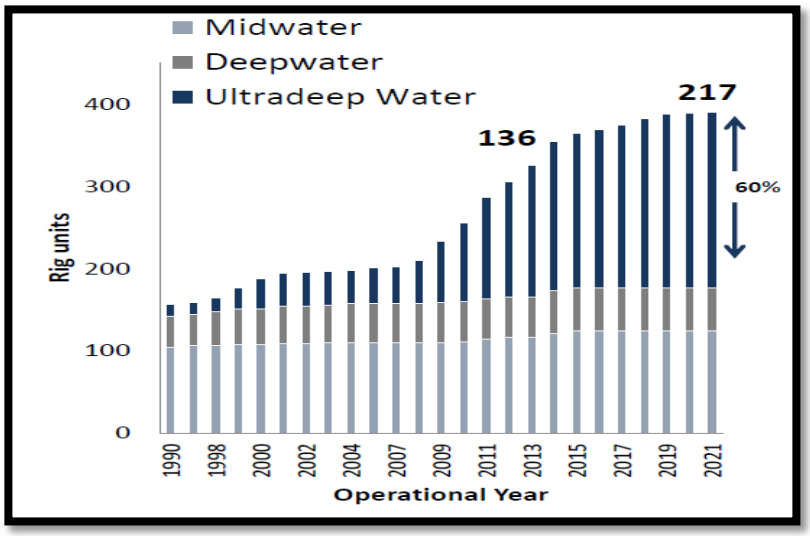
GEOG VetcoGray: the company will keep its average share in a growing market around 20% throughout 2017.

Aker Solutions: from less than 10% in 2012, Aker Solutions is expected to increase its capacity to hit 20% of the Christmas trees market by 2017.

Drill-Quip: weak performance is showing up by Drill-Quip in the market, a slight improvement is expected to increase investment in Christmas tree-s production by having 5% of 2017's market, in which is considered as good step forward after having almost zero percent mark share in 2013.

4.3.3.4 Drilling rigs:

The positive signs come from drilling rig installations. Compared to Mid-water and Deep-water, the biggest share turns to Ultra-deep water rigs, scoring 60% share of the market in 2021 with 217 rigs, and continuing an increasing trend since 2012 with 136 rigs.

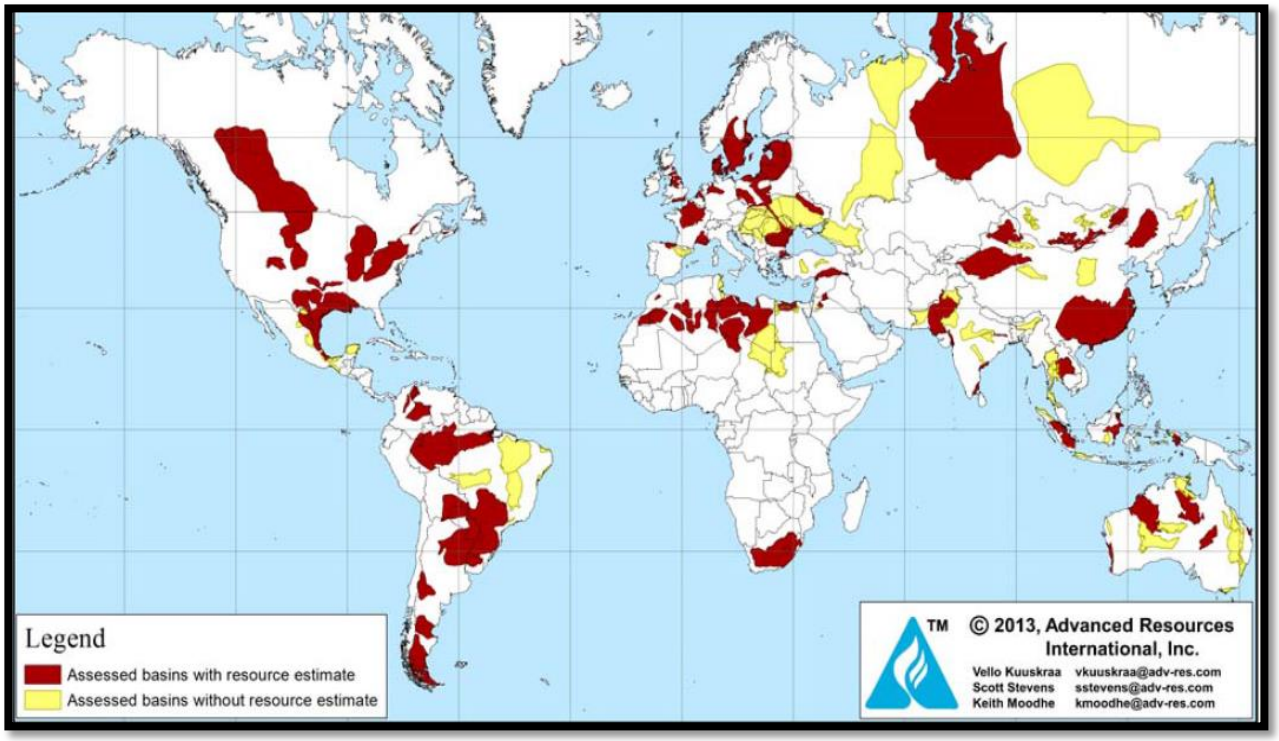


(John Ferentinos – Infield Systems, 2013). Figure 30, Ultra-deep Rig Fleet

4.4 Shale Oil&Gas

The other important market for M&M Forgings is the Shale oil and gas market, in which, the company forges the engine frameworks of the fracking pumps used in hydraulic fracturing.

The analysis will undertake the above mentioned market throughout the analysis of ; the approved reserves of shale oil and gas, the undergoing and future projects and the forecast of the market.



(U.S. Energy Information Adminstration , 2013).Figure 31, The world reserves of shale oil and gas:

The shale oil and shale gas resources in 42 countries represent 10% of the world's crude oil and 32% of the world's gas technically recoverable resources, as shown in the tables above.

Due to high prices of oil in which guarantee coverable expenditures and the technological innovation, huge amount of unconventional resources have been unlocked in the north America, especially in the United States which is considered the first and the leading in production of shale oil and gas.

Continent	Risked in place Shale gas reserves (trillion cubic feet)	Technologically recoverable shale gas (trillion cubic feet)	Risked in place Shale oil reserves (billion barrels)	Technologically recoverable shale oil (billion barrels)
North America	9,291	2,279	1,391	69.6
Australia	2,046	437	403	17.5
South America	6,390	1,431	1,152	59.7
Europe	4,895	883	1,551	88.6
Africa	6,664	1,361	882	38.1
Asia	6,495	1,403	1,375	61.1
Total	**35,782**	**7,795**	**6,753**	**334.6**

Table 12, the world global resources of shale oil and gas

Globally, 334.6 billion barrels are the expected overall technically recoverable resources, and 7795 trillion cubic feet of shale gas. Where, Asia contains 61.1 billion barrels of Shale oil and 1403 trillion cubic feet of Shale gas, and North America has approved 2279 trillion cubic feet of Shale gas and about 70 billion barrels as in 2012. As shown in the table above, Europe has huge reserves of shale oil, thanks to the massive quantities observed in the Russian basins and the other European countries.

Since, United States is number one shale oil and gas producer and is the first in a field that other nations still did not start producing yet or in the infancy stage, it is important to understand the so called Shale Boom and to analyze the future trend of Shale oil and gas trend starting from the U.S. experience.

United States of America has experienced an increase of its output to 20%, 30% of gas and oil respectively, in which the unconventional oil production was 2 million barrels per day, which is almost the 24% of the overall U.S. oil production, and the unconventional gas production was 24 billion cubic feet per day, about 37% of overall U.S gas production.

Due to the massive reserves of shale oil and gas, the advanced technology and the availability of resources needed to operate exploration and extraction, united states is expected to become the largest oil producer in the world, moreover, drilling intensity is an important factor of keeping the level of production, normally, shale oil wells start their flow at the beginning with high rate and as the well gets older as the flow declines, in which, drilling new wells every often is essential in order to maintain certain productivity. For example, in December 2012, more than 90 new producing wells were drilled in one month just to keep North Dakota's Bakken-Three Forks (the largest U.S. shale play so far) at production rate of 770,000 barrels per day.

Drilling intensity in the states has witnessed a large increase in 2012 compared to 2011, where, more than 4,000 oil and gas wells brought online in 2012 compared to few hundred wells in 2011.

One significant reason of the American success of Shale oil and gas is the availability of resources, such as; drilling rigs, notice that 60 percent of the global available drilling rigs are based in the United States, in which, 95 percent of U.S. drilling rigs can be utilized in horizontal drilling. There is no other region in the world has gone as deep as united states has done with shale oil and gas, for example, in 2012, united states has brought online 28,354 wells out of the 45,468 completed oil and gas wells, while in the rest of the world except Canada, only 3,921 wells were completed.

The table below shows the most important shale oil and gas plays basins in the United States, each with its productivity and location.

