OCS Study
BOEMRE 2010-042

Coastal Marine Institute

Fact Book: Offshore Oil and Gas Industry Support Sectors

U.S. Department of the Interior
Bureau of Ocean Energy Management, Regulation and Enforcement
Gulf of Mexico OCS Region

Cooperative Agreement
Coastal Marine Institute
Louisiana State University

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Fact Book: Offshore Oil and Gas Industry Support Sectors

Author

David E. Dismukes

December 2010

Prepared under BOEMRE Cooperative Agreement
1435-01-99-CA-30951-85248 (M07AC12508)
by
Louisiana State University
Center for Energy Studies
Baton Rouge, Louisiana 70803

Published by

U.S. Department of the Interior
Bureau of Ocean Energy Management,
Regulation and Enforcement
Gulf of Mexico OCS Region

Cooperative Agreement
Coastal Marine Institute
Louisiana State University

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CITATION

Suggested citation:

Dismukes, D.E. 2010. Fact book: Offshore oil and gas industry support sectors. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2010-042. 138 pp.

ABSTRACT

The purpose of this research has been to examine the nature and trends associated with a wide range of industries and activities that support offshore oil and gas exploration, development, and production. The sectors and activities examined include: drilling contractors; underwater contractors (diving); mud, drilling, and lubricants; air transport; water transport; geophysical services; dredging; catering; workover services and environmental consulting and mitigation.

A number of issues and aspects were examined for each of these sectors that includes a basic description of the industry and the types of services provided, typical industry characteristics that includes an examination of typical facilities, the geographical distribution of the firms and their location along the Gulf of Mexico, a description of each sectors' labor force, and identification of typical or leading firms in those particular sectors.

Each chapter includes an examination of the industry trends and outlook for that respective support sector/activity including a discussion of the impacts that hurricane activity of 2005 had on each of the various support sectors and activities.

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ABBREVIATIONS AND ACRONYMS

2-D	2-dimensional
3-D	3-dimensional
4-D	4-dimensional
AAPA	American Association of Port Authority
AAPG	American Association of Petroleum Geologists
AHTS	Anchor Handling, Towing and Supply vessel
AMSA	Australian Marine Sciences Association
ATP	airline transport pilot
AUV	autonomous underwater vehicle
AVO	amplitude variation with offset
BLS	Bureau of Labor Statistics
CERCLA	Comprehensive Environmental Resource Compensation and Liability Act
CGG	Compagnie Generale de Geophysique
CMP	Coastal Management Plan
CNSOPB	Canada-Nova Scotia Offshore Petroleum Board
CPRA	Coastal Protection and Restoration Authority
CRI	cuttings re-injection
CSEMI	controlled seismic electromagnetic imaging
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DNR	Department of Natural Resources
DOE	Department of Energy
DOT	Department of Transportation
DP	dynamic positioning
DWMIS	Drilling Waste Management Information System
EBJ	Environmental Business Journal
ECO	Environmental Careers Organization
ELG	effluent limitations guidelines
E&P	exploration and production
FAA	Federal Aviation Administration
FPSO	Floating, Production, Storage and Offloading
FSV	Fast Support Vessel
GDP	gross domestic product
GOM	Gulf of Mexico
HRSDC	Human Resources and Skills Development Canada
INC	incident of non-compliance
IPAA	Independent Petroleum Association of America
JPL	Jet Propulsion Laboratory
LCA	Louisiana coastal area
LCROV	"Low-cost" remotely operated vehicle
LCWC	Louisiana Coastal Wetlands Conservation
LNG	liquefied natural gas
LOOP	Louisiana Offshore Oil Port
LWD	logging while drilling
MMcf	million cubic feet
MMS	Minerals Management Service
MODU	mobile offshore drilling unit
MPRSA	Marine Protection, Research and Sanctuaries Act
MSV	mini-supply vessel
MWD	measurement while drilling
NAICS	North American Industry Classification System
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
OBM	oil-based drilling mud
OCS	Outer Continental Shelf

ABBREVIATIONS AND ACRONYMS (continued)

OMSA	Offshore Marine Service Association
OPA	Oil Pollution Act
OPEC	Organization of the Petroleum Exporting Countries
OSV	offshore supply vessel
PAH	polynuclear aromatic hydrocarbon
PGS	Petroleum Geo-Services
PHI	Petroleum Helicopters, Incorporated
PIC	pilot in charge
PSV	platform supply vessel
R&D	research and development
RCRA	Resource Conservation and Recovery Act
RON	remaining over night
ROV	remotely operated vehicles
SAT	saturation diving system
SBM	synthetic-based drilling mud
SDWA	Safe Drinking Water Act
SEC	Securities and Exchange Commission
SEG	Society of Exploration Geophysicists
SPCC	spill prevention, control, and countermeasure
SPE	Society of Petroleum Engineers
SPURV	self-propelled underwater research vehicle
STCW	Standards of Training, Certification and Watchkeeping
SWD	seismic while drilling
ULCC	ultra large crude carriers
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USDOC	U.S. Department of Commerce
USDOI	U.S. Department of the Interior
USEPA	U.S. Environmental Protection Agency
VLCC	very large crude carrier
VSP	vertical seismic profile
WBM	water- based drilling mud
WGN	World Geophysical News

EXECUTIVE SUMMARY

The purpose of this research has been to examine the nature and trends in the industries and activities that support offshore oil and gas exploration, development, and production. The sectors and activities examined include: drilling contractors; underwater contractors (diving); mud, drilling, and lubricants; air transport; water transport; geophysical services; dredging; catering; workover services and environmental consulting and mitigation.

The issues examined for each of these sectors includes a basic description of the industry and the types of services provided, typical industry characteristics that include an examination of typical facilities, the geographical distribution of the firms and their location along the Gulf of Mexico (GOM), a description of each sectors' labor force, and identification of typical or leading firms in those particular sectors. Each chapter includes an examination of the industry trends and outlook for that respective support sector/activity and the impact of 2005 hurricane activity on each of the various support sectors and activities.

Drilling

Drilling contractors provide the equipment, personnel, and expertise required to drill for oil and gas. They typically own and operate their own equipment, which can consist of onshore drilling rigs and offshore vessels, such as submersibles, jack-ups, semi-submersibles and drillships, and charge a fixed daily rate, or day rate, for the hardware (the rig) plus the associated costs of personnel and routine supplies. This cost may include fuel, but usually does not cover capital goods such as casing and wellheads; nor does it include special services, such as logging or cementing. As a guideline, the day rate can be considered as roughly half of the cost of the well (Schlumberger, 2007).

The tropical season of 2004-2005 caused considerable damage to drilling platforms throughout the GOM. Of particular concern during and immediately after these events was the dislocation and drifting of platforms during some of the more significant storms of this period (Ivan, Katrina, Rita). Numerous drilling platforms, primarily jack-ups, were pulled significant distances from their original drilling locations, in some instances up to 70 miles off station, causing damage to both the seafloor and the supporting pipeline infrastructure in the region and requiring restoration and recovery work for the drilling sector.

Overall industry trends have seen drilling contractor activity increase with high energy prices (oil and natural gas) starting in 2000, decreasing in 2002, then increasing considerably and staying robust through 2007 and into 2008. Despite the increase in overall drilling activity, however, a relative decrease in GOM activity has been caused by such factors as relative returns to drilling investments; regulatory regimes; and resource extraction opportunities.

Underwater contractors, specifically commercial divers, perform underwater activities related to construction, inspection, search, salvage, repair and photography. They can be employed by commercial diving contractors, shipping and marine construction companies or by the oil and gas companies themselves for these offshore operations.

Remotely operated vehicles (ROVs) are used in oil and gas production efforts world-wide, assisting or even replacing commercial divers in hazardous environments or water depths greater than 850 feet. The hurricanes of 2004-2005 increased the demand for offshore removal and repair work, and the increase in demand for subsea projects including inspection and repair has brought an influx of demand for both commercial divers and ROV equipment in the GOM. Underwater contracting trends are dependent on the willingness of oil and gas companies to invest in offshore exploration, drilling and production. The future outlook for underwater contractors depends on the economy and advances in technology. With further deepwater exploration in the future ROV demand is expected to continue.

Drilling fluids or muds are used primarily to lubricate drill bits and to help keep them clean and cool during operation. Drilling fluids are made from a mixture of natural clays, minerals and small amounts of chemicals suspended in water or an organic liquid. The three types of drilling muds used in offshore production are water-based, oil-based and synthetic-based. Drilling wastes must be disposed of in accordance with environmental regulations.

Because drilling fluids are costly—about 10 percent of the total cost of the well construction—reliable, accurate mud engineers are important to a drilling operation. The hurricanes' impact on drilling fluids was directly correlated to well shut-ins and damage to infrastructure. With production suspended, the need for fluids decreased. By 2006, repairs to wells increased production, and drilling fluids were in demand. Industry trends for drilling fluids depend heavily on the level, type, depth and complexity of oil and gas drilling. The amount spent on product has grown from 2005 to 2006. With high oil and gas prices and demand for deepwater drilling, the demand for drilling fluids will increase.

Transport

Air transportation involves the use of helicopters to transport equipment and/or personnel to and from vessels, drilling rigs, production platforms and pipeline terminals. Helicopters can be used for routine transport, time-sensitive operations and for surveying pipelines for damage. Helicopter service providers usually have helicopters of various sizes, used for different purposes. These helicopters are dispersed throughout the Gulf for quick response. This industry is very concentrated and specialized.

In the months after the 2005 hurricanes, helicopter services increased in the Gulf, yet many of the bases for the helicopters were destroyed, resulting in damages and loss of equipment.

This industry is largely dependent on the level of production, development and exploration in the Gulf. Demand for helicopters increases with an increase in activity levels associated with oil and gas production; however, as oil and gas companies seek to reduce costs with respect to air transportation services, demand for the frequency of these services is reduced.

Since the 2005 hurricanes, new equipment has been purchased and demand for services has increased along with the increases in offshore exploration and development. Water transportation vessels help transport supplies and personnel from land-based facilities to rigs and platforms in the Gulf. There are six general types of offshore supply vessels: tugs; marine platform supply vessels; anchor handling; towing and supply vessels; mini-supply vessels; fast support vessels and liftboats; and floating, production, storage and offloading.

After the 2005 hurricanes, supply vessels were used for repairs, and that trend continues even today, with most of the vessels being used for construction supplies. Because of the large demand and the decrease in the number of vessels available since the hurricanes, the day rates for these vessels have increased an average of 71 percent. Industry trends project an increase in specialized vessels that can handle a longer range and capacity for the deepwater drilling that has been increasing recently.

Dredging, the removal of sediments from navigation channels, ensures the correct depth of water for ships to move safely. With the recent trend in the use of larger container ships, dredging is crucial to keeping ports and channels deep enough for safe navigation.

Dredging operations work primarily on capital projects, beach nourishment and maintenance. Dredging can also be used for land creation, pipeline trenching and equipment recovery. The 2005 hurricanes damaged many shorelines, wetlands and barrier islands in the Gulf. Dredging plays a vital role in restoring these areas. Challenges to dredging operations include their proximity to protected areas, such as wetlands, estuaries and fisheries, and reduced funding for required port maintenance and improvements.

Geophysical & Environmental Operations

Geophysical services include acquiring, processing and selling seismic data. Services can be performed onshore from the seismic company's headquarters or in large seismic exploration vessels in deeper waters and can take several months to conduct. Services can be provided by a one-man seismic broker or a large company.

The 2005 hurricanes did not affect the geophysical services industry, as most of the work is performed in onshore facilities, where no damage was reported. The post-hurricane cleanup efforts, however, did affect this industry.

With increasing exploration, the demand for geophysical services is increasing. Deepwater exploration requires high-quality equipment. Strong demand, coupled with low reserve replacements, brings a high demand for geophysical services.

Environmental consulting and mitigation is a service offered by companies who provide advice and technical assistance to businesses, government agencies and other organizations regarding environmental issues. They advise clients on emissions control, clean up, recycling programs and compliance with environmental laws and regulations. These companies conduct studies, audits or any other types of research needed to help client operations run efficiently.

Impacts from hurricanes in 2005 called for the services of many environmental companies for clean-up and restoration efforts. The oil spills and damages to infrastructure increased demand for environmental consulting services.

Industry trends in environmental consulting and mitigation are greatly affected by changes in environmental regulations at the state, local, federal and foreign levels. Changes in environmental consulting can also be the result of changes in environmental regulations in other industries, as well as changes in the overall economy. As the economy expands, for instance, construction, industrial and manufacturing activity also tends to expand, increasing the need for permitting and other environmental consulting services.

Catering Services

Catering services for oil and gas structures and those who run them include food management, accommodation management, security, medical services, potable water, waste management and more. As with all other services during the 2005 hurricanes, catering services were on hold during the storms, as employees were removed from the platforms. Soon after, services resumed to employees who were back in operation.

Demand for catering services depends on worker schedules. Due to high operating costs and competitiveness, smaller companies are bought out by larger ones and lower prices are negotiated for goods. With the expansion of deepwater exploration, demand for these services will increase.

Workover Services

Workover services provide repairs and restoration to producing wells to prolong or enhance the production of hydrocarbons. There are five general types of tasks for workover service: excessive gas production; excessive water production; poor production rate; production of sand; and equipment failures.

With an increase in demand for drilling services, the demand for workovers increases as well. Since 2005, many new rigs are being built, with one company expecting to add 200 newly built workover and well-servicing rigs to meet the increased demand.

I. DRILLING CONTRACTORS

A. Description of Industry and Services Provided

Drilling contractors provide the equipment, personnel, and expertise required to drill for oil and gas. They typically own and operate their own equipment, which can consist of onshore drilling rigs and offshore vessels, such as submersibles, jack-ups, semi-submersibles and drillships.

The drilling contractor usually charges a fixed daily rate, or day rate, for the hardware (the rig) plus the associated costs of personnel and routine supplies. This cost may include fuel, but usually does not cover capital goods such as casing and wellheads; nor does it include special services, such as logging or cementing. As a guideline, the day rate can be considered as roughly half of the cost of the well (Schlumberger, 2007).

Other primary contracting methods are footage rates and turnkey operations. Under a footage rate agreement, the contractor receives an agreed upon amount per foot of hole drilled (Schlumberger, 2007). Under a turnkey arrangement, the drilling contractor is fully responsible for the well to some predetermined milestone. This milestone could be the successful running of logs at the end of the well or the successful cementing of casing in the well or even the completion of the well. The operator owes nothing to the contractor until the specified milestone is reached. This type of arrangement puts a considerable amount of risk and potential reward on the drilling contractor. The contractor bears all risk of trouble in the well, and in extreme cases, may have to abandon the well entirely and start over. In return for assuming such risk, the price of the well is usually set higher than the well would cost if it were relatively trouble free. Thus, if the contractor is successful in drilling a trouble-free well, the fee added as contingency becomes profit (Schlumberger, 2007).