	Shale gas resources		Shale oil resources	
	Distinct plays (#)	Remaining reserves and undeveloped resources (Tcf)	Distinct plays (#)	Remaining reserves and undeveloped resources (bbl)
Northeast				
Marcellus	8	369	2	0.8
Utica	3	111	2	2.5
Other	3	29	-	-
Southeast				
Haynesville	4	161	-	-
Bossier	2	57	-	-
Fayetteville	4	48	-	-
Mid-Continent				
Woodford	9	77	5	1.9
Antrim	1	5	-	-
New Albany	1	2	-	-
Texas				
Eagle Ford	6	119	4	13.6
Barnett	5	72	2	0.4
Permain	9	34	9	9.7
Rockies/Great Plains				
Niobrara	8	57	6	4.1

Lewis **Bakken/Three Forks**	1 6	1 19	- 5	- 14.7
	70	1161	35	47.7

(Belfer center for scines and international affairs , 2013). Table 13, shale oil and gas production from the most important shale basins.

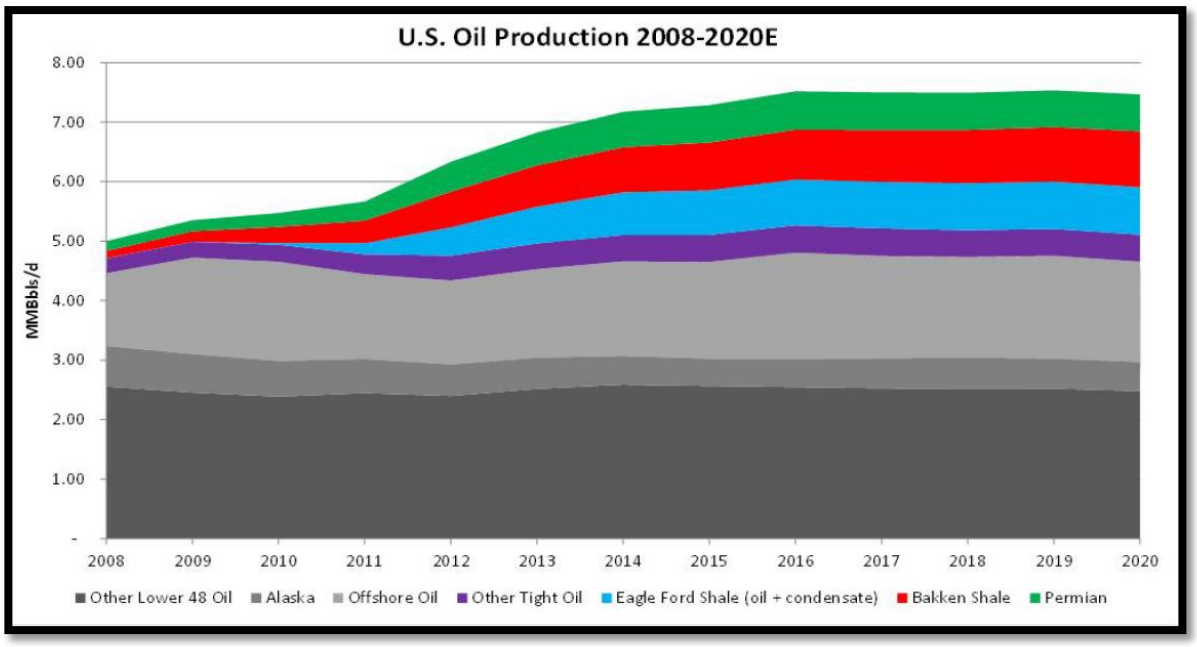


Figure 32, the effect of the Big Three shale plays on the U.S. oil production matrix for the current decade.

The Three Big (Bakken-Three, Eagle Ford and Permian Basin have a combined production capacity of shale oil of 4.7 million barrel per day by 2017, thee other plays are expected to have a combined output of 400,000 barrel per day

4.4.1. Drilling rigs market:

The most crucial indicator of shale oil and gas industry is the quantity of the active drilling rigs available in a region; therefore, the related drilling intensity is considered as a key support factor to the American Shale Boom and in sustaining its growth, the future of shale industry heavily depends on drilling and fracking tools capacity and availability.

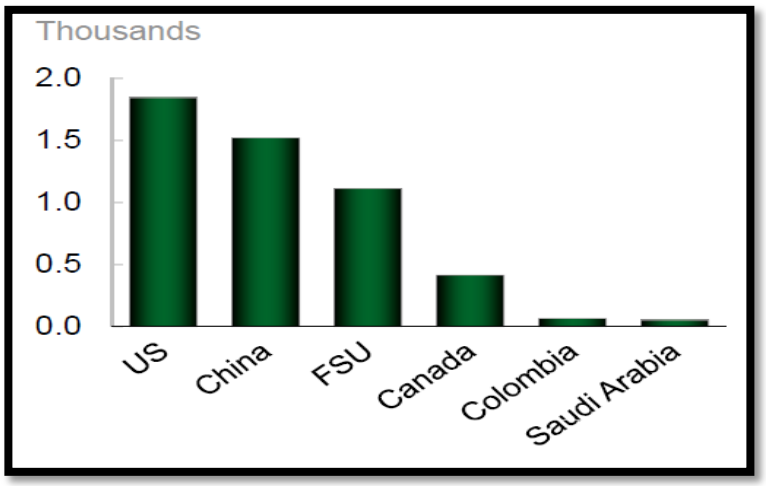


Figure 33, Global distribution of drilling rigs, (U.S. Energy Information Adminstration , 2013)

With 1,919 active drilling rigs, the United States accounts 60 percent of overall active rigs in the world and potential of 2,100 drilling rigs in total, while the second place comes Canada with only 356 active drilling rigs.

Almost 90 percent of the U.S drilling rigs are modified and equipped for horizontal drilling, while only 10 percent in the rest of the world.

Only in the Big Three shale plays, The Bakken-Three Forks, Eagle Ford and Permian basins, about 500 oil rigs already working shale operations, in which, each well can drill up to fifteen wells.

China is rich of drilling rigs, more drilling rigs are needed to reach the foreseen production of shale gas, the capacity of Chinese rigs is still unknown, but recently, Honghua sold three drilling rigs with shale specifications to Shell's JV in china.

China may need about 1800 drilling rigs to meet a production level of 60 billion cubic meters by 2020. The resources availability would not be a threat of Chinese oil and gas

industry, thanks to the industrial capabilities of China, more feasibility studies and extra scans needed to start utilizing the vast amount of Shale reserves. In 2012 China had drilled 63 wells, where 58 of them were shale gas and 5 shale oil wells.

Moreover, excluding Russia, the whole Europe contains 119 drilling rigs in which only one third was equipped for Shale drilling.

Ambiguous numbers of drilling rigs available in Russian Federation, the country has the potential to come up with the next shale boom, lately, the Russia's rosneft, ExxonMobile and Norway's Statoil, have already confirmed a joint venture to extract the mysteries of the massive reserves of the huge Bazhenov shale basin in western Siberia.

Another important factor that enhances the shale boom is the hundreds of independent companies that have experience in exploration, development and new technology.
Basically, the characteristics of Shale industry is suited the smaller independent companies rather than the big oil firms, as shown in fig (), the top ten producers in Bakken-Forks and Eagle Ford by the end of 2012 were big and small independent operators except few which were acquired by big international oil firms such as; ExxonMobile, Conoco Philips and Norway's Statoil, in which they have taken over existing independent companies, Burlington, Brigham and XTO, respectively.

Bakken-Forks	**Eagle Ford**
Continental Resources	**EOG Resources**
Whiting Petroleum	**Burlington Resources (acquired by Conoco Philips)**
Hess Corporation	**Chesapeake Energy**
Brigham Exploration (acquired by Statoil)	**GeoSouthern Energy**
EOG Resources	**Anadarko**

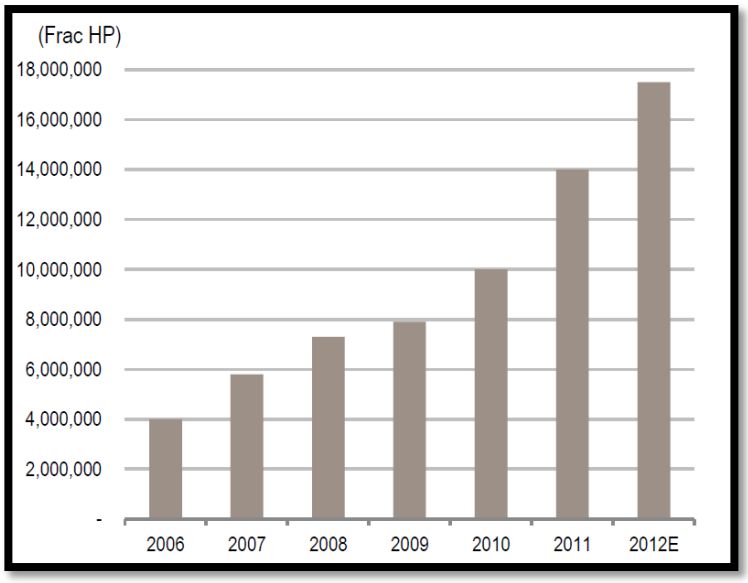
XTO (acquired by ExonMobile)	**Plains Exploration & Production**
Marathon Oil	**EP Energy**
Petro-Hunt	**Marathon Oil**
Slawson Exploration	**Murphy Oil**
Kodiak Oil & Gas	**Pioneer Natural Resources**

Table 14, the big ten operators of the most two productive shale basins in the United States

Big independent companies such as; as EOG, Chesapeake, or Continental Resources, correlate their current status and success to their early move in the shale industry. Therefore, the independent players search for risky projects with high expected returns, focusing on cash flow and fast growth rather than long term stable profits,

4.4.2. Shale pumps market

Another key indicator of industry growth and robustness is the fracking pumps market.