B. Industry Characteristics

1. Typical Facilities

Unless otherwise indicated, the following information is summarized from "Schlumberger Oil Field Services Glossary" (Schlumberger, 2007); and "NaturalGas.org" (NaturalGas.org, 2004a, 2004b, and 2004c).

Onshore

There are two main types of onshore drilling. Percussion, or 'cable tool' drilling, consists of raising and dropping a heavy metal bit into the ground, punching a hole down through the Earth. After a few impacts from the bit, the cable is reeled in and the cuttings are removed from the well. The bit is then reeled back to the bottom of the hole and the process is repeated. Due to the increasing time required to retrieve and deploy the bit as the well is deepened, the cable tool method is limited to shallow depths. Recognized as being the first drilling method used, cable tool drilling is now largely obsolete, although it is used in some of the shallow wells of the Appalachian Basin.

Modern drilling activity has shifted mainly towards the more widely used method of rotary drilling. This method of drilling works like a screwdriver or hand-held drill, with a sharp, rotating metal bit used to drill through the Earth's crust. Much more efficient than cable tool drilling, it is a nearly continuous process, as well cuttings are removed as drilling fluids circulate through the bit and up the wellbore to the surface. The difference in efficiency becomes particularly significant as hole depth increases.

Offshore

Each type of offshore rig has a specific environment it was created to work in, from the protected shallow waters of inland marshes that are only a few feet deep, to hostile oceans in water depths thousands of feet deep. Offshore rigs can either be moved from place to place, allowing for drilling in multiple locations, or permanently placed. Some of the most common types of rigs are described below.

Moveable Offshore Drilling Rigs


Source: rigzone.com

Drilling barges are used mostly for inland, shallow water drilling, typically in lakes, swamps, rivers, and canals. These large floating platforms must be towed by tugboat from location to location. These rigs are kept in still, shallow waters, as they are not able to withstand the water movement in large open water situations.


Source: rigzone.com

Drillships are self-propelled and typically have a drilling platform and derrick located on the middle of the deck. The 'moonpool' of a drillship is a hole that extends through the ship down through the hull, allowing for the drill string to run through the boat and down into the water. Drillships are moored either by a standard anchoring system or by dynamic positioning of the vessel. Dynamic positioning is the use of a computer-operated thruster system which keeps the vessel on location without the use of anchors. This allows vessels to drift in extremely deep water, often more than 6,000 feet deep.


Source: moc.noaa.gov/gu/visitor/gu0303/rigs.htm

Jack-ups are used in waters up to 600 feet deep. Once a jack-up rig is towed to the drilling site, heavy machinery is used to jack 3 or 4 'legs' down to the seabed. The platform containing the work area is then jacked-up above the water's surface, allowing the working platform to rest above the surface of the water. Jack-up rigs are suitable for shallower waters – it would be impractical to extend the legs in deep water. Because their working platform is elevated above the water, these rigs are typically safer to operate than drilling barges.

Source: rigzone.com

A *submersible* is towed to its location and submerged until it sits on the seabed. It consists of a platform with two hulls positioned on top of one another. The upper hull contains the living quarters for the crew, as well as the actual drilling platform. The lower hull works much like the outer hull in a submarine. When the platform is being moved from one place to another, the lower hull is filled with air, making the entire rig buoyant. When the rig is positioned over the drill site, the air is let out of the lower hull, and the rig submerses to the sea floor. This type of rig has the advantage of mobility, however its use is limited to shallow water areas (usually 80 feet deep or less).

Source: rigworker.com/ industry/semisub.shtml

Semisubmersible rigs are the most common type of offshore drilling rigs. This rig combines the advantages of submersible rigs with the ability to drill in deep water. Semisubmersible rigs use the same principle as submersible rigs; through the 'inflating' and 'deflating' of its lower hull. The main difference is that when the air is let out of the lower hull, the rig does not submerge to the sea floor. Instead, the rig is partially submerged, but still floats above the drill site. The lower hull is filled with water and provides stability to the rig when drilling. These rigs are held in place by huge anchors, each weighing upwards of ten tons. The anchors, combined with the submerged portion of the rig, ensure that the platform is stable and safe enough to be used in turbulent offshore waters. Semisubmersible rigs can be used to drill in much deeper water than the rigs mentioned above.

Moveable rigs are most often used to drill exploratory wells. If a commercially viable deposit of natural gas or petroleum is found, it may be more economical to build a permanent platform from which well completion, extraction and production can occur.

Offshore Drilling and Production Platforms – Permanently placed large drilling platforms are expensive and generally require large expected oil and gas deposits to be economical to construct. As described below, there are a number of different types of permanent offshore platforms, each useful for a particular depth range. See Figure 1 for examples of platforms at varying depths.

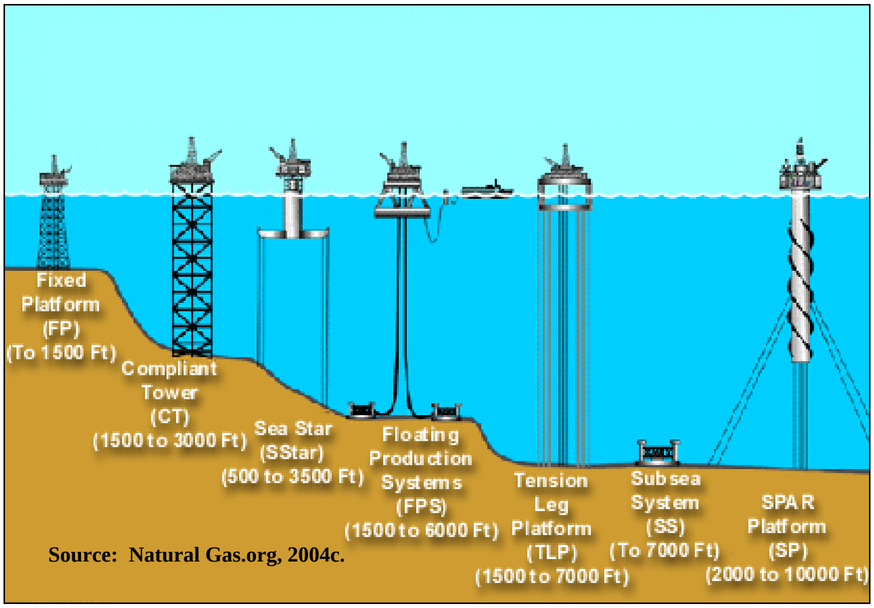


Figure 1. Offshore drilling platforms.

Fixed Platform Rig: Sometimes in shallow water it may be possible to actually attach a platform to the seafloor. The fixed platform has 'legs' that extend down from the platform rest on the seafloor. These legs are constructed of concrete or steel and their mass is so great, they do not need to be attached to the seafloor. These rigs are very stable as there is limited exposure to movement due to wind and water forces. These platforms cannot be used in deep water as it would not be economical to build legs that long.

Compliant Towers are similar to fixed platforms. The platform has a narrow tower that is attached to a foundation. The tower is flexible, allowing it to operate in much deeper water, as it can absorb much of the pressure exerted by the wind and sea.

Seastar Platforms are platforms with a floating rig, like a semisubmersible, but with tension legs like a tension leg platform. The Seastar's lower hull is filled with water when drilling to increase the platform's stability. It also has long, hollow tendons extending from the seafloor to the platform that are kept under constant tension. The tension restricts any up or down movement, but allows for side-to-side motion, which helps the platform withstand the force of the ocean and wind, without breaking off the legs. Typically, Seastar platforms are used for smaller deepwater reservoirs, when building a larger platform is not economical. They can operate in water depths of up to 3,500 feet.

Tension Leg Platforms are larger versions of the Seastar platform. The long, flexible legs are attached to the seafloor, and allow for significant side to side movement (up to 20 feet). Tension leg platforms can operate as deep as 7,000 feet.

Subsea production systems are located on the sea floor, as opposed to the surface. The well is drilled by a moveable rig, and rather than tying the well to a platform, the oil and natural gas is transported by riser or undersea platform to a nearby production platform. This format allows for one production platform to service many wells. Subsea systems are typically in use at depths of 7,000 feet or more, and do not have the ability to drill, only to extract and transport.

Spar platforms are huge platforms that consist of a large cylinder supporting a typical fixed rig platform. The cylinder does not extend all the way to the seafloor, but rather is tethered to the bottom by a series of cables and lines. The large cylinder stabilizes the platform in the water, and allows for movement to absorb the force of the ocean and wind.

Offshore Statistics

According to the ReedHycalog annual rig census, and as shown in Table 1, jack-ups comprise almost 60 percent of the global offshore mobile fleet and have the highest utilization rate at 89 percent. Semisubmersibles comprise 24 percent of the worldwide offshore fleet and have the second highest utilization rate, 87 percent. Drill barges account for 6 percent, as do drill ships, and submersibles account for only 1 percent of the worldwide fleet (Berkman and Stokes, 2006).

Table 1

Worldwide Offshore Fleet by Type

Type of Rig	Number of Rigs	Percent of Fleet	Utilization Rate
Jack-ups	385	59%	89%
Semisubmersibles	158	24%	87%
Drill barges	40	6%	48%
Drill ships	37	6%	78%
Drilling tenders	25	4%	76%
Submersible	9	1%	89%
Total	**654**		**85%**

Source: Berkman and Stokes, 2006.

2. Geographical Distribution

As shown in Figure 2, the U.S. employs 23 percent of the global offshore mobile fleet. Rigs off of South America account for 12 percent and the Middle East accounts for 12 percent. Northwest Europe has 11 percent of the world's offshore fleet, and Southeast Asia and West Africa account for about 10 percent and 8 percent, respectively. The remaining offshore rigs are working in Mexico, Indian Ocean, Far East, Mediterranean, Black Seas, Caspian Sea, Central America, Australia and New Zealand. Rigs offshore of Canada, the Russian Arctic and the Baltics account for less than 1 percent (Berkman and Stokes, 2006).

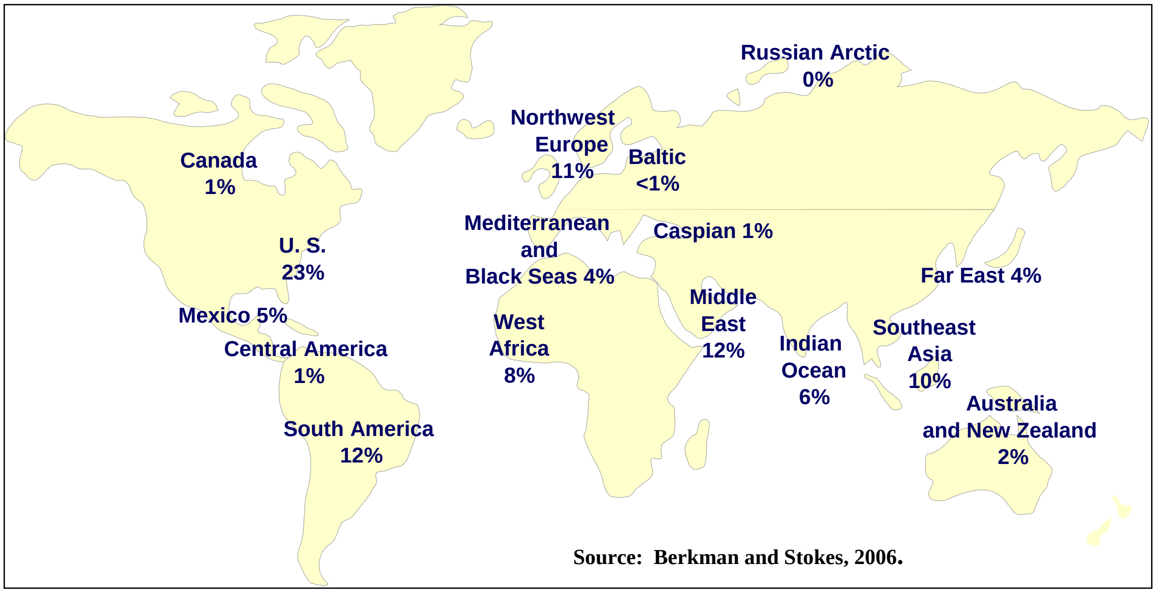


Figure 2. Worldwide offshore mobile fleet.

3. Labor Force

Unless otherwise indicated, the following information is summarized from "Schlumberger Oil Field Services Glossary" (Schlumberger, 2007); and the OTS Heavy Oil Science Center 2006 website (OTS Heavy Oil Science Center, 2006).

There are a number of specific jobs on an offshore rig. While the operating company usually has a representative at the drill site to protect its interests, the positions on the rig are filled by the drilling contractor.

The top representative of the contractor at the site is a "toolpusher." The toolpusher is responsible for supervising the rig, its daily operations and the crews. As long as the rig is operating, the "toolpush" is always on call. This position is largely administrative, making sure that the rig has sufficient materials, spare parts, and skilled personnel available to continue efficient operations. Each morning the toolpusher compiles the results of the past 24 hours of drilling into a daily drilling or morning report. The report is phoned back to the drilling superintendent at the contractor's office. The report includes the depths, footage drilled, supplies used, and other drilling and geological data.

The next job in the chain of command is the driller, who leads each shift and ensures the efficiency of the drilling operation and the safety of the crew. The driller's role is supervisory, but he or she must be capable of performing each job on the rig and maintain control of the major rig systems. From the control room, the driller operates the pumps, drawworks, and rotary table. It is the driller who operates the drawworks brake, which controls the speed and motion of the drilling line and the drillstring. For this reason, the driller is referred to as the person "on the brake" (Schlumberger, 2007).

The derrickman is second in command after the driller. The derrickman wears a special safety harness that enables him to climb to the monkeyboard, a platform near the top of the derrick, and reach the drillpipe in the center of the derrick or mast, throw a line around the pipe and pull it back to its storage location until it is time to run the pipe back into the well. In terms of skill, physical exertion and perceived danger, a derrickman has one of the most demanding jobs on the rig crew. On newer drilling rigs, automated pipe-handling equipment allows the derrickman to control the machinery without physically handling the pipe. Using an escape line often referred to as the Geronimo line, the derrickman can quickly reach the ground during an emergency. Between trips, the derrickhand is usually responsible for the mud system, and making sure that it meets the specification for drilling a particular part of the hole (Schlumberger, 2007).

On the derrick floor there are usually two to four roughnecks (rotary or floor helpers), depending on the size of the rig. They handle and maintain the drilling equipment. One person is hired to maintain the engines. On a typical drilling crew, two roughnecks are responsible for lowering the end of the pipe when it is tripping out or in and for attaching each length of new drill pipe as needed. The work is heavy and exacting, requiring precise timing and teamwork. Roughnecks maintain and repair the rig and equipment, and ensure a safe operating area on the rig floor (OTS Heavy Oil Science Center, 2006).

Other jobs on the rig can include cleaner/painters, roustabouts, riggers, floorhands, crane operators, welders, electricians, mechanics, motormen, oilers, engineers, chief engineers, warehousemen, medic/safety persons, ballast controlmen, DP operators, barge operators, barge engineers, rig managers and rig superintendents. In addition, service and supply companies provide specialized tools and services needed during the drilling operations.

4. Labor Statistics

The number of jobs in oil and gas drilling can be measured by the “Oil and Gas Extraction” series as reported by the U.S. Department of Labor’s Bureau of Labor Statistics. As shown in Figure 3, employment in the U.S. oil and gas drilling industry has been decreasing. Since its peak in 1982 of 264,500 jobs, employment fell over 50 percent, to its lowest point of 120,100 in 2003. Some of this decline can be attributed to industry consolidation, the decline of offshore drilling, and increasing competition, all of which is discussed later in this chapter. Oil and gas drilling employment has increased in recent years, to an annual average of 136,000 in 2005 and an average of 147,600 by July of 2007 (U.S. Dept. of Labor, BLS, 2007a).

Average earnings in the oil and gas extraction industry are significantly higher than the average for all industries. The average weekly earnings for production workers in the oil and gas extraction sector in 2006 was $920 per week. This translates to almost $48,000 per year. In comparison, the average weekly earnings for all workers in private industry in 2006 was $568 per week, or $29,530 per year. Also, because of their intense working conditions, employees at offshore operations generally earn higher wages than their onshore counterparts (U.S. Dept. of Labor, BLS, 2007a).

A description of typical companies and their number of employees is found in the next section.

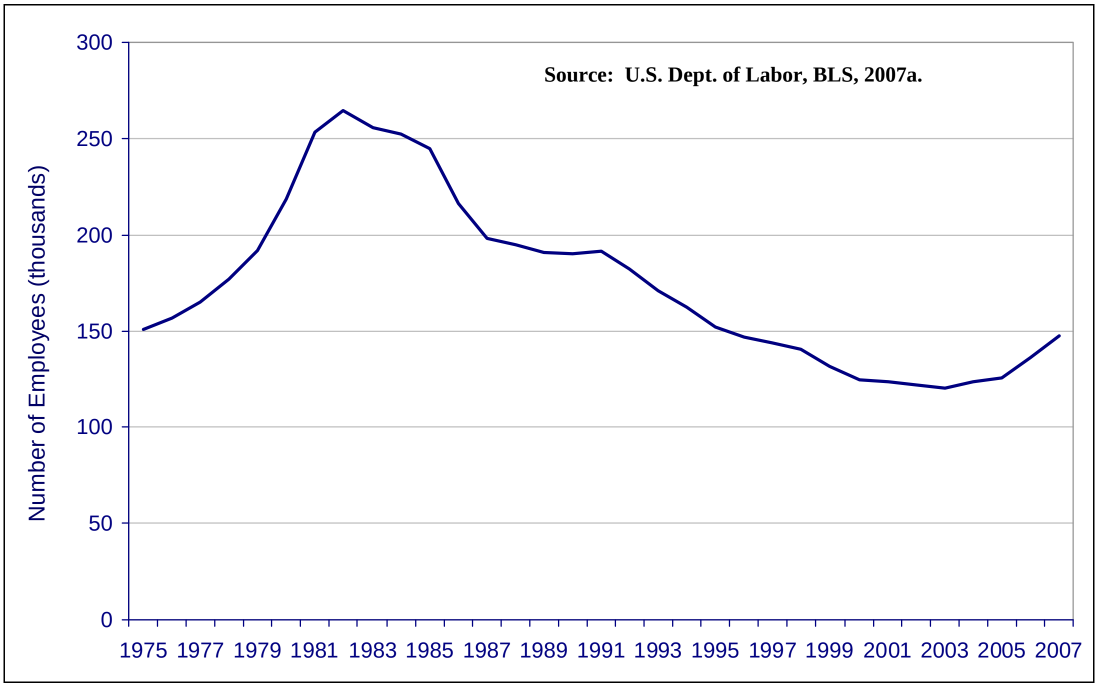


Figure 3. Number of employees, oil and gas extraction.

5. Typical Firms

RigData (2009) compiles a monthly list of the top 100 drilling companies ranked by footage. Table 2 shows the top 25 drillers from this list (from January through July of 2009). As shown in the table, the top 25 drillers account for 60 percent of the well footage drilled. The remaining 40 percent is divided among over 75 smaller companies.

As shown in Table 2, Helmerich & Payne I.D.C leads the group in 2009 with over 8.4 million feet drilled, over nine percent of total footage drilled. Helmerich & Payne owns and operates land rigs in the U.S. as well as abroad and has offshore platform rigs which are mostly located in the GOM (Helmerich & Payne, 2009).

Second on the list is Nabors Drilling USA with almost nine percent of total footage drilled. The Nabors companies own and operate almost 600 land drilling and 800 land workover and well-servicing rigs in North America. Offshore, Nabors operates 41 platform rigs, 14 jack-ups, and four barge rigs in the domestic and international markets. In addition, Nabors markets 25 marine transportation and support vessels, primarily in the U.S. Gulf of Mexico (Nabors Industries LTD, 2007).

Patterson UTI provides onshore contract drilling services to exploration and production companies in North America. The Company owns 336 marketable land-based drilling rigs that operate primarily in oil and natural gas producing regions of Texas, New Mexico, Oklahoma, Arkansas, Louisiana, Mississippi, Colorado, Utah, Wyoming, Montana, North Dakota, South Dakota and western Canada. At the end of 2006, Patterson-UTI had approximately 9,000 full-time employees (SEC, 2006a).

Table 2

Top 25 Drillers Ranked by Footage Drilled (January – July 2009)

	Drilling Company	Footage Drilled	Percent of Total Footage	Average Footage	Well Starts	Percent of Total Starts
1	Helmerich & Payne I.D.C.	8,454,504	9.1%	9,774	939	7.2%
2	Nabors Drilling USA, LP	8,121,720	8.8%	10,887	809	6.2%
3	Patterson-UTI Drilling Company, LLC	5,464,122	5.9%	9,586	584	4.5%
4	Nomac Drilling, LLC	4,166,965	4.5%	7,441	566	4.3%
5	Precision Drilling Oilfield Svcs, Inc.	3,945,843	4.3%	10,636	381	2.9%
6	Ensign United States Drilling, Inc.	3,505,228	3.8%	8,763	417	3.2%
7	Trinidad Drilling, LP	2,053,428	2.2%	10,115	208	1.6%
8	Unit Drilling Company	1,924,106	2.1%	13,179	150	1.1%
9	Pioneer Drilling Company	1,771,241	1.9%	10,934	163	1.2%
10	Scandrill, Inc.	1,695,056	1.8%	12,745	133	1.0%
11	Nabors Well Services Company	1,268,564	1.4%	9,192	153	1.2%
12	Cactus Drilling Company, LLC	1,258,650	1.4%	11,442	110	0.8%
13	Union Drilling, Inc.	1,141,482	1.2%	5,679	216	1.6%
14	Xtreme Coil Drilling Corporation	1,121,491	1.2%	7,843	143	1.1%
15	Saxon Drilling, LP	1,034,649	1.1%	6,426	162	1.2%
16	Desoto Driling, Inc.	955,374	1.0%	4,227	226	1.7%
17	Goober Drilling LLC	930,892	1.0%	7,106	131	1.0%
18	Savanna Drilling LLC	905,809	1.0%	10,657	85	0.6%
19	Capstar Drilling, LP	898,473	1.0%	4,937	182	1.4%
20	Union Drilling Texas, LP	876,100	0.9%	9,734	90	0.7%
21	Bronco Drilling Company, Inc.	859,518	0.9%	9,658	94	0.7%
22	White Mountain Operating	858,260	0.9%	13,623	63	0.5%
23	Felderhoff Brothers Drilling, LLC	850,886	0.9%	9,561	89	0.7%
24	Falcon Drilling Company, LLC	815,035	0.9%	5,470	150	1.1%
25	Key Energy Services, Inc.	794,752	0.9%	12,042	69	0.5%
	Total of Top 25 Companies	**55,672,148**	**60.2%**		**6,313**	**48.1%**
	Remaining Companies	**36,756,810**	**39.8%**		**6,800**	**51.9%**

Source: RigData, 2009.

Although it is not shown in Table 2, Diamond Offshore is well known in offshore markets. It operates in four continents with a fleet of 30 semisubmersibles, 13 jack-ups and one dynamically positioned drillship. Diamond staff consists of approximately 500 shore-based support personnel and 3,800 offshore rig personnel (Diamond Offshore, 2007).

Another offshore leader is ENSCO, one of the leading offshore oil and gas drilling contractors with a fleet of 50 offshore drilling rigs. Its fleet includes 44 jackups, one deepwater semisubmersible, one barge rig, and four ultra-deepwater semisubmersible rigs under construction (ENSCO International, 2007).

GlobalSantaFe owns or operates a fleet of 59 offshore drilling rigs. GlobalSantaFe's fleet includes: 43 cantilevered jackup rigs capable of drilling in maximum water depths of 200 feet to 400 feet; eight semi-submersible rigs suited for midwater drilling and/or harsh environments; one deepwater semi-submersible capable of drilling in water depths up to 5,750 feet; three dynamically positioned, ultra-deepwater drillships, two of which are designed for the ultimate drilling capability of up to 12,000 feet of water; two ultra-deepwater semi-submersibles, capable of drilling in water depths of up to 7,500 feet, in either DP or moored mode; and two semi-submersibles owned by third parties and operated under a joint venture agreement (GlobalSantaFe, 2007).

C. Industry Trends and Outlook

1. Rig Count

According to the Baker-Hughes Rig Count, worldwide drilling activity has been increasing since the middle of 2002. As shown in Figure 4, the number of active rigs worldwide peaked in February 2007 at 3,325 rigs – a 7 percent increase from the previous year's peak (February 2006) and a 190 percent increase from the historic low of 1,156 active rigs in 1999.

North American rig counts have also been climbing since 2002, reaching a high of 1,771 in June 2007. This is more than a 6 percent increase since June 2006, and a 257 percent increase since the historic low of 496 rigs in April 1999.

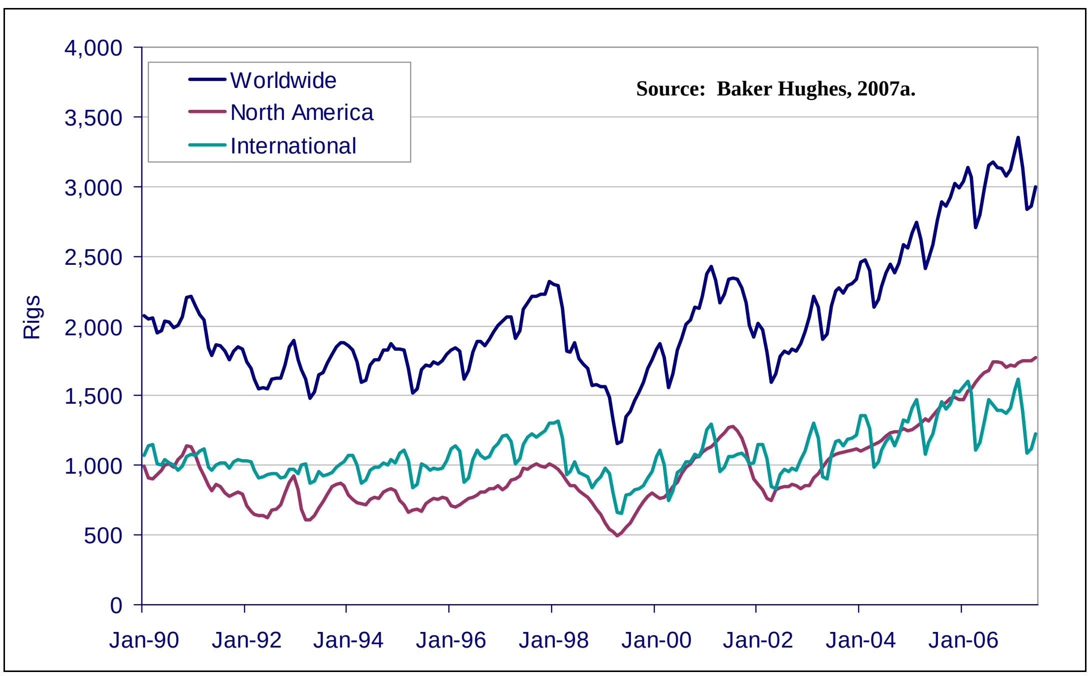


Figure 4. Worldwide rig activity.

Despite the increase in drilling activity worldwide and onshore in the U.S., U.S. offshore operations have been decreasing over the past five to six years. In fact, Figure 5 shows that the number of active rigs in the U.S. and the Gulf of Mexico has decreased 55 percent since its high of 167 rigs in January 2001.

Throughout the first half of 2005, the number of rigs in the Gulf began to increase. This increasing trend was halted by the hurricanes of 2005 as shown by the quick downturn in August 2005. By February 2006, however, rigs had rebounded almost to their pre-2005 hurricane levels. Impacts from these hurricanes will be discussed in the next section.

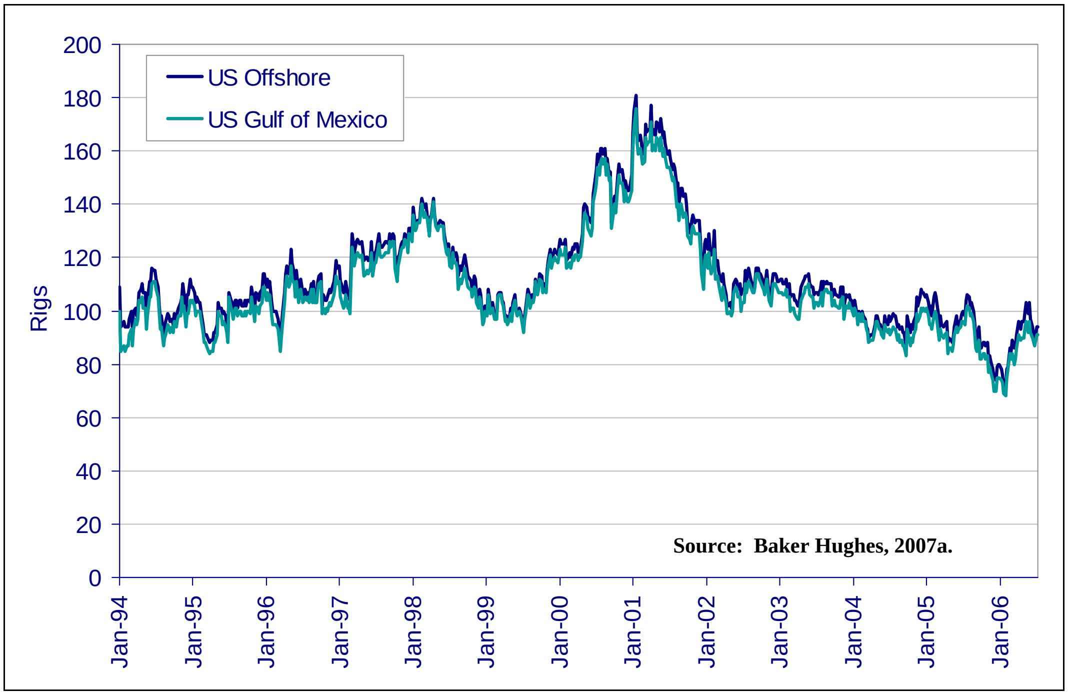


Figure 5. Active rigs offshore.