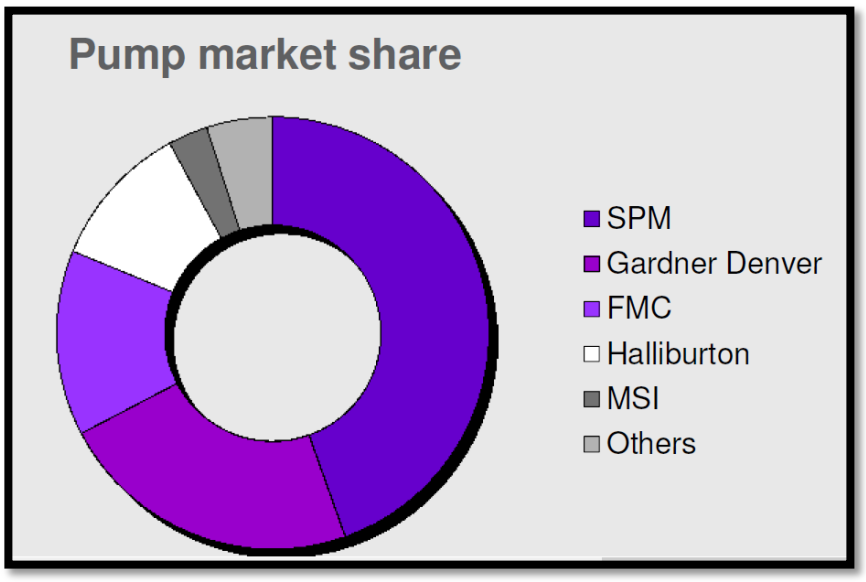
(credit Suisse , 2012), Figure 34, US fracturing horsepower (HP) capacity

It is obvious from the graph above that U.S fracturing horse power increases dramatically from 2006 to 2012 and is showing high growth rate, which is a result of the shale revolution in the region, while China contains in the best scenario less than the half of U.S. horsepower fracturing capacity.

4.4.2.1. Pressure pumps

An overall pumping capacity of 14 million HP is available in the United States, compared to 1 million HP in china, according to industry experts 1000 HP is needed to drill one horizontal well, is expected that china needs 4.2 million additional HP to meet the foreseen production level.

The fracturing pump market is becoming bigger day by day and year by year, along with the expansion of fracturing process in the whole world, in particular, the United States.

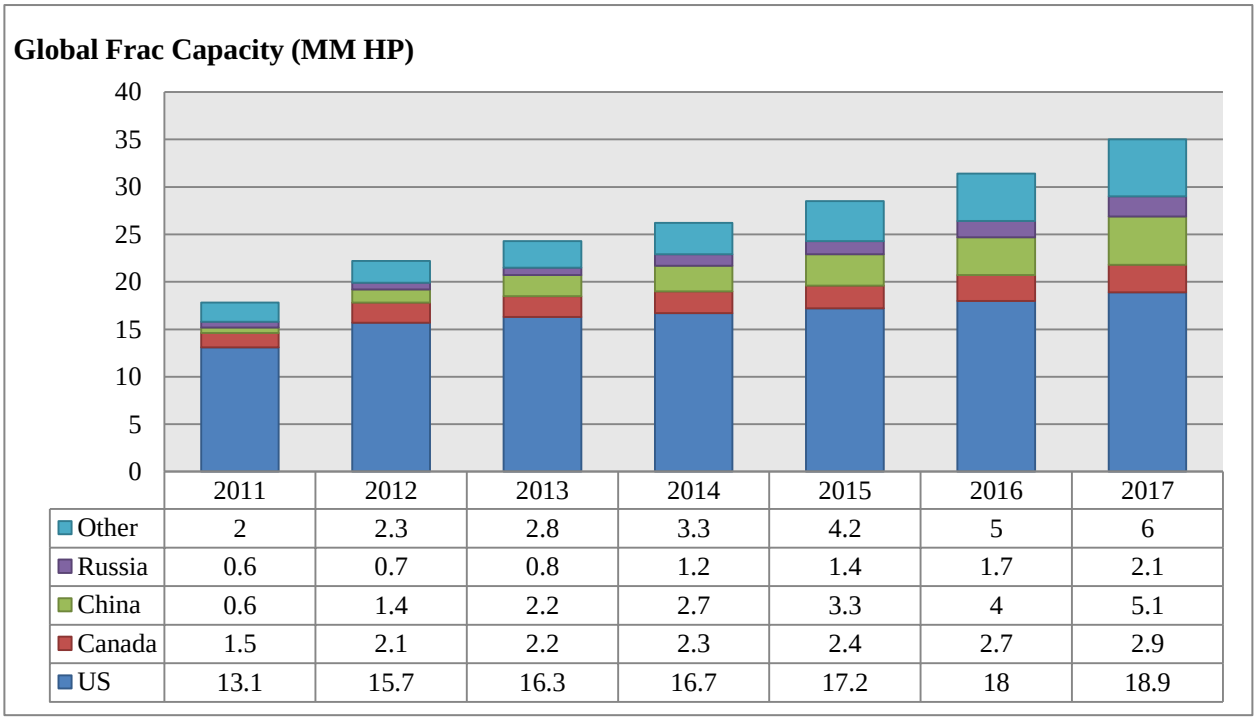


(Weir report, 2013), Figure 35, the global fracking pumps market share

From the figure above, it is shown that Wier SPM is the market leader with almost 45%, secondly with 24% Gardner Denver, while the remaining 31% is divided between FMC

with 15% , Halliburton with 9%, MSI 2% and others sharing 5%. These players could be the target of M&M Forging's Shale market.

Analysis have been made by Wier SPM, fracking pump manufacturer, it illustrates the trend of fracturing capacity in terms of HP, and gives a forecast of the future market dynamics. See figure 42.



	2011	2012	2013	2014	2015	2016	2017
Other	2	2.3	2.8	3.3	4.2	5	6
Russia	0.6	0.7	0.8	1.2	1.4	1.7	2.1
China	0.6	1.4	2.2	2.7	3.3	4	5.1
Canada	1.5	2.1	2.2	2.3	2.4	2.7	2.9
US	13.1	15.7	16.3	16.7	17.2	18	18.9

Figure 36, the global fracturing capacity in horse power, (Weir report, 2013)

The market is expected to grow 58% in five years. China is growing rapidly, in which it is expected to overtake Canada as the second largest fracturing market after the US by the end of 2014, promising market in Russia and Australia, moreover, positive signs come from other regions of the world such as; Argentina and Mexico, good opportunities are expected to show up in North Africa and Middle East, as a result, global sales are estimated to go further than 75 million dollars in the current year.

In summary, it is essential for every tier in the shale value chain to understand the world's movement towards shale exploration and extraction as the world demand of energy increases by time. The following table illustrates shale industry adoption so far, clarifying how governments around the world act with shale revolution.

Country	Actions towards shale oil and gas industry
The United States	U.S. is officially number one shale oil and gas producer in the world, thanks to the Shale Boom, high production growth rate showing recently. U.S. is expected to be a net oil exporter in the near future.
Canada	Alone with the United State who have already produced shale oil and gas in commercial quantities. Shale oil has been produced recently from Alberta, Quebec will witness soon the start of exploratory drilling in the Gulf of St. Lawrence, while, a moratorium has been considered on shale gas drilling.
Argentina	The country floats on massive reserves of shale oil and gas, in particular, Vaca Muerta, is estimated to contain shale potential, in which, big oil companies such as; ExxonMobile, Total and YPF, have already started exploring the regions' shale formations. Some concerns about the hydrocarbon prices, inflation, currency exchange rates and un accurate economic policies, could negatively affect the developing of the unconventional resources in the country.
Mexico	Significant shale gas resources located in the northeast of the country (Burgos Basin),

	which is considered as the extension of Texas's Eagle Ford. Explorations have taken place in 2011; the first drill was performed by PEMEX with 2.9 million cubic feet. So far, the company has drilled eight additional wells, thus, they have recorded a production of 400 barrel per day from Anhelido well in Tamaulipas by the first quarter of 2013.
Brazil	Is focusing on its pre-salt and post-salt, conventional deep-water resources, with future plans mostly for shale gas.
Colombia	in 2012, the Agenxia Nacional de Hidrocarburos (ANH), had organized the first auction of shale gas, thanks to the potential of Magdalena Valley Basin.
Venezuela	Venezuela has excellent potential as Colombia, but is much lower than its conventional proved reserves. The national oil and gas company, PDVSA, did not approve any development activity yet in the shale field.
Poland	Poland is considered as the leader of European shale movers, many international firms have already started their operations of drilling test wells, however, the results were not as expected in which affected new investments to be undertaken, and also some

	of the existing operator have already reneged.
United Kingdom	In the U.K. the government adopts the idea of pushing shale industry forward and shows significant support to the ongoing projects of drilling test wells in the country side of Sussex, Southeast England. On the other hand, high pressure coming from the national campaign against fracturing due to environmental threats is putting (Question marks) on the future of fracking in the Kingdom.
Denmark	Two exploration licenses have been issued recently by the Danish government, due to the ongoing studies of the impact of shale extraction on the environment; the operations have been postponed to start in 2014 when all the uncertainties are clarified.
Ukraine	The Dutch Shell is due to start operations after the agreement that has been signed with the Ukrainian government.
Spain/Romania	In these two countries, licenses of exploration have been issued recently.
Russia	The world's largest resources of shale oil are merged in the Russians shale formations, in which it became an attractive target of oil companies. Therefore, Shell has signed an agreement with the Russian giant oil company (Gazprom) in April 2013, to drill in the Khanty-Mansiysk, central of Siberia. While

	a joint venture between Russia's rosneft, ExxonMobile and Norway's Statoil to explore the massive reserves of Bazhenov shale basin in west of Siberia.
China	The government is encouraging drilling and still waiting for the expected results. Some concerns about the cost of drilling compared to U.S drilling cost, in which cost of drilling a well in Chin costs double of the same in U.S.
Australia	Australia has considerable reserves of unconventional resources, in which prospecting has already started in the area.
Lithuania	Due to sign an exploration deal with Chevron
Germany	A political debate of authorizing shale drilling under certain controls.
Algeria	Exploration for its huge resources of shale gas has been approved.
South Africa	The country is expected to decline the moratorium on shale drilling and start to explore the unconventional resources by April 2014.
France	A moratorium on fracking is applied since 2011; the banned has been reinforced by the new government.
Bulgaria/Czech Republic	Announced moratorium last year
Netherlands	Two exploration licenses have been issued and then stopped due to the unclear environmental impacts.

(Japantimes.co.jp, 2013), Table 15

4.5. S.W.O.T Analysis:

4.5.1. S.W.O.T

SWOT, analysis for deep and Ultra-Deep water oil and gas as far as M&M Forgings concerned.

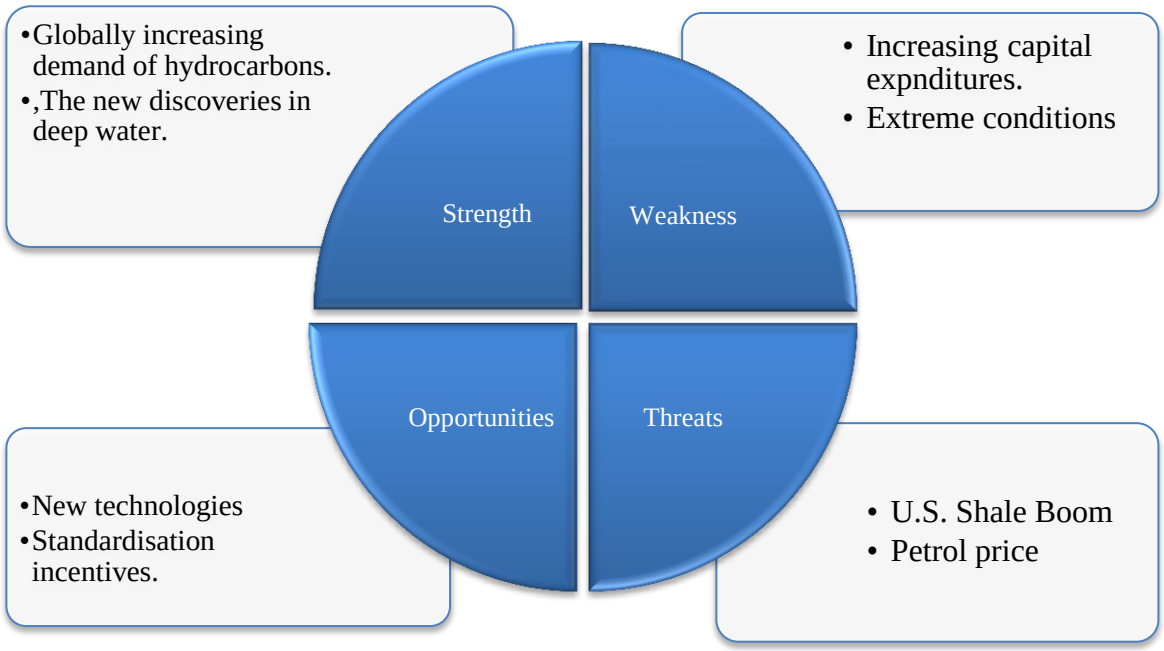


Figure 37, S.W.O.T. Analysis for deep water.

Strength:

It has been noticed that the world population is increasing and it is expected to be doubled in some regions, an increase of approximately 2.4 billion people will impact several sectors, the most important sector is the energy demand. However, hydrocarbons will keep their position as number one energy source, this growth has to be faced from the opposite side with an increase of production.

Basically, the most of onshore fields became matures and some of them are diminishing already without any significant discoveries onshore, an offset is expected to show up due to the dramatic increase of the offshore exploration, and especially from deep sources in sea floors, drilling deeper and further from the coast is unlocking giant basins worldwide, for example, the Gulf of Mexico's basins such as; Shenandoah with estimated 15 billion

barrels and Mad Dog of 4 billion barrels, moreover, the Brazilian deep-water boom has a significant impact on the market along with West African fields, the trend of deep-water doesn't stop there, the other hemisphere is witnessing a deep water oil and gas boom as well, the Caspian sea, the eastern Asian waters and the massive resources of the arctic sea, all of the mentioned recoverable resources are empowering the growth of the industry.

Within the next ten years is projected that production oil and gas from offshore wells will exceed the onshore production, as Rystad Energy has estimated, no sector is increasing than the deep-water, 13% annually growth rate for the next six years is boosting the global subsea market, as the agency reported, from 2011 to 2016 a powerful upturn hits the industry rising the number of globally producing subsea fields by 100% from 450 to 900 fields. The so-called the deep-water revolution will positively influence the whole value chain, rising the number of Christmas trees startups from 300 to more than 650 within the same period, the vast numbers of subsea systems installations have encouraged many players along the chain to invest more and more in a charming market.

Therefore, M&M Forgings since the alliance was made; it combines the ability of Forge Monchieri to deal with the huge forgings up to 120 tons and the wide variety of smaller size forgings that Forgiatura Mamé offer, in which the company has a competitive advantage in such fast growing and promising market.

Weakness:

Two main factors that can be characterized as weak points under certain circumstances, in which they are correlated to each other, the increasing costs of extraction from deep water and the extreme conditions of seabed (high temperature, high pressure and corrosion),the reason why the deeper the drilling goes in water the higher costs show up, is the fact that more specific tools needed for complicated works, critical characteristics of material needed to manufacture such tools, for example; corrosion resistance alloys (CRA), which are considered as the row material of subsea system tools such as; Nickel alloy 625

(58%Ni, 22%Cr, 5%Fe,9%Mo, 4%Nb, 1%Co) costs more than £30 per Kilo, while the standard Stainless steel costs £4 to £5 per Kilo, despite the price, those alloys are on high demand for the above mentioned extreme conditions.

Nevertheless, after the Gulf of Mexico oil spell disaster, the global oil and gas regulatory regime has tightened up the insurance conditions, in which oil and gas companies have to proof their potential in terms of robustness and quality of subsea tools such as Blow Out Preventers (BOP), thus, deep water metal tools producers are required to invest intensively in material tempering and cladding for superior forged products.

The above mentioned weaknesses are more related to the market in general, while M&M Forgings is indirectly affected, in which they appear in its difficulties of achieving the Economy of scale.

The increased cost of extraction applies more pressure on service companies to reduce costs as much as possible, in which they ask M&M Forging's to produce customized forgings for each single project with different conditions. In this case M&M Forgings could not produce for stock or plan for mass production.

Opportunities:

The new technology is unblocking new subsea reserves every day, by drilling deeper and further from shores. In general, oil and gas industry is technology based, in particular the offshore and deep offshore oil and gas is critically related to technology, in which more reserves are waiting the appropriate technique and technology to be utilized, reaching the 2000 and 3000 depths was impossible some years ago, nowadays, thanks to the latest technology, the industry is even looking deeper than 3000 meters, in which technology development is integration of all the value chain tiers, including manufacturers of subsea systems, the most challenging point is how to overcome the harsh environment of ocean floors, the latest technology of deep-water such as; 3-D seismic scan, integrated wells in which one subsea system used for more than one well and seabed water separation.