In the deepwater Gulf, production and the number of discoveries have increased substantially in recent years. As of March 2006, there were 118 deepwater hydrocarbon production projects online (French et al., 2006).

According to a 2006 BOEMRE report, there are many deepwater prospects waiting to be drilled. Many of these prospects might not be drilled because of the limited number of rigs available for deepwater drilling in the GOM. Also, as some operators are drilling more often in increased depths this will cause rigs to be under contract for longer periods and unavailable for new prospects (French et al., 2006).

Figure 6 shows deepwater rigs operating in the Gulf from 1992 through 2005. The average number of rigs increased steadily from 1992 to a peak in 2001. The average number of rigs operating in the deepwater GOM decreased from 2002 through 2004, but increased in 2005 (French et al., 2006).

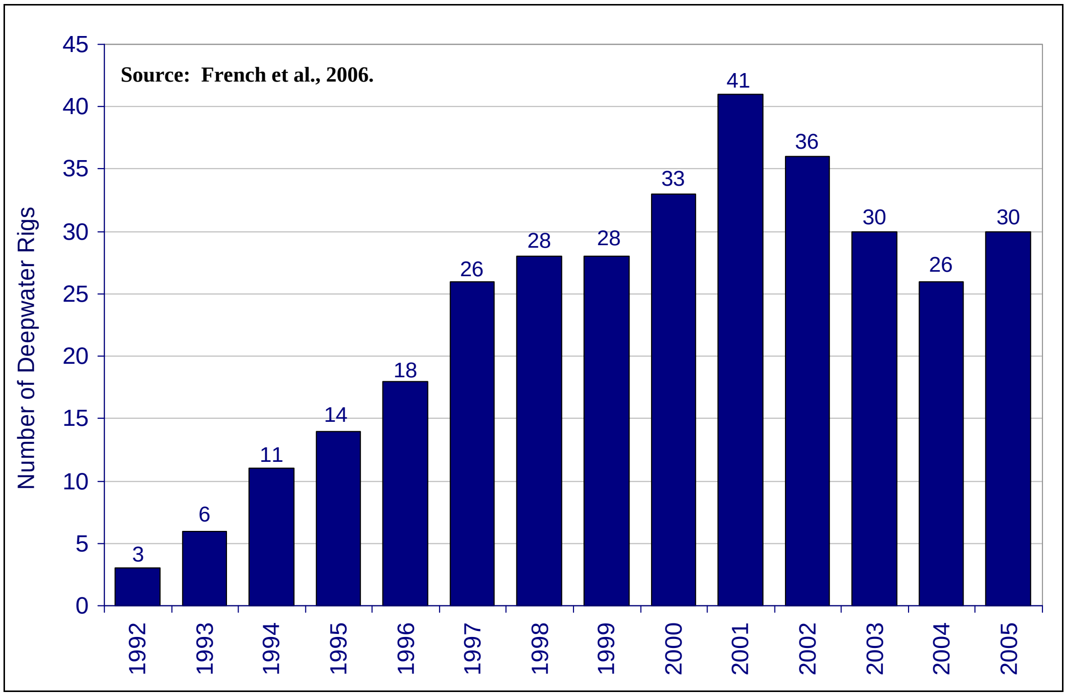


Figure 6. Average number of rigs operating in deepwater Gulf of Mexico.

2. Rig Contractors

For the past two decades, the number of drilling contractors in the U.S. has been decreasing. Because of industry consolidation, the almost 700 rig contractors that existed in 1987 had decreased to 179 in 2003. The 2004 and 2005 data show a slight increase to 213 and 226 contractors. In 2004 this increase was attributed to better data collection and the addition of several small companies. However, the addition of 13 companies in 2005 and 31 companies in 2006 was actually a result of new, small companies entering a rejuvenating industry (Berkman and Stokes, 2006) (see Figure 7).

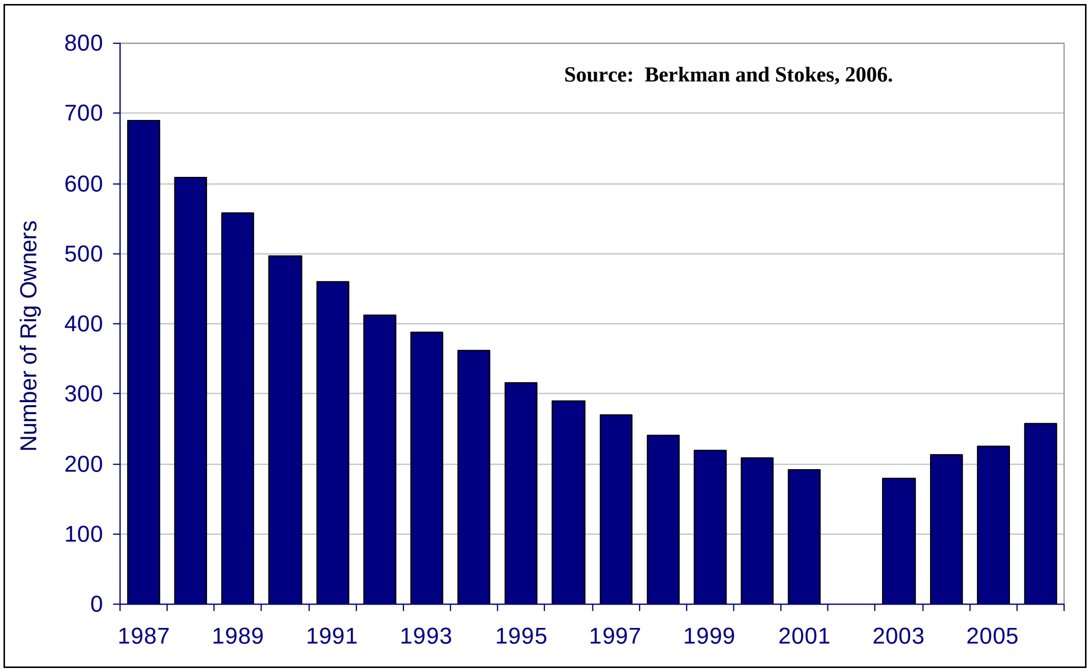


Figure 7. Drilling contractors, number of rig owners.[1]

Reasons for merging include access to capital at better rates and more efficient scales of operation. A large company has more geographical reach and can realize significant savings through lower insurance rates and large-scale purchasing. Also, a larger company will have more types of rigs available to meet cyclical markets.

As consolidations in the industry continued, the big companies got bigger. Figure 8 shows that in 2003, at the height of industry consolidation, 63 percent of rig contractors in the U.S. had fleets with more than 20 rigs. However, with additional companies entering the market, this number fell to 55 percent in 2005. U.S. companies holding 11 to 20 rigs, and those with just one rig both saw percentage gains.

[1] Data for 2002 was not collected.

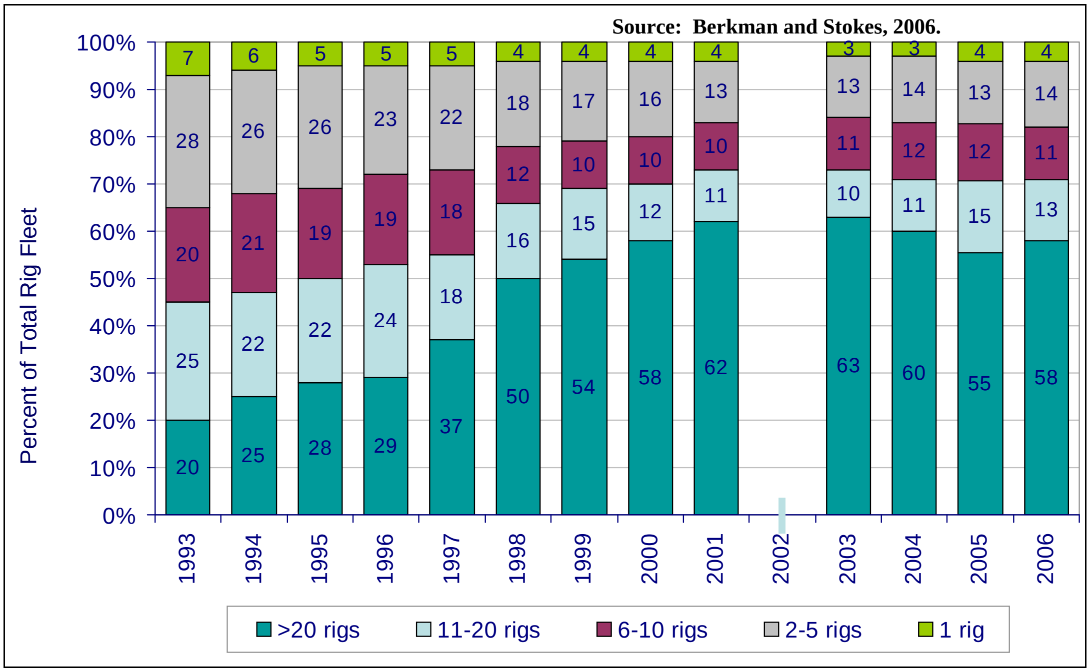


Figure 8. Drilling contractors, owner fleet size.[2]

Improved market conditions have not only encouraged new companies to enter the market, but the market has tightened, causing utilization rates to increase. Figure 9 shows that rig utilization in the U.S. GOM has been high in recent years, averaging 95 percent in 2005.

Despite these improved market conditions, the number of rigs in the U.S. GOM has fallen significantly, which also contributes to higher utilization rates (see Figure 9). Much of this has been due to increased competition from overseas prospects and impending expiration of leases in the GOM. A migration of rigs out of the Gulf of Mexico has also been supported by longer-term contacts that larger oil companies throughout the world are willing to sign. Rigs have been moving to places such as the west coast of Africa, Brazil and the Middle East. The number of rigs in the GOM fell by 19 from September 2006 to September 2007 (Sridharan, 2007).

[2] Data for 2002 was not collected.

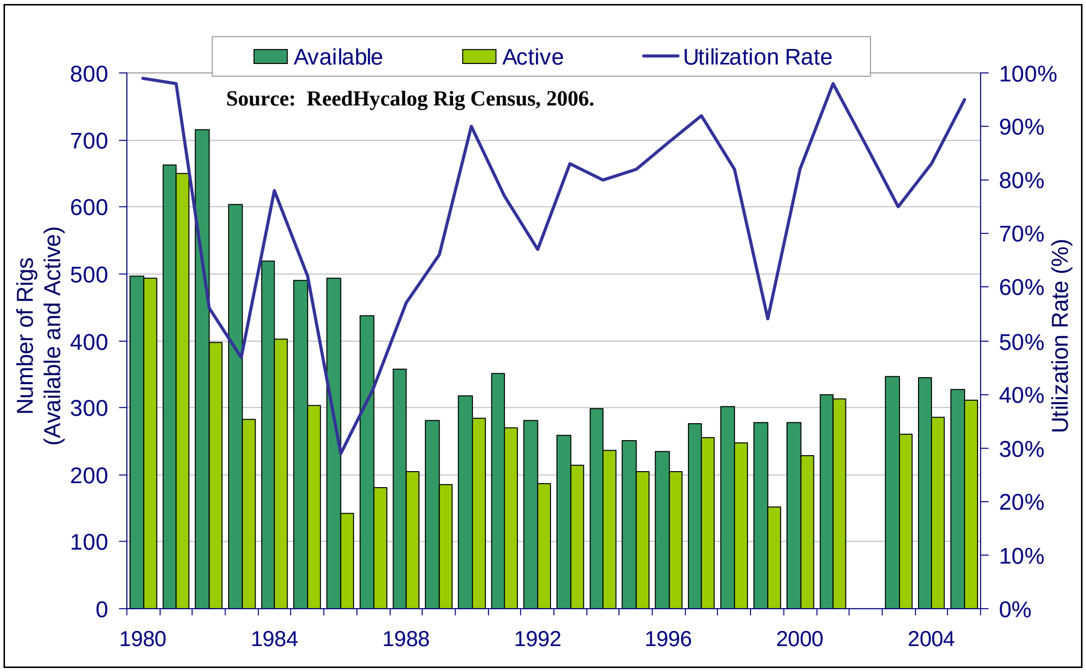
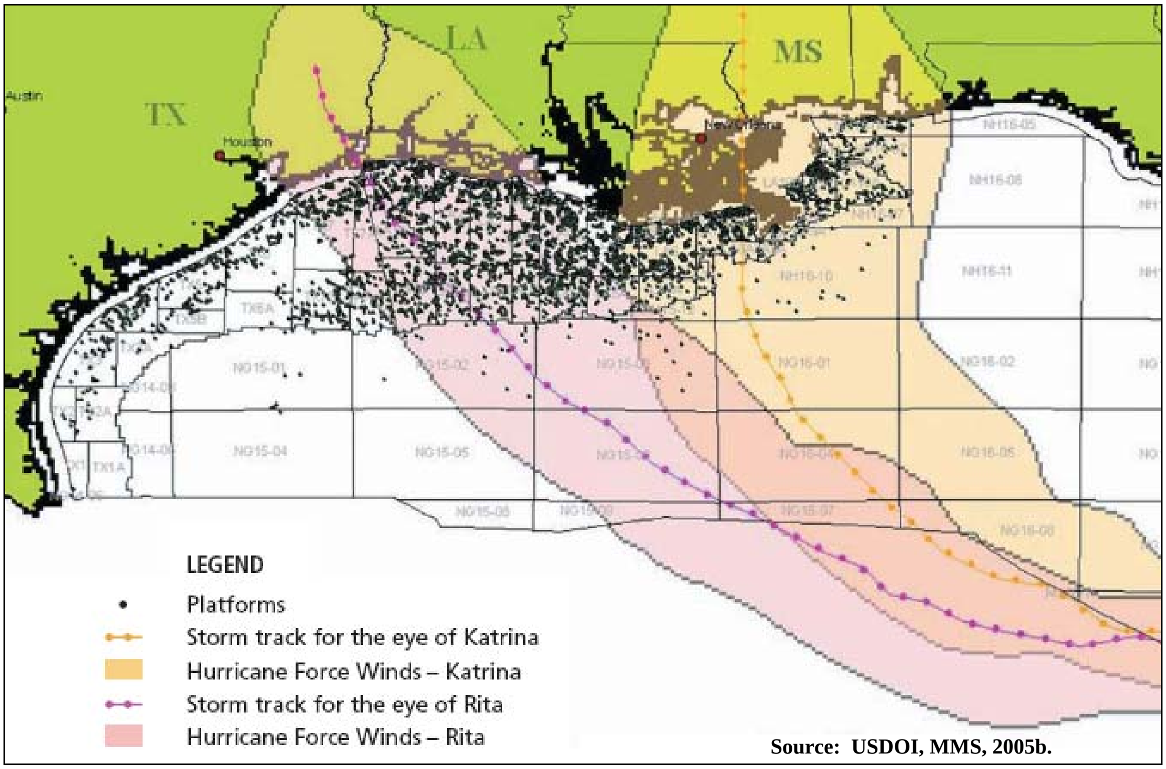


Figure 9. Number of available and active rigs in the U.S. GOM.

3. Hurricane Impacts

Hurricanes Katrina and Rita caused a substantial amount of damage to the production platforms of the GOM (see Figure 10). It is estimated that 3,050 of the GOM's 4,000 platforms (or 76 percent of platforms) were in the direct path of either Hurricane Katrina or Hurricane Rita (USDOI, MMS, 2006a). Hurricane Katrina, which was a category 5 hurricane when it entered the GOM OCS, destroyed 46 platforms and four drilling rigs, and damaged an additional 20 platforms and nine drilling rigs. Shut-in production at its peak after Katrina was 95 percent for oil production and 88 percent for natural gas. Then, in just three weeks, as the industry was recovering, Hurricane Rita hit. Hurricane Rita, which was a category 4 hurricane when it entered the GOM OCS, destroyed 69 platforms and four drilling rigs. In addition, 32 platforms and 10 drilling rigs were damaged (Tubb, 2005). In the days following Hurricane Rita, 100 percent of oil production was shut-in as was about 80 percent of natural gas (USDOI, MMS, 2005a and 2006b).

In comparison, Hurricane Ivan moved through the GOM as a Category 4 hurricane in September 2004. Of the 4,000 platforms in the GOM, only 150 facilities were in its direct path. Hurricane Ivan resulted in an interruption of more than 10 percent of the Gulf's production for at least four months. This seems pretty minor compared with Hurricanes Katrina and Rita (Drilling Contractor, 2005).



Source: USDOI, MMS, 2005b.

Figure 10. Hurricanes Katrina and Rita paths, 2005.

Most of the structures that were lost were built 20 to 30 years ago when there were less stringent standards than what is currently in effect (Tubb, 2005). However, there were some exceptions. Chevron U.S.A. Production Company's Typhoon production facility, a SeaStar Tension Leg Platform located in 2,100 feet of water, was found upside down after Hurricane Rita. The deepwater TLP was less than four years old and produced about 40,000 barrels per day of oil and 60 MMcf per day of natural gas (Tubb, 2005). Many other mobile drilling units were torn from their anchor moorings and became adrift during the hurricanes. Drifting units not only means a lost facility, but also potential damage to existing fixed facilities, including underwater pipelines. Anchors being dragged across the ocean floor have a good chance of breaking segments of pipeline (Tubb, 2005).

The tropical season of 2005 damaged many production facilities beyond repair. Chevron announced that it would sink its $250 million Typhoon oil platform that was damaged by Hurricane Rita. The Typhoon platform will be donated to a federal program that uses decommissioned platforms and rigs to create new reefs on the seafloor (Bloomberg.com, 2006).

Hurricanes Katrina and Rita resulted in losses to the industry of $26 billion and $12 billion respectively, largely as a result of platform and pipeline damage. The previous year, Hurricane Ivan caused an estimated $5.7 billion in losses (Energy Trader, 2007). Recently, it was projected that a Category 5 hurricane could cause more than $65 billion in damage to offshore platforms and undersea pipelines in the GOM region. This estimate included property damage of $35 billion and losses associated with business interruption and lost production capacity of $30 billion (Energy Trader, 2007).

4. Outlook

Markets outside the GOM are going strong and rigs continue to leave the Gulf of Mexico. Demand is being driven by the Middle East market and markets in the West Africa coast, the North Sea, Southeast Asia, the Mediterranean and India remain strong. All of these markets have significantly higher rig utilization rates than the GOM and demand is expected to remain strong in these areas (Donovan, 2010). While the GOM offers well-to-well drilling programs and lowering dayrates, other world markets are offering three to five year contracts and much higher dayrates. As stated by Mark Keller, Rowan Companies executive vice president of business development, "[j]ackup migration will continue until the U.S. Gulf of Mexico offers a more stable work environment (Hsieh, 2007)."

"Major challenges facing U.S. GOM drilling contractors today are short-term contracts, unstable natural gas prices, increased insurance premiums and fleet risk associated with hurricane season. A confluence of these dynamics — natural gas prices, majors' budget shifts, reservoir sizes, stability and higher dayrates in other markets, and weather — over the past few years have taken its toll on the Gulf of Mexico with both opportunistic mobilizations and deliberate relocations (Hsieh, 2007)."

For example, of Rowan's 22 jackup rigs, nine are in the GOM. Of the nine, four are idle and one is scheduled to come off contract in September 2009 (Rowan Companies, 2009a). Rowan's other jackups have been mobilized to other markets including the Middle East, West Africa and the North Sea (Hsieh, 2007; and Rowan Companies, 2009a). Another example of the migration is Global SantaFe (GSF). In early 2006, GSF had 10 jackups in the GOM. By mid 2007, two were basically destroyed by Hurricane Rita, and five left for long-term contracts with much higher rates than could be found in the Gulf. GlobalSantaFe also has four semisubmersibles in the Gulf, two of which left the region in 2007 (Hsieh, 2007).

In September 2009, there were 77 jackups reported in the Gulf of Mexico (RigZone, 2009). However, of these 77 rigs, only 12 were actively drilling and five were on workover projects. Over 30 percent, or 25 of the GOM jackups were ready stacked, meaning while not in use they can be brought back to service easily. Even more rigs however, (28 rigs or 36 percent) were cold stacked (RigZone, 2009). These are rigs that are completely shut down and not being actively marketed.

In August 2009, in reporting its second quarter operating results, the Rowan CEO stated that "[l]ooking forward, we expect that excess rig capacity will continue to put downward pressure on day rates. Though we are seeing signs of a pick-up in drilling demand in certain areas, there are still more available rigs than drilling tenders (Rowan, 2009b)." A Rowan Company representative also recently stated that the GOM rig market is "definitely continuing to weaken (Natural Gas Week, 2009)."

Some companies like Pride International are attempting to attract operators to employ idle jackups by offering incentives like a financial grace period in the event of a hurricane-related evacuation (Natural Gas Week, 2009). Should the rig be evacuated during a hurricane, an operator using one of Pride's idle rigs will be exempt from the standing dayrate (Natural Gas Week, 2009).

D. Chapter Resources

Baker Hughes Rig Counts
North American rig counts are updated weekly; worldwide rig counts are updated monthly.
http://www.bakerhughes.com/investor/rig/index.htm

ReedHycalog Rig Census
Annual Census of available and active rigs by U.S. region. U.S. totals are available from 1955 and historic data for regions is mostly available from 1980.
http://www.grantprideco.com/

RigData
Provides monthly statistics for permit counts, rig counts, well starts by depth, well starts by state and district, and driller and operating rankings. Custom reports and data sets are available for purchase.
http://www.rigdata.com/c-26-nbspmonthly-statistics.aspx

RigData
Provides a comprehensive directory of U.S. land and offshore rigs. Entries include driller, rig, rig type, horsepower, depth, rating, and work history. The directory is sorted by company and by geographic region.
http://www.rigdata.com/c-66-rigs-drillers.aspx

U.S. Department of Labor, Bureau of Labor Statistics
The Current Employment Statistics survey provides monthly employment statistics for major industrial categories (including oil and gas extraction). These data are available for statewide and metro area.
http://www.bls.gov/data/home.htm

U.S. Securities and Exchange Commission
Quarterly and annual reports of operations for publicly traded companies are filed with the Securities and Exchange Commission.
http://www.sec.gov/edgar/searchedgar/companysearch.html

II. UNDERWATER CONTRACTORS

A. Description of Industry and Services Provided

Since the earliest days of the offshore oil and gas industry, there has been a need for underwater contractors – particularly commercial divers. Companies that employ commercial divers include diving contractors, shipping and marine construction companies, and oil and gas companies that operate offshore. The work of the commercial diver can include construction, inspection, search, salvage, repair and photography. Commercial divers can perform the following tasks (HRSDC, 2007):

- Perform offshore oil and gas exploration and extraction duties such as underwater surveys, nondestructive testing, blasting, construction, and repair and maintenance of drill rigs and platforms;

- Operate underwater video, sonar, recording and related equipment for scientific or exploratory purposes;

- Inspect vessels, buoyage systems, pipelines, sluice gates, plant intakes and outfalls and other materials, visually and by nondestructive testing;

- Perform construction duties such as welding and installing pilings for cofferdams or footings for piers, and maintain these and drydocks, breakwaters, marine ways and bridge foundations using hand and power tools and pneumatic equipment;

- Operate winches, derricks or cranes to manipulate cables and chains to raise sunken objects;

- Set up and detonate explosives to remove obstructions and break up or refloat submerged objects;

- Participate in underwater search and rescue, salvage, recovery and clean up operations; and

- Check and maintain diving equipment such as helmets, masks, air tanks, harnesses, gauges, air compressors, diving suits, underwater cutting torches and welding equipment.

Remotely operated vehicles (ROVs) assist and sometimes replace commercial divers underwater. An ROV is an underwater robot that allows the vehicle's operator to remain in a comfortable environment while the ROV works remotely in a potentially hazardous environment. Although regulations vary internationally, generally diving saturation techniques are prohibited in water depths of greater than 850 feet. Since a considerable percentage of offshore oil and gas reserves are located in water depths in excess of diver depths, the importance of ROV technology is significant (Marine Technology Society, ROV Committee, 2006a).

The ROV vehicle is connected by an umbilical cable to the control van and the operators on the surface. A handling system is used to control the cable dynamics. Other parts of the ROV system include a launch system (such as the A-frame shown in Figure 11 below) and associated power supplies. The umbilical carries the power and the command and control signals to the vehicle and the status and sensory data back to the operator. In addition, the umbilical may be reinforced to have the strength to recover heavy devices or wreckage (The ROV World Portal, 2006).

Source: Marine Technology Society, ROV Committee, 2006b.

Figure 11. What is an ROV?

Modern ROVs cover tasks from inspecting the hazardous inside of nuclear power plants to repairing complex deepwater production systems offshore in the oil and gas industry. In general, ROVs are used to perform the following (The ROV World Portal, 2006):

- **Diver Observation –** act as a dive buddy to ensure diver safety and provide assistance.
- **Platform Inspection –** from visual inspection to using instruments to monitor the effects of corrosion, fouling, locating cracks, estimating biologic fouling, etc.
- **Pipeline Inspection** – follow underwater pipelines to check for leaks, determine overall health of the pipeline and insure the installation is acceptable.
- **Surveys –** both visual and acoustic surveys are necessary prior to installing pipelines, cables and most offshore installations.
- **Drilling Support –** everything from visual inspection, monitoring installation, operational support and repair when necessary using multiple manipulators.

- **Construction Support** – a natural follow-on to drilling support. The tasks here can become more complex with the use of manipulators and powered tools and cutters.

- **Debris Removal** – offshore platforms can become a "trash dump" underwater. ROVs provide a cost effective method of keeping the area clean and safe.

- **Call Out Work** – support in many of the previous areas, however, the tasks are usually for one or several days for systems not permanently assigned to offshore platforms or drill ships.

- **Platform Cleaning** – one of the most sophisticated tasks using manipulators and suction cups for positioning and 100-horsepower systems driving brushes, water jets and other abrasive devices.

- **Subsea Installations** – as capability has increased, vehicles have begun to support the construction, operation, inspection, maintenance and repair of subsea installations, especially in deep water.

- **Telecommunications Support** – Inspection, burial or repair–from towed plows that bury cables for protection from trawlers and anchors to sophisticated vehicles that can locate, follow, retrieve and rebury subsea telecommunication cables.

- **Object Location and Recovery** – ROVs may have received their highest level of recognition from tragedies such as passenger jet crashes and the space shuttle disaster.

Unless otherwise noted, the remainder of this section is summarized from the Marine Technology Society, ROV Committee (2006a).

By far the greatest use of ROVs around the globe is their application in the oil and gas industry for the exploration and production of hydrocarbons. Since the mid-1970s, ROV technology has been used in the search for hydrocarbons underwater. Today, an estimated 85 percent of the 400 commercial systems deployed worldwide are used to support hydrocarbon production. The highly sophisticated, capable and reliable work class systems routinely undertake operations in water depths greater than 7,000 feet.

As described in the Drilling Contractors chapter, there are several standard means of extracting hydrocarbons in various water depths – from jackup drilling production rigs in very shallow water to subsea completion, tension leg platforms and spars in deep and ultra deepwater. The ROV technologies support operations for services such as drilling and completion, installation/construction, and inspection/maintenance and repair.

Over 60 percent of the world's ROV systems supporting oil and gas production are engaged in drilling support operations. Systems are utilized in water depths as shallow as 100 feet on jackup rigs and as deep as 10,000 feet on semi-submersibles and drillships. This means that the full range of ROV systems are engaged worldwide to support these activities. Observation ROV systems are typically used in shallow water and when surface trees are utilized. Work class ROV systems are used in deeper water, areas of high current, and when intervention tasks require the use of manipulators, fluid transfer or load bearing capabilities.

Installation and construction support is the most demanding service offered by an ROV contractor, requiring the most capable equipment and the greatest experience and skill of the ROV crew. Installation and construction support is the realm of the work class ROV (see descriptions of system categories below). A key element in the development program, ROV systems are used before, during and after the installation of platforms, subsea production systems and others, and the installation, laying, hook-up and commissioning of flowlines, trunklines, export lines, cables and umbilicals.

B. Industry Characteristics

1. Typical Facilities – Diving

Commercial divers must be skilled not only in diving but in performing other work tasks while under water, including welding, repairing underwater structures or collecting marine species. Some divers have received formal training and are skilled workers in those fields (BC Work Futures, 2009).

The two general categories of commercial diving are surface diving, which is performed at shallow water depths, and saturation diving, which requires divers to work for prolonged periods of time and at greater depths. While shallow divers must decompress to allow their bodies to adjust to pressure changes as they surface, saturation divers, who often live aboard pressurized diving vessels at 600 and 1,000 feet below the surface, are not required to undergo decompression procedures after each dive (U.S. v. Cal Dive, 2005).

Saturation diving systems often include one or more saturation chambers and other safety, monitoring and life support systems. These systems can be transported from one vessel to another. Anchor-and-chain mooring systems and dynamic positioning maintain the diving vessel's position during a saturation dive.

Pressure-related and gas-related injuries are avoided by strict adherence to safety guidelines. Dangers associated with working underwater near heavy construction and oil drilling operations include near-zero visibility, waves and currents, darkness, confined spaces and ice (Alberta Learning Information Service, 2008).

In shallower, accessible water, typical diving tasks include surveying, sand bagging, piles recovery, pipeline routing, inspecting, anchor recovery and pipeline and cable laying. To position a drilling unit, for example, an underwater survey must first be performed. Divers use echosounding, side scan sonar and sub-bottom profilers. Later, carrying a metallic rod and/or metal detector, a diver will walk the sea floor in semi-circular patterns until the area has been completely covered. The drilling unit is positioned according to the diver's survey (Underwater Magazine, 2002).