The table below indicates the most important trends of technology that directly affect deep water oil and gas evolution.

Technology	2005-2009		2010-2014		2015	
Well drilling technology	Through tube rotary drilling (TTRD)	Downhole production optimization	Slender wells / light drilling		Autonomous downhole systems	
					Subsurface robotics	
	Light well intervention	Downhole e-survey		Extended Reach Drilling	Drilling under ice	
Subsea production system	High pressure/ high temperature production (Kristin)	Ocean bottom seismic (4C/4D)	Subsea MMX System		Subsea production in water depths >3000m	
			Subsea production in water depths >2000m			
Control systems and power	220km remote power link (Snohvit)	Electronic actuators	All electric subsea	600km remote power link	Environmental monitoring	Local subsea power generation
		E-field solutions		Advanced	Drilling under ice	

				condition monitoring	50MW over 200km	250MW over 600km
Subsea processing	Bulk oil / water separation (Tordis IOR)	Subsea sea water injection (Tyrihans)	Subsea wet gas compression (Asgard)	Deepwater processing	Compression / long step-out (Snohvit, Troll, Foinvaen)	
Flowlines / assurance	160km subsea gas – shore (Snohvit)		Low cost flowlines		200km subsea oil flowlines (Johan Sverdrup	
	45km subsea oil flowline (Tyrihans)		300km subsea gas flowline (Tamar, Discovery)			
Flexible pipelines	40km flowline (Frade)		Hybrid riser towers in water depth >2000m		22" outside diameter flowline (Uge)	
	2000m water depth flowline (Lula)		2300m water depth flowline (Cernambi, Sapinhoa, Stones)		2800m water depth flowline (Pao de Acucar, Gavea)	

Source: (Infield Systems, 2013)

Table 16, overview on subsea technology evolution

Oil and gas consultants cooperate with resource and development departments in big oil companies in order to keep improving the deep water sector, in terms of production enhancement, cost reduction and better performance in harsh and remote areas.

One of these projects and incentives is the JIP (joint industry project). The project was proposed by DNV the Scandinavian consultant giant, as an interaction with key stakeholders in the subsea community, the aim of the project is to improve quality, cost, delivery times of forgings for deep-water tool industry. subsea material failures are critically related to forging quality, Nowadays, the utilizers of subsea systems have their own specification requirements for forgings aiming at risk reduction, therefore, oil and gas forging companies struggle to make a stock of high demanded forgings and thereby reduced lead time is hard to achieve.

Experience of oil and gas forgings is critical factor in the market, in which it is absent in many forging shops, having a material standard combined with a clear methodology of controlling material quality along the supply chain is the approach to ensure high and continues quality, as a result, this unified path will shrink the risk of failure. Recommended Practice (RP) undertaking subsea forging specifications based on several grades and quality standards will be developed within JIP. Initially this project will focus on carbon steel and low alloy steel, and afterwards will cover the most of subsea forgings. (DNV, 2012)

M&M Forgings could benefit from the above mentioned market opportunities, firstly, the continues improving technology is opening new doors for deep-water industry by reaching new records of water depths accompanied with harsher seabed conditions, in which will increase the demand for M&M Forgings products, thanks to the company's repetition and experience in dealing with such scenarios. Moreover, the JIP project could be a very good opportunity for M&M Forgings to early participates and be part of the standard makers. This kind of incentives help in better standardize the oil and gas forging industry in order to help in reducing manufacturing costs and better utilization rate of resources.

Threats:

The most critical factor influencing the future of deep water industry is the cost, the increasing capital expenditures of subsea operations due to the new era of deep water with above 2000 meters depth, thus, the growth of this industry seen these days is because of the high oil prices. Since, the price of petrol barrel is in the range of $80-$100, investing in ultra-deep water is feasible and beneficial. The growth of subsea industry will continue its trend, unless, positive indicators appear in the field of shale oil and gas explorers. the U.S. Shale Boom is an influential sign of shale revolution, on one hand, united states of America is expected to be net oil exporter in the near future, thanks to the shale boom that boosted up the U.S. domestic production, this flow of shale oil and gas will continue its growth in the US and in the rest of world where the massive reserves are, consequently, the demand from US of exported oil will be dropped, as a result the price will drop as well making deep water extraction unfeasible. Moreover, shale oil and gas capital is much less than deep-water's, the expensive shale well costs about $10 million, while a deep-water well costs about $100 million, in summary, shale production affects deepwater operations directly and indirectly, in which global expansion of deep-water could damage the business of subsea investors.

4.5.2 S.W.O.T analysis for Shale oil and gas as far as M&M Forgings concerned.

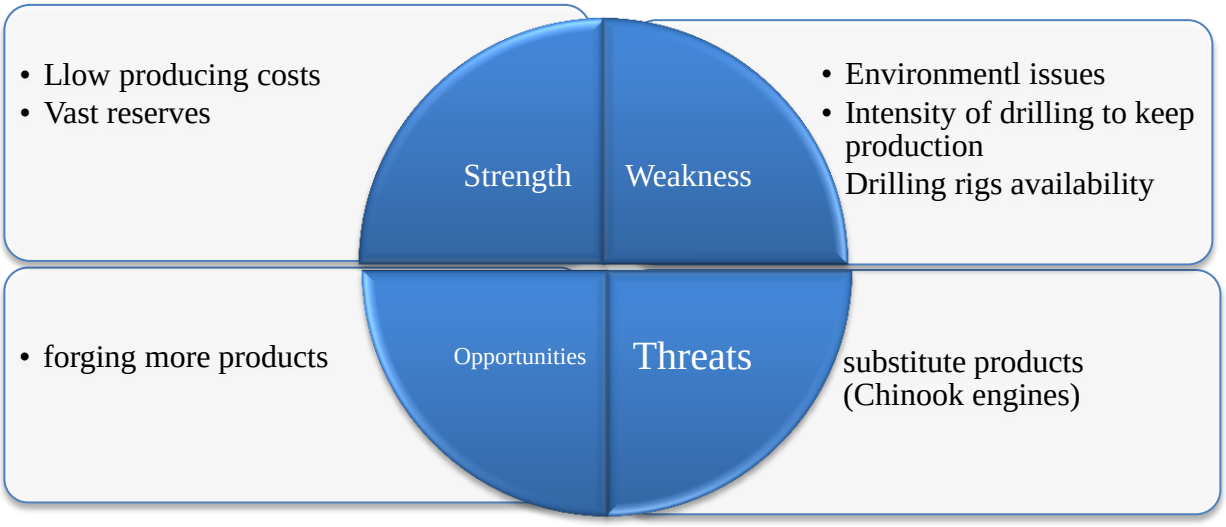


Figure 38

Strength:

The strength of shale oil and gas industry comes from the fact that massive amounts of unconventional resources are being discovered day by day, currently, the Energy Information Agency (EIA) has published in 2013 an update of the 2011 shale assessment report, illustrating that from 2011 to 2013 the world shale oil technically recoverable reserves rose by 11% and about 47% increase in global shale gas reserves, thanks to the new discoveries worldwide.

The technically recoverable resources are the extractable by the available technology, while, massive resources are still buried in the ground layers waiting for the appropriate means in order to turn them into feasible to extract.

As described previously in this chapter, the world has vast amount of unconventional oil and gas reserves, in which they might change the world energy map, United States is the leader in shale industry, thanks to the huge resources combined with the adequate technology and means, in which U.S. is expected to become a net exporter and to produce about 5 million barrel per day by 2020.

Another interesting factor that enhances the shale revolution is the drilling costs, in which drilling a shale well costs no more than 10 million dollars compared to 100 million dollars deep-water well, moreover, shale oil breakeven average prices are less than seabed operation prices, figure (BofA Merril Lynch Global Research) (45) shows the average breakeven point of the most important U.S. shale producing basins.