In shallow water, divers perform pipeline routing and inspections using routine procedures, but when pipes are buried beneath sediment deposits and must be tracked, they must employ specialized equipment, such as metal detectors and small air dredging systems. The two types of pipe located underwater are abandoned pipelines from old oilfields and newer pipelines, which require inspection in localized sections. Cable laying is a favorite among divers because of the speed at which cable can be buried. Getting the cable to shore requires physical protection (often light concrete mattresses) because of shallow water and tidal changes. Typical tasks associated with these diving operations include: verifying remote sensing results by inspecting localized areas along the proposed cable route, placing and securing concrete mattresses, installing I-tubes, and confirming the curve and cable elongation near the I-tubes (Underwater Magazine, 2002).

2. Typical Facilities – ROVs

Unless otherwise noted, the text and pictures in this section are from the Marine Technology Society, ROV Committee (2006c).

The ROVs can vary in size from small vehicles with TVs for simple observation up to complex work systems, which can have several dexterous manipulators, TVs, video cameras, tools and other equipment. Today's systems can be categorized by size, depth capability, onboard horsepower and whether it's all-electric or electro-hydraulic:

Source: rov.org

Small Vehicles. These "low-cost" ROVs (*LCROV*), used typically used for inspection and observation tasks, tend to be all electric and operate to water depths of up to 984 feet (300 meters). Demand has increased for small vehicles, due primarily to technical advances that have improved performance, especially at greater depths. Today LCROVs account for about 22 percent of all ROVs.

Source: rov.org

The ROVs in the "low cost" category typically sell for $10,000 to more than $100,000. The *Quest* LCROV (left), Hydrovision's *HyBall* (left, below), and others like them, cost less than larger work class ROVs. Today's LCROVs are used for science, marine recreation, search and rescue; dam, waterway and port inspection; training, shipping, nuclear inspection and coastal offshore inspection and observation tasks.

Source: rov.org

High Capability Electric ROVs. These are a fairly new class of ROV (born less than five years ago). These high capability units are small and electric but can cost close to $500,000. These new vehicles feature the latest in technology from Brushless DC motors (thrusters) to PC-based control systems and fiber optic telemetry systems. Electric ROVs can operate at depths of 20,000 feet (6,096 meters) and require much less power to do so; however, due to the electro-hydraulic design of the modern manipulator and work systems, these vehicles are not capable of performing heavy work.

Source: rov.org

The Perry Tritech *Voyager* (left), and electric inspection systems like it, employ state-of-the-art fiber optic telemetry and control systems. For more power and work capacity at depths of up to 9,842 feet (3,000 meters), one option is the Deep Sea Systems International *MaxROVER* (left, below), which is far less expensive to operate than electro-hydraulic systems.

Military and scientific programs use electric vehicles in part because of their quiet operation and because the vehicles meet their work requirements, which are less complex than those of the oil and gas industry. Work capabilities of the all-electric ROVs should continue to expand.

Source: rov.org

Source: rov.org

The ***Medium Size*** ROVs are electro-hydraulic vehicles, 20-100 horsepower, that handle moderate payloads and have limited through-frame lift capability. They weigh 2,205-4,410 lb (1,000-2,200 kg) and have payload capacities of 220-440 lb (100-200 kg). Most carry a single manipulator, but larger types can carry two. The through-frame lift capability of this class can exceed 992 lb (450 kg). With its origins in the early “eye ball” systems used for dive observation and inspections, this class of ROVs is the most widely used. Developed for work in high current conditions, carrying one or two manipulators, these ROVs provide drilling support, construction support, pipeline inspection and general "call out" work. Early ROVs, like Perry Tritech’s (originally AMETEK’s) *Scorpio* (left) and International Submarine Engineering’s *Hydra* vehicles, continue to be used today.

Vehicles of the same horsepower that have been built using the latest technology, providing greater reliability and efficiency, include the Perry Tritech *Viper*, *Super Scorpio* and *Scorpio Cobra*. These vehicles can operate at 3,281-foot (1,000-meter), the depth at which, until recently, the majority of drilling support has taken place.

Source: rov.org

Large, Work Class Vehicles are used in deepwater operations to 8,202 feet (2,500 meters). Vehicles in this class are 100-250 horsepower and have through-frame lift capabilities to 11,025 lb (5,000 kg). It is this feature that distinguishes large from medium class ROVs. Large, work class vehicles, such as Perry Tritech's *TRITON XL* (left), weigh 4,410-14,333 lb (2,000-6,500 kg).

These powerful ROVs, dubbed by the industry as "heavy work class vehicles," perform subsea tie-in operations on deepwater installations and carry large, diverless intervention systems.

Vehicles in this class can reach 8 feet (2.4 meters) or more in height after installation of a tool package.

The new generation of large work class ROVs operates at 9,842 feet (3,000 meters). Constructed on smaller frames, these ROVs provide the same power and lift capabilities of the large systems. Use of advanced technology keeps umbilical size to a minimum. Unlike “ultra deep” diving ROVs, which carry minimal power to minimize umbilical size, this new class carries between 75-100 horsepower. This work class is capable of performing heavy work at great depths. Because exploration is taking place in depths to 12,000 feet (3,658 meters) and production in depths of over 6,000 feet (1,829 meters), continued advancement in technology is required to meet the needs of the industry.

Source: rov.org

The ***Ultra-Deep Vehicle*** class consists of special-built ROVs that operate at 13,123 feet (4,000 meters) and beyond, tend to be lower in power to keep umbilical sizes small, and are used primarily for deep ocean research, search and salvage missions. For observing or attaching a salvage line, these ROVs do not require a large amount of power. Many ultra-deep systems, such as Monterey Bay Aquarium Research Institute's (MBARI’s) *Tiburon* (left), are designed for scientific research and allow for long-term observation in the very deep ocean. The military has developed ultra-deepwater vehicles for missions including assets salvage.


Source: rov.org

Towed Systems are vehicles towed behind ships and boats to perform underwater tasks. Typically, the vehicle is launched and towed at the desired depth by varying the length of the electromechanical cable. Today’s fiber optic tow cables provide broad bandwidth for the transmission of data from sensors and TVs.

Many towed vehicles, whether conventional towed systems or sleds, which hold either a magnetometer or fluxgate gradiometer for locating metallic objects, are capable of locating cables or pipeline on the seabed, buried or unburied. Seatec’s unique design (left) uses spinning rotors on the tow body to allow the vehicle to be guided along a pipeline.

Search and survey is a primary use of towed vehicles. Systems designed to survey the seafloor for mapping, search and salvage, route survey, pipeline survey, environmental survey, and more, range in size and weight from very small, shallow water bodies to large full ocean depth systems. Surveying equipment on board the towed system includes TV cameras, film cameras, digital cameras, laser imaging systems, side scan sonars, swath bathymetry sonars, multibeam sonars, sub-bottom profilers and magnetometers.


Source: rov.org

Bottom Crawlers and Plows. Bottom crawlers, primarily used for cable laying and burial, are usually tracked vehicles, or in some cases, employ an Archimedes screw. Perry Tritech's *Gator* (left) and other cable burial vehicles carry one of four tools for burying cable, depending on soil condition: water jets, chain trencher, wheel trencher or plow. These systems can be operated remotely or from a diver station onboard the vehicle. Crawlers are also used for sediment preparation, pipeline trenching and dredging.


Source: rov.org

Plows, which represent a large class of technologically sophisticated vehicles, are designed to work in varying soil conditions around the world. Weighing up to 80 tons (81,280 kg), resisting tow forces to 250 tons (254,000 kg) and capable of shallow water work to 4,921 feet (1,500 meters), plows vary greatly in size and design. Soil Machine Dynamics (SMD) Ltd.'s line of ploughs (left) illustrates the size of such systems.

Source: rov.org

Untethered, Autonomous Underwater Vehicles. Autonomous Underwater Vehicles (AUVs) are unmanned, untethered vehicles that house operations equipment and power sources onboard. The offshore oil and gas industry is considering the use of AUVs, such as the *Hugin*, used by Norway's Statoil, to lower the cost of operations in many areas.

Development of AUVs began in the early 1960s, with vehicles such as Rebikoff's *SEA SPOOK* and the Applied Physics Laboratory, University of Washington's *SPURV* (Self-Propelled Underwater Research Vehicle). Many early AUVs were large, inefficient and expensive. While advanced technology was applied to ROVs in the early 1980s, AUV technology lagged behind. Currently, more than 60 AUVs are under development or are operational in at least 12 countries. In the U.S., the military has invested hundreds of millions of dollars in AUV development. Japan plans to employ an AUV to reach the depths of the Mariana Trench, while the Jet Propulsion Laboratory, U.S. (JPL) is creating AUVs capable of boring through the ice and gathering data from the seas of other planets and moons. Technological breakthroughs from scientists at Florida Atlantic University, Massachusetts Institute of Technology and Woods Hole Oceanographic Institution are expected to reduce the high cost of AUV development.

3. Geographical Distribution

Unless otherwise noted, the text in this section is from the Marine Technology Society, ROV Committee (2006d).

There are several spots around the world where the majority of diving and ROV operations occur. They are primarily tied, of course, to the production of oil and gas. It is estimated that nearly 400 work class ROVs are in operation at this time servicing the oil and gas industry. The following bullets discuss the level of ROV activity around the world.

- **Europe –** Because the North Sea is a treacherous work environment with cold waters and severe wind and current conditions, it is an area of high ROV activity.

- **Asia -** Much activity stretches from Western Australia (Asia Pacific) to Malaysia and the South China Sea.

- **South America -** The majority of ROV operations in South America are occurring off Brazil, mainly in the oil rich Campos Basin. Petrobras continues the move to deeper water in the Campos Basin in depths up to 6,562 feet (2,000 meters).

- **North America –** As companies in the GOM are move into deeper waters, their reliance on ROVs increases.

- **Arctic –** ROVs assist with major developments in the icy deepwaters of the Barents Sea and Kara Sea.

- **Africa -** West Africa is a major hot spot with new leases available in water over 2,500 meters.

- **Other -** Other areas where ROVs are required are off Newfoundland, Alaska, the Caspian Sea off Azerbaijan, Trinidad, the West Coast of California, off Australia in the Indian Ocean, the Bass Strait in the Tasman Sea and the Mediterranean Sea off Egypt.

Three major diving and ROV contractors have locations throughout the GOM. In addition to the three companies shown in Table 3 below, a number of smaller companies have locations in places such as Mobile, Alabama; Gulf Shores, Alabama; Belle Chasse, Louisiana; Galliano, Louisiana; Harvey, Louisiana; and Slidell, Louisiana (Atlantic Communications, 2006).

Table 3

Location of Major Diving and ROV Contractors

	Helix Energy Solutions	Global Industries	Oceaneering
Louisiana			
Carlyss		✓	
Port of Iberia	✓	✓	
Fourchon	✓		
Morgan City			✓
New Orleans	✓		
Texas			
Houston	✓	✓	✓
Dallas	✓		

Source: SEC, 2006h; SEC, 2006i; SEC 2006j.

4. Labor Force

The Bureau of Labor Statistics provides labor statistics for a generalized category of "commercial divers." The BLS estimates that 2,680 commercial divers are employed in the U.S., with the highest concentration located in Florida, Virginia and South Carolina. According to 2006 salary estimates, commercial divers had average annual earnings of $45,410 (U.S. Dept. of Labor, BLS, 2007b).

The BLS breaks out employers of commercial divers into five categories: other support services, other heavy and civil engineering construction, highway, street and bridge construction, support activities for water transportation and amusement parks and arcades.

Often divers have to piece together short periods of work for a number of employers or work on contracts. For example, construction divers rarely have a project that supplies more than 90 consecutive days of work. Therefore, self-employment is quite common among commercial divers.

All three major diving companies report that the ability to attract and retain skilled employees is an important factor in their success. Global Industries, Ltd. reports that their ability to expand operations is impacted by their ability to increase their labor force. The demand for skilled workers in the underwater construction industry is high, and supply is limited. As a result of the cyclical nature of the oil and gas industry as well as the physically demanding nature of the work, skilled workers may choose to pursue employment in other fields. A significant increase in the wages paid or benefits offered by competing employers could result in a reduction in one company's skilled labor force, increases in employee costs, or both. If either of these events occurs, Global Industries' operations and results could be materially adversely affected (SEC, 2005g).

5. Typical Firms

The underwater contracting industry is divided into two segments, large corporations operating in all water depths with their own support fleet of vessels, and small organizations targeting surface diving projects, with some ownership of vessels.

The Atlantic Communications' Gulf Coast Oil Directory lists a total of 46 Diving and ROV contractors in its directory. Of these 46, 26 are reported with a range for the number of employees. As shown in Figure 12, the majority of companies (17 companies) in the GOM area are smaller with a range of 1 to 25 employees. Only two companies, Helix Energy Solutions Group Inc and Oceaneering International have over 500 employees.

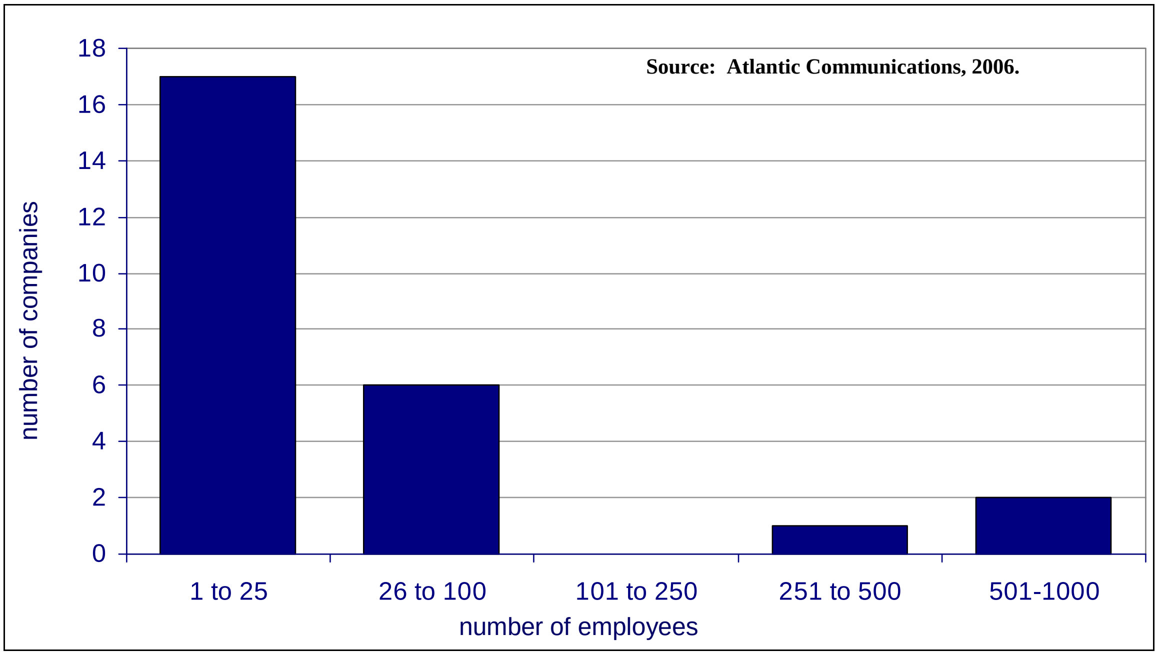


Figure 12. Number of employees at GOM-based diving and ROV contractors.