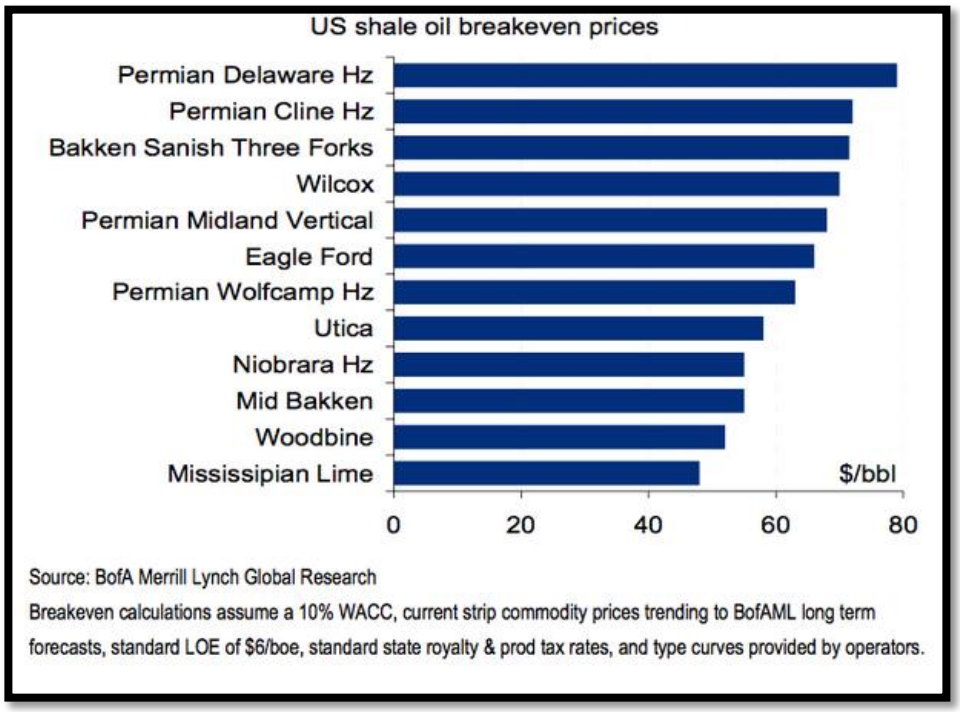


Figure 39, (BofA Merril Lynch Global Research)

The huge reserves being found and the low drilling costs compare to deep-water drilling could drive oil and gas forging industry to serve shale service firms, in which M&M forgings has the potential to grow and to benefit from the shale boom.

Also, the intensity of drilling needed to maintain production from a field. Basically, due to drop of rate that occurs after the initial production of well (30 to 90 days), intensity of drilling is required, thus, more fracking pump engines will be demanded from M&M forgings.

In the M&M forgings and the other manufacturers of fracking tools perspective, could be a positive factor, since drilling intensity would directly affect their market and increase the demand on their products

Weakness:

After the undertaken analysis of shale oil and gas industry in this chapter, there are two weak points of shale oil and gas production came to the surface, in which they indirectly affect M&M Forging's shale business.

1- Environmental impact of shale drilling, as explained earlier in the PESTE analysis, hydraulic fracturing impacts on the environment are summarized into; water resources pollution due to the chemical mixtures used in drilling and extraction process, that might leak through well cases to reach water underground reserves, and also earthquakes that might result from intensive fracturing and damaging the geological rock formations. These uncertainties have made many countries to adopt moratorium on fracking, unless new techniques of drilling are developed or new scientific proofs decline all the fears, thus, the environmental issue form barriers to limit the global shale oil and gas growth.

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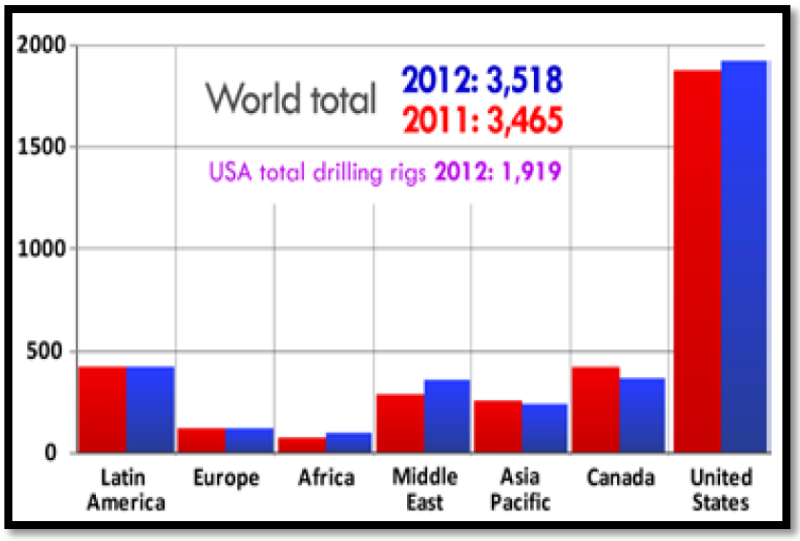
2- Finally, as discussed earlier in this chapter, the availability of drilling rigs worldwide make the expansion of shale revolution out of North America is really challenging, the drilling intensity needed to achieve the economic production quantities is based first of all on the availability of fracking resources and in particular, drilling rigs. In which U.S. has more about 500 drilling rigs equipped for hydraulic fracturing, while across the whole Europe excluding Russia, there are only 119 drilling rigs, one third of them were suited for hydraulic fracturing. No other country in the globe apart of the United States has the potential in the specialized crews, tools and the abilities to perform.

The following chart gives an overview on the rig count worldwide, simply, reaching the level of drilling rigs in the United States is crucial to start producing shale oil and gas in economic quantities.



Source: (Baker Hughes, 2013). Figure 40

The weakness points of shale industry negatively affect the whole chain of the industry and its spread around the world.

On the other hand, some weak points regarding M&M Forgings business in this field is the lack of product diversity for shale industry, considering that M&M Forgings is manufacturing only the engines of fracking pumps compared to many different operation and forged elements globally required by the shale sector.

Opportunities:

As shale oil and gas exploration and drilling increase, the demand on fracking pumps accordingly increases, this could be an opportunity to M&M forgings as fracking pump engine producer to increase its capacity in order to meet the projected growing need for huge numbers of pumps, for example, only China will need 7.1 million horse power to achieve the expected 100 billion cubic meter of shale gas production by 2020, by taking into consideration that every 12,000 cubic meter is produced per horse power. It illustrates predicted growth rate for the shale value chain.

Threats:

the main threats on shale oil and gas industry in general could be addressed to ; increasing cost due to intensive drilling needed to maintain production from shale fields and its relation with oil price, in which low oil prices could limit the expansion of the industry worldwide, another threat comes from the fact that U.S shale boom starts and dies in America and doesn't spread globally for the near future due to the lack of the needed technology and tools outside the U.S. moreover, the rising voices to banned fracturing due to its environmental impact could be a real threat if they have been approved and supported by public.

On the other hand, M&M Forgings as a manufacturer of engines used for fracking pumps, could be more concerned with a threat of substitute products, however, a substitute product for M&M forging's product, which is the used helicopter engines.

The scrap jet turbine helicopter fig (47) that once flew for the U.S military are now used for shale oil and gas fracking.

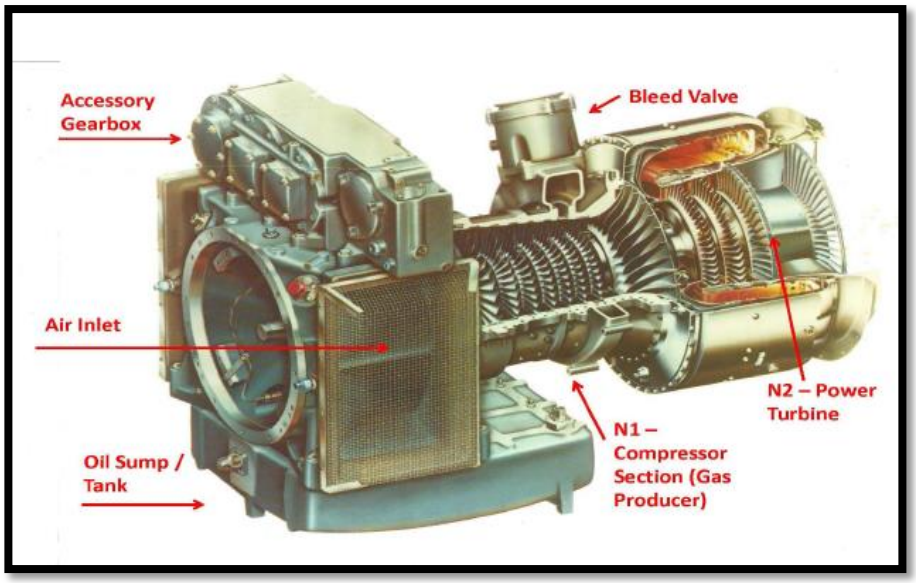
Figure 41, Chinook helicopter.

Green Field Energy Services (GFES), is leading a project to convert the makeshift pumps which are already two times powerful cheaper than the diesel based engines, those jet engines operate efficiently with cheap natural gas that can be used directly from the field being drilled.

The Royal Dutch Shell funded project since 2011, 70 hydraulic fracturing pumps working with the second hand military engines that one time were powering army Chinook helicopters, moreover, extra 70 have started this year.

Those engines need to be in a specific horse power within 3850 and 4000 HP in order to be compatible for fracking, while GFES use smaller turbines from another type of army helicopter (Bell Ranger helicopter) as mobile power generation unit.

Basically, the turbine is light and powerful enough to double the fracking power, thus, the pump forces water, sand and chemical to get into the fractures of shale formations and hold them opened releasing hydrocarbons to the surface throughout risers.



(Green Field Energy Services , 2012). Figure 42, jet turbine

U.S. shale boom has increased shale drilling activities, in which equipment manufacturers have leveled up costs, however, the U.S. boom has helped in decreasing gas prices, therefore, gas became six times cheaper than diesel. Almost $100 million loan was granted by Shell with engineering expertise to the private entity GFES to carry on the jet turbine project.