There are three major competitors in the U.S. GOM. These companies are Helix Energy Solutions Group Inc. (formerly Cal Dive Inc.), Global Industries, Ltd, and Oceaneering International, Inc. (SEC, 2006i).

The companies report that the marine contracting industry is highly competitive. Price is a factor, however, the ability to deploy modern equipment and techniques, acquire specialized vessels, attract and retain skilled personnel, and demonstrate a good safety record is also important (SEC, 2005g and SEC, 2005h). Competition for ROV services has historically been based on equipment availability, location of or ability to deploy equipment, quality of service and price. The ability to develop improved equipment and techniques and to attract and retain skilled personnel is also an important competitive factor in the ROV market (SEC, 2006j).

Helix Energy Solutions Group Inc. is the market leader in the diving support business in the GOM OCS. Their services include construction, inspection, maintenance, repair and decommissioning. Helix owns a fleet of 26 vessels, including 23 surface and saturation diving support vessels capable of operating in water depths of up to 1,000 feet, as well as three shallow-water pipelay vessels (SEC, 2006i). In August 2005, Helix acquired five diving support vessels, two shallow water pipelay vessels and a portable saturation diving system from Torch Offshore. In November 2005, Helix acquired all of Stolt Offshore's assets operating in the GOM. Stolt Offshore was previously Helix's major competitor in the GOM. In January 2006, Helix also acquired Stolt's shallow water pipelay vessel (SEC, 2005h).

Oceaneering International owns the largest and most technically advanced fleet of ROV's in the world. Oceaneering owns 186 work-class ROV's and estimates that it has a market share of 36 percent. Oceaneering's major customers accounted for 23 percent of consolidated revenue. Four of their top five customers are oil and gas exploration and production companies. The other top-five customer was the U.S. Navy (SEC, 2006j).

In March 2004 it was estimated (most recent estimate) that approximately 435 work- and heavy work-class ROV systems were active in the world (see Table 4), representing approximately $1.5 billion in capital assets. The majority of these systems are owned by seven major commercial operators (totaling approximately 405 systems). Another 30 systems are operated by smaller companies, academia, and other non-commercial organizations (Marine Technology Society, ROV Committee, 2006e).

Table 4

Work Class ROV Systems Operating Worldwide

Work Class ROV Systems Operating Worldwide	
Oceaneering International, Inc.	152
Subsea 7 (Halliburton/Subsea)	78
Stolt (Stolt/Comex/Seaway)	35
Sonsub (Saipem)	59
Fugro (ex Racal/Thales)	36
Canyon (Cal Dive)	23
Technip-Coflexip	22
Others- Approximate number of specialty systems, plus systems operated by smaller companies.	30
Total Systems	**435**

Source: Marine Technology Society, ROV Committee, 2006e.

The health of the ROV industry is closely tied to the level of activity in the offshore oil and gas industry. The majority of work class ROV systems are employed by offshore hydrocarbon exploration and production companies. The second most significant market is the support of installing and maintaining undersea cable systems. The split between these two markets can be difficult to define because of the dual use of many systems. However, it is estimated that of the 400 commercial systems deployed, about 85 percent is for hydrocarbon production and 15 percent is for undersea cable support (Marine Technology Society, ROV Committee, 2006e).

C. Industry Trends and Outlook

1. Trends

The underwater contracting industry is "substantially dependent on the condition of the oil and gas industry, and in particular, the willingness of oil and gas companies to make capital expenditures for offshore exploration, drilling and production (SEC, 2006i)." The level of these capital expenditures by and large is dependent upon the forecast of oil and gas prices. The factors that influence oil and gas prices include but are not limited to (SEC, 2006i):

- worldwide economic activity;
- economic and political conditions in the Middle East and other oil-producing regions;
- coordination by OPEC;
- the cost of exploring for and producing oil and gas;
- the sale and expiration dates of offshore leases in the United States and overseas;
- the discovery rate of new oil and gas reserves in offshore areas;
- technological advances;
- interest rates and the cost of capital;
- environmental regulations, and
- tax policies.

During the year 2005, Helix Energy Solutions Group's revenues increased 47 percent to $799.5 million. Of the $256.1 million increase, 50 percent (126.4 million) was generated by the Company's Deepwater Contracting segment. Its Shelf Contracting segment generated almost 40 percent of that increase. The Company attributes the increase in the Deepwater Contracting segment to improved market demand resulting in significantly improved utilization rates and contract pricing. The increase in the Shelf Contracting segment's revenues can also be attributed to improved market demand, but mostly as a result of damages to structures sustained from Hurricanes Katrina and Rita (SEC, 2005h).

Helix Energy Services experienced even larger increases in 2006. Revenues increased by 71 percent compared to 2005. Their Contracting Services revenues increased primarily due to improved market demand and the addition of acquired vessels. Shelf Contracting revenues increased because of acquired vessels in addition to improved market demand – much of which was the result of damages from the 2005 hurricanes. This resulted in improved utilization rates and increased pricing for services (SEC, 2006i).

Oceaneering also saw increased revenues in 2005 and 2006. About 90 percent of Oceaneering's revenue is from services provided to the oil and gas industry. In 2005, revenue increased by 28 percent (SEC, 2005i). The Company's ROV business accounted for 41 percent of this increase. The Company attributes this increase to increased utilization rates and a larger average work-class fleet size (SEC, 2005i).

In 2006, Oceaneering increased its revenue by 28 percent. Thirty percent of this increase was in the ROV segment. This increase was primarily a result of an improvement in average pricing and growth in days on hire for the work-class fleet. The Subsea Projects segment continued to benefit from increased demand, which resulted in improved rates and high utilization for Oceaneering's seven vessels and diving assets (SEC, 2006j).

Oceaneering is anticipating that ROV demand will continue and in 2006 it invested in a new generation Saturation Diving System (SAT) (Natural Gas Week, 2005; and SEC, 2006j). The three-man SAT system was built in response to the demand for underwater construction and repair work in the GOM following Hurricanes Ivan, Katrina and Rita. The ROVs and SAT system can also be used to replace aging infrastructure in the GOM. Also in response to increasing demand to support deepwater drilling and future construction and maintenance work, the company added 82 ROVs to its fleet from 2007 through 2009 (SEC, 2009b).[3] The company expects its operating income to increase through 2010 (SEC, 2009b).

2. Hurricane Impacts

In addition to the steady work created by increased offshore activity, as well as removal work, the hurricanes of 2004 and 2005 provided a boom for underwater contractors.

In 2004, Hurricane Ivan mangled miles and miles of seafloor pipe. In 2005, after Hurricanes Katrina and Rita, companies like Helix and Oceaneering were in high demand inspecting and repairing damage (Elliot, 2005). Helix's fleet of shallow and deepwater dive support and construction vessels had been fully utilized prior to the hurricane (Spencer, 2005). After Hurricane Katrina, shares for Helix (then Cal Dive International) jumped $3.02, nearly 6 percent. Shares of Global Industries based in Carlyss, Louisiana, increased nearly 13 percent (Ivanovich, 2005).

John Huff, of Oceaneering International, said his company began to see an increase in demand for both subsea projects and ROV almost immediately after Hurricane Katrina. "We've deployed all our available ROV equipment in the (Gulf) and we're trying to bring in additional equipment from our worldwide system (Spencer, 2005)."

For Global Industries, Ltd., revenues in its Global Divers and Marine Contractors Division increased 70 percent for the GOM. Revenues in its Offshore Construction Division in the GOM increased 147 percent in 2005 from $65.1 million to $160.6 million. Activity and pricing had already begun to improve in the fourth quarter of 2004 after Hurricane Ivan and continued to increase during the first two quarters of 2005. Demand for the services of the Company's Gulf of Mexico segment increased even further during the third and fourth quarters of 2005 due to the effects of Hurricanes Katrina and Rita, and the Company initiated numerous projects for

[3] During this time, 20 units were disposed.

hurricane repairs on a day-rate basis during these quarters. The number of diver-days increased 64 percent in 2005 and utilization of Global Industries' six major construction vessels in the Gulf of Mexico during 2005 was 74 percent compared to seven vessels achieving 20 percent in 2004. (SEC, 2006h).

3. Outlook

In June 2009, Oceaneering International reported that over the past few years, it has had a high level of demand due to high prices for oil and gas as well as the damage caused by the 2004 and 2005 hurricanes. Oceaneering started experiencing a decline in hurricane-related repair work during the first half of 2008 as work was completed, but then experienced yet another increase at the end of 2008 after Hurricanes Gustav and Ike. The damage repair work from the 2008 hurricanes continued into 2009. Oceaneering expects its ROV and subsea operating income to increase through 2010, due to increases in days on hire (SEC, 2009b).

According to a 2007 report by energy-analysts Douglas-Westwood, since 2002 expenditure on work-class ROV operations has more than doubled, and further strong growth is expected over the next five years – leading to a total market of some US$1.46 billion per year by 2011. "We estimate that, in 2006, some US$827 million was spent on the operation of work-class ROV units worldwide – an increase of some 86 per cent on the 2002 value. We forecast that this will increase by a further 76 per cent to a 2011 value of US$1,458 million – a [*sic*] more than a tripling of the market over the 10 year period. Regionally, we expect North America and Western Europe to account for the largest proportion of ROV activity – some 50 percent of the total units we expect to operate in 2007 are associated with these regions (Offshore Shipping Online, 2007)."

D. Chapter Resources

Atlantic Communication's Gulf Coast Oil Directory
Includes a wide range of data from company name, address, web and email addresses to contact names with titles, direct phone numbers, and email addresses all organized alphabetically by industry categories. Also included is "Company Detail" information such as company size, revenue, areas operated in last 12 months, operations onshore or offshore, and stock information for publicly traded companies.
http://www.oilonline.com/store/directory.asp

U.S. Department of Labor, Bureau of Labor Statistics
Occupational Employment Statistics summary is available annually for selected occupations.
http://www.bls.gov/oes/

U.S. Securities and Exchange Commission
Quarterly and annual reports of operations for publicly traded companies are filed with the Securities and Exchange Commission.
http://www.sec.gov/edgar/searchedgar/companysearch.html

III. MUDS, DRILLING FLUIDS AND LUBRICANTS

A. Description of Industry and Services Provided

Drilling mud, also called drilling fluid, is a mixture of natural clays and heavy minerals, and small amounts of other chemicals suspended in water or an organic liquid. Mud is an essential part of any oil and gas production operation and is used primarily to lubricate, clean and cool the drill bit during operations. However, drilling mud also serves other purposes as well, including: 1) as a transfer medium for removing cuttings produced by the drill bit at the bottom of the hole and carrying them to the surface; 2) as a method of maintaining hydrostatic equilibrium that prohibits fluids and gas in the formation from entering the well bore (which causes the well to flow, kick or blow out); and 3) as a support of the wall of the hole, which helps prevent the hole from collapsing. In short, there would be no drilling without these important fluids.

Mud is pumped down a hole where it is applied to the drill bit, and then is pumped back up the hole in the annular space between the drill string and the sides of the hole to the surface. Metal cuttings are carried to the surface and are then filtered out and the mud enters a mud pit, where it is treated and is re-used. Offshore facilities have drilling mud transported to their rigs via offshore supply vessels (OSVs).

The efficiency of a drilling fluid depends on physical properties such as density (weight), viscosity, plastic viscosity, yield point, gel strength, solid contents, and sand. Wells in the GOM are considered “deep wells” if they are drilled beyond 15,000 feet, where high pressures, high temperatures, and high flow rates are the norm and require drilling fluids able to withstand these enormous pressures. (IPAA, 2004)

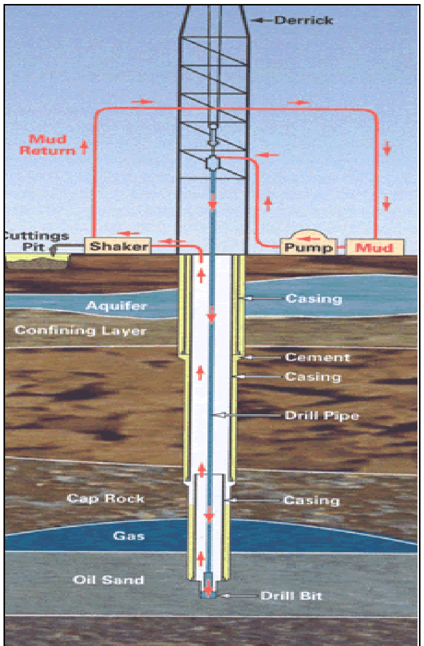
Drilling muds are made of bentonite and other clays, and/or polymers, mixed with water to the desired viscosity (Wills, 2000). Three types of drilling muds are used offshore: water-based drilling mud (WBM), oil-based drilling mud (OBM), and synthetic-based drilling mud (SBM). The OBMs are best for drilling, but have the potential to cause damage to marine communities. WBMs and cuttings are less toxic for the environment and until recently were the only types of drilling wastes permitted for ocean discharge in U.S. waters. The down side of WBMs is that they do not work well, particularly when drilling a very deep or deviated well. SBMs were developed to combine the favorable drilling properties of OBMs with the low toxicity of WBMs. In its liquid phase, SBMs are a synthetic organic chemical (usually an ester or olefin), which do not pose as serious environmental concerns as OBMs (Battelle.org, 2004).

The SBMs have only been used in the last 15 years, primarily in the Gulf of Mexico and the North Sea, and though their cuttings are discharged into the ocean, the drilling mud itself is recycled. Research and development of these materials is focused on improving the synthetic drilling fluids to withstand high solids content and temperatures while meeting environmental discharge standards (Battelle.org, 2004).

Over the years individual drilling companies have devised formulations of muds to deal with specific types of drilling. These mud "recipes" are based on long experience, arcane knowledge and special skills, and are closely guarded secrets, making it difficult to determine if particular types of muds are hazardous. However, each product must have on file with the government a

Material Safety Data Sheet in which hazardous ingredients, physical data, reactivity data, health hazard, first aid requirements, etc. are included (Wills, 2000).

It may vary greatly, but the cost of the drilling fluid is typically about 10 percent of the total cost of well construction. Good mud engineers are essential, their competence has a large impact on the cost of a drilling project. (Brandt/EPI, 1996). Use of drilling muds is as important for offshore production as it is onshore. Once the drilling bit encounters sediments it is essential that muds be employed (see Figure 13).



Source: USDOE, DWMIS, 2007b.