The GFES, is very close to become profitable after more than $600 million profit in 2013, compared to $140 million in 2012.

New turbines are expensive to use in fracking, however, the GFES, has announced that they have a reliable supply of used military helicopter engines, mostly made by Honeywell engineering group.

The idea of using turbines has attracted many industry players such as; Shell. Apache Corp and GE, each of them has already started to cooperate with Green Field Energy Service, moreover, Caterpillar, which manufactures conventional diesel engines and turbines for other uses has shown interest in the project.

Moving to gas instead of diesel would make huge saving for shale oil and gas business, in 2012, the expenditure on fracking diesel was $2.38 billion, Apache estimates that if natural gas was used directly from the field 70 percent of cost about $1.67 billion would have been cut. Many companies are trying to produce turbine powered pumps working with mixture of natural gas and diesel, but only GFES has performed fracking with natural gas alone, Green Field's turbine also flexible that can be easily modified to run with diesel as well.

(Green Field Energy Services , 2012). Figure 43, Turbine fracking pump

Green Field Energy Services Features: Turbine Frac Pump (TFP) vs. Diesel			
Description	Turbine Fracking Pump (TFP)	Diesel Farcking pump	comments
Size – Single Frac	8’ x 9’ x 11’	40’ – 45’ Trailer	The TFP unit can fit two on a trailer with a full control house. Three per trailer without a control house
Weight – Single Frac	32,000 lbs.	65,000 lbs +/-	Weights are w/o trailer. GFES’s frac unit is road legal with two on a trailer.
Exhaust Heat	Massive exhaust heat available	No waste heat available	The turbine produces 27 lbs/sec of 1,000 F heat. Use for process work, fuel heating, including well water evaporation.
Profitability	Chopper, air cargo and highway	Highway	The TFP frac is manufactured with forklift pockets and is light enough for air transport.
Multi-Fuel Capability	Bio-fuel, diesel #2, kerosene , natural gas or Jet A	Diesel #2	Natural Gas is a proven fuel source for the TFP.
Emissions	75 – 85% Lower	Higher emissions	The TFP was certified on #2 diesel and B-100 bio-fuel. The TFP was 75% - 85% lower Nox and CO than a diesel.
Maintenance	Easy PM’s and same day exchanges	Higher labor hours	The turbine only weighs 770 lbs – PM’s only take 4 hours – Field repairs and engine exchanges done on one shift.
Operating life	10,000 hours TBO	Life is reduced when running at max power	The turbine has fewer moving parts - designed for harsh military duty and high cycles. Overhaul @ 10,000 hours +/-.
Noise Level	78 – 91 DBA	No sound reduction	Two TFPs were measured on one trailer with all equipment running (14 bpm @ 9000 psi).
High Altitude Power	Excess power available	Cannot achieve rated power	The 3800 turbine has power to spare to meet pump demand when at high altitude.

From the above table, it is obvious that Green Field's Turbine Pump could represent a real threat for the diesel fracking pumps.

5.0. Conclusion:

As a result of the analysis undertaken so far, the deep-water oil and gas industry looks healthy and growing steadily; nevertheless, the sudden expansion of shale oil and gas could interrupt the growth story of deep-water.

- Deepwater: on one hand, all the indicators from deep-water processes deliver the message of the continued sector growth; oil price forecasts support the sector's development, and the growing demand for oil opens the doors to more discovering projects.

  Subsea market is potent. Many projects are being implemented, more than 200 projects are in the planning stage, in which they pull subsea systems demand, the utilization of deep-water drilling facilities is at high level, and there are more than 90 new drilling ships to be delivered in the near future, deeper reserves have been unlocked, further distances from shores have been reached, therefore, all these factors positively affect the ultra-deep water oil and gas sector.

- Shale: on the other hand, an impressive signs coming from the U.S. shale industry, an accelerating rhythm of growth due to the Boom, in which, 5 million barrel per day in 2017 is the expected U.S. shale oil production, while in 2012 was only 1.5 MMb/d.

  Update of U.S shale sources keep boosting the technically recoverable oil reserves, in five years the giant US basin Bakken-Three Forks increased its reserves from 3.65 billion barrels to 7.3 billion barrels.in additions, these promising quantities of reserved shale oil arise from the other U.S shale sources such as the Texas Eagle Ford.

  There are two main impacts on deepwater projects:

1- Basically, the shale oil supply from the U.S sources will reduce its exports and some optimistic estimation say that U.S will be net exporter in the near future, in which less U.S. imports will cause a demand reduction in the oil world market, thus, crude oil price will eventually drop.
2- The other impact is that oil companies who tend to invest in shale industry would use resources were earmarked for deep-water projects.

Uncertainties about shale:

- Environmental impacts.
- Fracking moratorium in Europe and other countries could influence the expansion of the industry around the world.
- The lack of technical resources such as drilling out of the North of America where are they concentrated could cause some delays on projects worldwide.
- Disappointing results from test wells fracked in Poland, in which many companies started to renege after investing in was expected to be the European shale boom.

Cost:

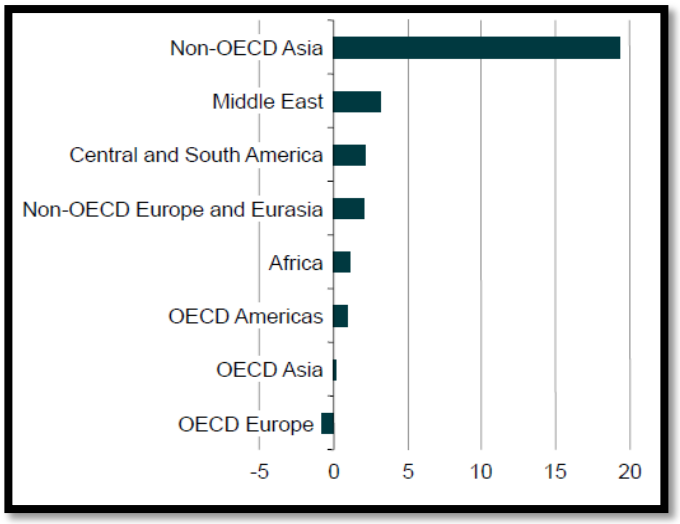
A comparison between shale oil and gas, and subsea sector in terms of expenditures, the cost of producing shale oil and gas is falling, while subsea costs are increasing due to the harsh environment of seabed.

recently, new records of Floating Production units have been reached due to the continues drilling in deeper water, the $3.1 billion FSPO Egina became the most expensive ever, while prices of $ 1 billion for FSPO are nowadays normal prices, in which few years back were 50% cheaper.

In Summary, the volume of shale oil and gas being produced is still low relative to the world crude oil production, 1.5% is the share of unconventional oil on the world oil supply matrix, thus, is still early to say that deep-water activities are in risk of shale oil impact. The Canadian sand oil will be the most threatened resources by the shale boom.

The only single sign of the impact on deep water sector is that U.S. shale boom could affect some of the deep-water projects in the Gulf of Mexico as the postponement of the so called Mad Dog 2 project.

Therefore, all players in the deep-water sector (oil companies, service companies and subsea tool manufacturer), should pay attention and keep watching the expansion of Shale industry. Finally, the Shale boom could impact the growth of the deep-water industry only it expands and hits the whole world, even though, United States becomes a net exporter there is always an increasing demand from the Non-OECD countries as shown in figure (),



(U.S. Energy Information Adminstration , 2013), The change in the world petrol consumption from 2010 until 2040 (million barrel per day)

While the massive increase comes from the Non-OECD Asia, especially from India and China, in which almost a twenty million barrel per day demand increase by 2040 could definitely offset the drop in American demand associated to the shale boom.

Thus, the final result achieved is that, shale boom will not affect the M&M Forgings deep-water market for the short term, unless, shale industry expansion spreads worldwide and world unconventional industry reaches the current level of the America's, another factor is the ambiguous future of the U.S. shale boom and for how long it will last, since each field requires continues intensive drilling of several wells to maintain productivity in economical quantities. However, the company should focus on deep-water industry and in the same time keeps an observing eye on Shale trend, also, moving towards natural gas powered engines for fracking pumps instead of the standard diesel ones could open new frontiers for the company in the shale market and it keeps it up to date with the latest technologies, in which, helps in positioning the company in such promising market.

Even if a shale revolution increases the growth worldwide a sufficient market share should be present, for the reason that, M&M Forgings with only one product in a growing and huge market with aggressive competition will be as question marks in the BCG Matrix parameter.

While the wide variety of products that M&M Forgings manufactures for deep-water could guarantee the foreseen position in such an attractive market.

In summary, deep-water growing market will boost up the M&M Forgings market share, this would be compatible with the increased capacity achieved by the Monchieri and Mamé integrated alliance.

On the other hand, the shale boom would not affect the M&M Forgings deep-water business, thanks to the world oil increasing demand and the limitation of the shale industry expansion around the world due to the early mentioned technical and environmental issues,

Works Cited

Anna Karra – Associate Consultant. (2013). *Subsea Market Overview.*

Baker Hughes. (2013). *Worldwide Rig Count.*

Belfer center for scines and international affairs . (2013). *the Shale Oil Boom.*

BofA Merril Lynch Global Research. (n.d.).

Canadian Society for Unconventional Gas. (n.d.). *Understanding Hydraulic Fracturing.*

credit Suisse . (2012). *the Shale revolution* .

DeepWik,i the well service authority . (n.d.). Christmas trees.

DNV. (2012). *PROPOSAL FOR JOINT INDUSTRY PROJECT (JIP).*

Global Subsea Outlook . (2013). *Trends and Opportunities.*

Green Field Energy Services . (2012). *Jefferies Global Energy Conference.*

Infield Systems. (2013). *Subsea evolution.*

Japantimes.co.jp. (2013).

John Ferentinos – Infield Systems. (2013). *Global Offshore Oil and Gas Outlook.*

Quest Offshore. (2011). *Subsea Market Review* .

Reuters . (2010).

Schlumberger. (2011). *Completion & Stimulation of Unconventional Gas Reservoirs – Shale Gas.*

Steel Market Intelligence GmbH and Quest Offshore Resources, Inc. (2013). *Corrosion Resistant Steels and Alloys in the Oil & Gas Industry.*

Steel Market Intelligence, Austria and Quest Offshore Resources, Houston, Texas, USA. (June, 2013). *The future of corrosion resistant steels and alloys in the oil and gas industry.*

The Guardian. (September 20, 2010).

the NPC North American Resource Development Study. (2011). SUBSEA DRILLING, WELL OPERATIONS AND COMPLETIONS.

U.S. Energy Information Adminstration . (2013). *International Energy Outlook* .

United States Environmental Protection Agency. (2013). *potential impacts of hydraulic fracturing at each stage of the Hydraulic Fracturing Water Cycle.*

Weir report. (2013). *the Shale Revolution* .

Appendix

Questionnaire

Ultra deep oil and gas

The world energy consumption is increasing rapidly and the demand for oil & gas is higher than ever before witnessed in the history. Currently the onshore fields are responsible for 60% of the oil and gas in the world and no promising new fields are being found anywhere. Only 50 years ago, even the thought of drilling out in the waters and extracting oil& gas was considered madness.

Thanks to human ingenuity and innovativeness, offshore extraction of oil and gas now stand for more than one third of the global oil and gas supply and is still going forward with huge steps. Because of the rapidly increasing energy demand and the decreasing onshore findings, companies are constantly searching for new sources to tap. These sources have, thanks to extensive research and innovations, been found in ultra- deep waters. However, drilling and extracting in these depths give rise to challenges not experienced before.

Jim Pearce, partner in the energy and process industries practice, describes some of these challenges as: "the water is deep and also the well is deep, so often what you get is high pressure and high temperature. It may be very cold in the bottom of the ocean but the deeper you drill the higher pressure and temperature you get, it can go till 241325 kPa in deep holes and temperatures above 232 degrees Celsius.

Has M&M – forgings started to produce or is interested in producing products that can confront these physically hard conditions of rising pressure and temperature as the drilling depths increase?

What kind of property enhancements have you made on your products in order to cope with the abovementioned new challenges introduced by the deeper depths?

What is the impact of the new generation of forged products on your prices?

Many existing and new ultra-deep water projects are either being developed or are planned to come on- stream between now and 2016. Projects such as Cascade & Chinook, Galapagos, Thunder Bird, Cardamom, Jack & St. Malo, Lucius, Knotty Head, Puma, Big Foot and Mars B are expected to bring more than 1 mb/d of net additional capacity in the medium-term, even accounting for natural declines in existing fields. **Have you received any orders or are you already supplying any of these ultra- deep water projects?**

How will you supply these projects, since some of them are in complex locations, and be able to keep your promised lead times?

Supply and Competition

Since the supply chain of this industry is a network of different suppliers and customers, with high interdependencies, decisions made upstream or downstream the chain will ultimately affect the price of the end product, in this case the oil and gas. It is sometimes difficult to understand who the key players are in this network. For this reason a deep study is to be undertaken in order to understand them in the network, thus, we would like to know the following:

Who are the main suppliers of M&M Forgings?
How does the purchasing process proceed, that is how does it start and how does it end?
Who are the initiators, buyers and the deciders in the buying process?
Since you have more than 110,000 tons/year of combined production capacity, do you have a bargaining power over your raw material suppliers?
What conditions you include in your contracts for suppliers and clients in terms of after sales services, delivery, quality, responsibility and risk?
What type of relationships do you have with your suppliers?
What strategy do have you implemented in your production, are you making-to-order or making-to-stock?
Who are the main clients in the offshore field of M&M Forgings?
How do you supply your customers during the PLC, is it periodical supply or a product for each well and the product lasts during the entire life cycle of the well?
Do you offer any free of charge maintenance or you sell this service also?
In what products in the offshore field are you experiencing the toughest competition?
What is the real competitive advantage that you have in relation to your competitors in the offshore field?
How does the competition look like in the new development areas, such as the ultra-deep offshore drilling?
Where are you in relation to this competition when it comes to R&D, are you in front of your competitors or behind them?
Are you one of the first movers in this new area?
Which are the geographical markets that you serve in the offshore field?

Shale oil & gas and different offshore projects

Many new offshore projects are being currently developed in the world. According to the World Oil Outlook made by OPEC, the mean estimate of undiscovered resources is set to 732 billion barrels, and this is more than a 30% increase from the previous years' estimation.

Among the offshore projects, Brazil is the main growth source and is seeing the biggest expansion with over 26 new projects that are under development. All the new projects are expected to contribute to the medium- term growth.

In the Caspian region, Kazakhstan is going to make expansions at the Tengiz, Kashagan, Akote and Karachaganak Phase III fields.

Expansions are also seen in Russia with a number of major projects planned for the next few years. The new fields are anticipated to add a total production capacity of more than 1.5 mb/d.

The World Oil Outlook made by OPED foresees a big increase in Asia, India being the main growth area with many new offshore projects. Some of them being the Bhagyam, Aishwariya, Saraswati/ Raageshwari, Heera & South Heera and the Krishna-Godavari Cluster expansion. These projects are anticipated to add a production capacity of about 230,000 b/d by 2016.

Have M&M-forgings utilized this business potential and signed new clients?

Norway sees a fall of productivity for the period until 2016, but several new offshore projects are being introduced to offset the decline in mature fields.

Will this decline result in loss of sales for M&M-forgings? Or are the sales increasing due to the new projects?

In the UK, both crude oil and NGLs production fell and are expected to continue falling during the coming years. The complexity of maintaining production in mature fields in combination with the possibility of starting to extract from shale plays tends to reduce levels of investments in new offshore projects.

What impact does this have on M&M forgings in terms of sold components?

How will the prices change due to the current dynamics of offshore projects?

Have you noticed any of your clients drawing back/ retreating from the UK?

Since shale oil and gas extraction is in its infancy, no in-depth research has been made globally. The country that is in this frontline is the USA, and experts say that it will remain in USA in the near future. It has been seen that the extraction has increased rapidly these years and is continuing to increase. The imports of natural gas from Canada have decreased steadily, from the peak of 2002. The exports however have increased with almost 2 billion cubic feet a day from USA to Canada.

Has this development had any impact on the business of M&M-forgings?
What kind of opportunities do you see in this development for future business?
What forged components are being used in the facilities that conduct the extraction of shale oil and gas?

In a report made by PwC, there are estimates that shale oil could displace around 35-40 percent of waterborne crude oil imports to the US in the medium term future.

Does this mean that offshore plants that are mainly supplying USA will stop production and hence affect the customers of M&M forgings or will they continue to produce and find other customers?

A discovery that might be the largest shale oil find ever recorded is in an area of Australia called the Arkaringa Basin and contains as much as 233 billion barrels of recoverable shale oil (or more). To understand the size of the amounts, a comparison can be made with the Bakken plays of America, which have between 6-24 billion barrels of recoverable oil. And it is more than all of the estimated oil in Iran, Canada or Venezuela.

The discovery is so big that there is talk being made of energy independence for Australia in the same way as in America after the similar discoveries in Bakken, Marcellus, Eagle Ford and Utica basins.

And there is one small company that controls what is shaping up to be the biggest worldwide oil project to hit in decades, the company is called Linc Energy. Small companies being in the driver's seat of big findings, forces big players to rethink their strategies. This results in huge opportunities for individual investors to buy into projects with small companies at low cost and can result in huge profits.

Chevron once again made news by announcing it had agreed to pay as much as $349 million to join Australian minnow Beach Energy in two separate projects. Both are shale gas plays - one in South Australia and the other in Queensland.

Have the customers of M&M forgings initiated any involvement in this huge project?
How will this huge finding affect the offshore operations already existing outside the shores of Australia?
Is it more difficult for M&M forgings to enter the game when such a small company is in control of the finding?