Figure 13. Mud injection process.

B. Industry Characteristics

1. Typical Facilities

Waste Disposal

In both onshore and offshore applications it is essential that drilling muds are cleaned and that unusable wastes are disposed of properly. Generally, the cost of treating and discharging drilling wastes is lower than the cost of hauling them back to shore or applying other management options. The cost of transporting wastes is eliminated when wastes are discharged. When offshore discharge is an option approved by the regulatory agency, most operators choose that option (USDOE, DWMIS, 2007a).

In early offshore oil and gas development, for the most part, drilling wastes were discharged straight from the platforms to the ocean. However, during the 1970s and 1980s, evidence began to mount that some of these discharges could have damaging effects on local ecology, particularly in shallow water. Limited environmental damage was likely to occur from WBMs, but when operators were using OBMs on deeper sections of wells, the resulting cuttings piles created impaired zones beneath and adjacent to the platforms. Piles of these oil-based cuttings affected the local ecosystem by (1) smothering organisms; (2) direct toxic effect of the drilling waste; and (3) anoxic conditions caused by microbial degradation of the organic components in the waste (USDOE, DWMIS, 2007a). The current regulations lessen the impacts of permitted discharges. Although WBMs and limited amounts of SBMs retained on cuttings can still be discharged, discharges of OBMs have been outlawed completely (USDOE, DWMIS, 2007a).

Usually, the most affected area is the seafloor immediately below the rig (see Figure 14). The impacts are short-term (a few years) as the accumulated drill cuttings break-up and spread out with time, while components of drilling fluids, such as mineral oil, can decompose and dissipate in the environment (CNSOPB, 1998).

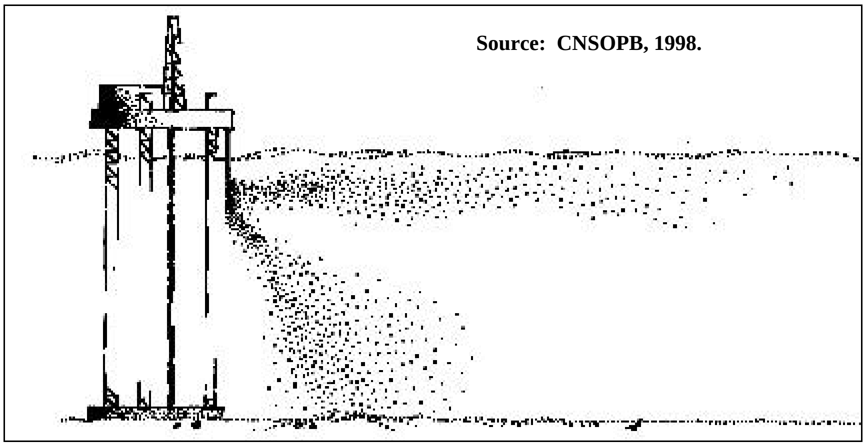


Figure 14. Typical dispersion of ocean discharge.

Once released into the water, fine particles from the discharges become suspended and move with the water, following the currents. The farther the discharge moves, the more dilute and less harmful it becomes. Studies examining the effects of exploratory drilling on the U.S. portion of Georges Bank found that small amounts of some drilling muds (in particular the weighting agent barite) had been transported as much as 60 km from the well site (CNSOPB, 1998). Sea scallops and other filter feeding organisms are particularly sensitive to fine particles (CNSOPB, 1998).

By 1996, a number of international agreements had been made that outlawed the discharge of OBMs containing diesel or mineral oils. This was the result of findings that large areas of seabed around hundreds of offshore installations had been adversely impacted by oil based muds and cuttings (OSPAR. 1992. *PARCOM Decision 92/2 on the Use of Oil-based Muds. See also:* OSPAR. 1996. *PARCOM Decision 96/3 on a Harmonized Mandatory Control System for the Use and Reduction of the Discharge of Offshore Chemicals;* OSPAR. 1997. *PARCOM Decision 97/1 on Substances/Preparations Used and Discharged Offshore;* OSPAR. 1999. *List of Substances / Preparations Used and Discharged Offshore Which Are Considered to Pose Little or No Risk to the Environment (PLONOR)*) (Wills, 2000).

In the late 1970s the U.S. Environmental Protection Agency (USEPA) began to restrict ocean discharges of drilling muds and cuttings through the Clean Water Act, Effluent Limitation Guidelines, and National Pollutant Discharge Elimination System (NPDES) permits. This included the prohibition of the discharge of OBMs and OBM wetted-cuttings. In 1993, the USEPA adopted enhanced national discharge standards that established additional requirements for wells drilled in federal waters at least 3 miles from shore and prohibited discharges within states' territorial seas (with the exception of Alaska) (USDOE, DWMIS, 2007a).

Synthetic-based muds (SBMs) were developed and promoted to offer drilling performance similar to that of OBMs, but much closer to WBMs in terms of environmental impact. The USEPA's discharge regulations of 1993 did not consider SBMs. Consequently, there was considerable uncertainty about the use and discharge of SBMs offshore. Various federal agencies and numerous companies and industry associations worked together following an innovative expedited rulemaking process to finalize new effluent limitations guidelines (ELGs) for SBMs in 2001. Those guidelines were included in NPDES permits to allow for discharge of SBM cuttings, subject to various restrictions, but prohibit the discharge of drill muds themselves (USDOE, DWMIS, 2007a). SBMs are expensive so they are cleaned and recycled. SBMs use results in far less wastes and allows for faster drilling. Based on the scientific evidence, the discharge of very low quantities of SBMs adhered to the cuttings allowed by the current regulations appears to have minimal and brief impact on the ocean environment (USDOE, DWMIS, 2007c).

Treatment Processes Prior to Discharge

Solids-control equipment is used to remove drill cuttings from the fluid system once it is brought to the surface, allowing the drilling fluid to be cleaned and recirculated. Solids are normally separated from the drilling fluid using one or a combination of the following: balanced elliptical and linear-motion shale shakers, desanders, desilters, hydroclones, mud cleaners and centrifuges (see Figure 15). Each successive shale shaker uses finer mesh screen to collect smaller and smaller particles. The liquid mud passes through the screens and is returned to mud pits on the platform for reuse. If the recycled mud still has fine particles that could interfere with drilling performance, the muds are treated using mud cleaners or centrifuges to remove the remaining particles (USDOE, DWMIS, 2007b).

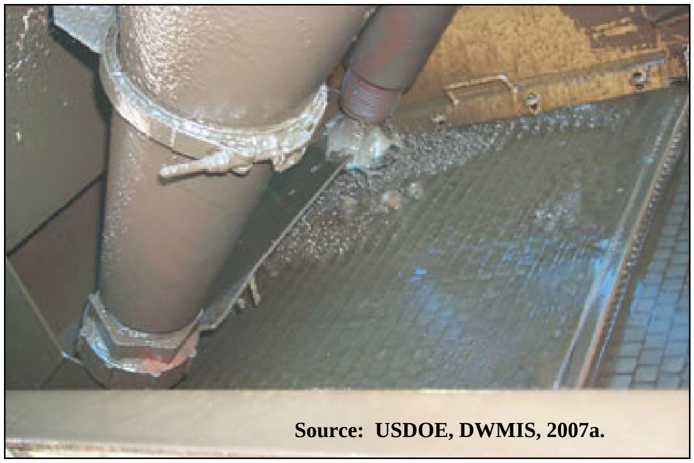


Figure 15. Shale shaker.

If the solid cuttings that are collected by the shakers meet the discharge standards then they are generally discharged. However, if the cuttings do not meet the discharge standards they are collected and returned to shore or injected for disposal (see Table 5) (USDOE, DWMIS, 2007a).

Table 5

Summary of U.S. Offshore Requirements for Drilling Wastes

Baseline Requirements

- No discharge of free oil (using a static sheen test) or diesel oil
- Acute toxicity must have a 96-hour LC50 > 30,000 ppm
- Metals concentrations in the barite added to mud must not exceed:
  - 1 mg/kg for mercury
  - 3 mg/kg for cadmium
- No discharge of drilling wastes allowed within 3 miles of shore (except for Alaskan facilities in the offshore subcategory)

Additional Requirements for Synthetic-Based Muds (SBMs)

- SBMs themselves may not be discharged
- Cuttings coated with up to 6.9% SBMs may be discharged
  - Ester SBMs can have up to 9.4% SBM on cuttings
- Polynuclear aromatic hydrocarbon (PAH):
  - Ratio of PAH mass to mass of base fluid may not exceed 1×10^{-5}
- Biodegration rate of chosen fluid shall be no slower than that for internal olefin
  - Base fluids are tested using the marine anaerobic closed bottle test
- Base fluid sediment toxicity shall be no more toxic than that for internal olefin base fluid
  - Base fluid stocks are tested by a 10-day acute solid-phase test using amphipods (*Leptocheirus plumulosus*)
  - Discharged cuttings are tested by a 4-day acute solid-phase test using amphipods (*Leptocheirus plumulosus*)
- No discharge of formation oil
  - Whole muds are tested onshore by GC/MS analysis
  - Discharged cuttings are tested for crude oil contamination by fluorescence method
- Conduct seabed survey or participate in industry-wide seabed survey

Source: USDOE, DWMIS, 2007a.

Technology does exist to contain contaminated drill cuttings in underground reservoirs. This can be done either by installing equipment on each rig, platform or drill ship, or by shipping the wastes to a port for onshore re-injection. Or, operators can consider alternative disposal methods such as treatment, recycling, incineration and/or landfill onshore. Efforts are being made to reduce the volume of drilling wastes produced and to minimize their effects on the sea. Among these efforts include: using less toxic alternatives, including less reliance on SBM and more effective WBM; shipment of wastes ashore; and re-injecting cuttings offshore in an injection well (Wills, 2000).

Cuttings Re-Injection (CRI)

Cuttings re-injection is a form of waste disposal where drill cuttings and other wastes are mixed into slurry filled with water and pumped down an injection well at a high pressure. The hydraulic pressure can be used to help make the injection easier by breaking down particles.

Re-injection of drill cuttings normally begins by collecting the wastes and transporting them to a processing station where they are milled and sheared in water. The resultant slurry is then pumped, usually by batch nature, at low rates (2.0 – 8.0 barrels/minute) into a disposal well.

Sequential annulus injection is a method used where cuttings from the well being drilled are injected into the annulus of the most recently completed well (Orszulik, 2008). This method can be advantageous, mostly because of its flexibility and because it does not require drilling a dedicated disposal well. However, in general these wells are often ruled out because of their high cost (Wills, 2000).

2. Geographical Distribution

Drilling fluids suppliers can be found wherever drilling activity is taking place, and near all on-shore supply bases along the Gulf Coast.

3. Labor Force

The drilling fluids industry employs many workers as laborers as well as specialized workers such as drilling fluids or mud engineers, who often work for the company selling the chemicals for the job and are specifically trained with those products. Independent mud engineers are still common as well. A mud engineer has a general salary of $57,000 (USD) (OilCareer.com, 2007). Mudloggers monitor gas from the mud and collect wellbore samples to be analyzed by geoscientists to gain more information about rock structures and the presence of hydrocarbons. Entry-level salaries for mudloggers range from $30,000 (USD) to $45,000 (USD) with average salaries for experienced personnel ranging from $45,000 (USD) and $55,000 (USD) for onshore positions, and up to $70,000 (USD) for offshore experience (Nova Scotia Department of Energy, 2007).

In offshore drilling, with new technology and high total day costs, wells are being drilled extremely fast. Having two mud engineers makes economic sense to prevent down time due to drilling fluid difficulties. Two mud engineers also reduce insurance costs to oil companies for environmental damage that oil companies are responsible for during drilling and production.

4. Typical Firms

The Atlantic Communications' Gulf Coast Oil Directory lists a total of 61 Drilling Mud and Services companies in its directory. Of these 61, 39 report their number of employees. As shown in Figure 16, the majority of companies (23 companies) in the GOM area are smaller with a range of 1 to 25 employees. Only two companies, Cabot Specialty Fluids and Halliburton, are reported as having over 500 employees.

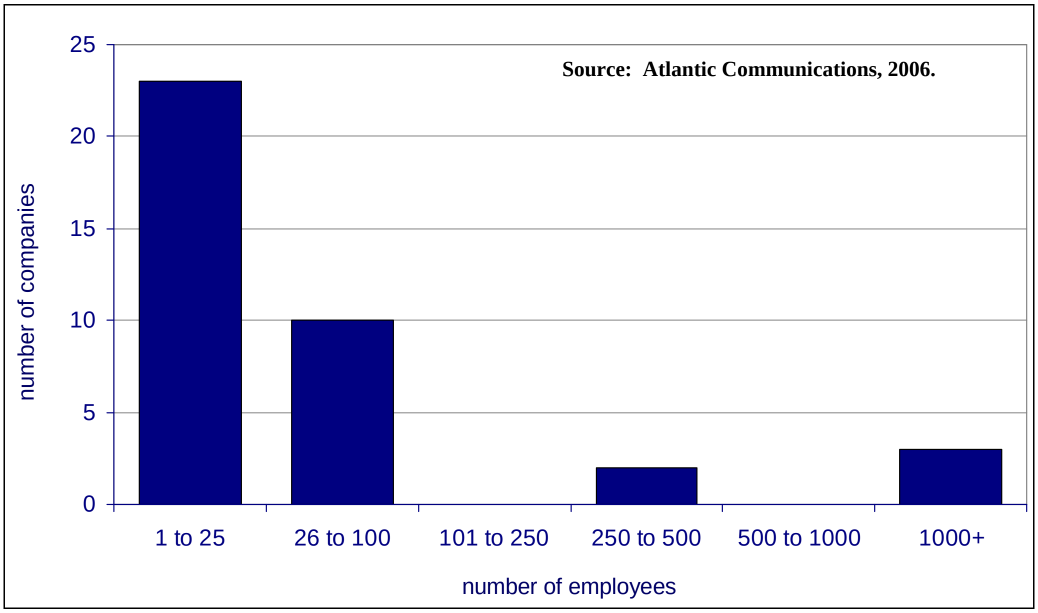


Figure 16. Number of employees at GOM-based drilling mud and services companies.

The drilling fluids, or muds, industry has always been very competitive, and the market is driven by price and performance. As shown in the figure above, the majority of competitors in the GOM are smaller, private companies. There are however, large integrated major companies such as Cabot, Halliburton, and Newpark Resources. Generally, competition is based on several factors, including well site engineering services, product quality and availability, technical support, service response, and price.

Perhaps the largest company in this segment is Halliburton, a $13.5 billion conglomerate of which fluid services is just one of six business units. Based in Houston, the Fluid Systems division had revenues exceeding $3.5 billion in 2006 with $1.8 billion attributed to the North America market (SEC, 2006k).

The Specialty Fluids Business of Cabot Corporation produces and markets cesium formate as a drilling and completion fluid for high pressure and high temperature oil and gas well operations. Cesium formate is rented to customers for use in drilling operations on a short-term basis. After completion of a job, the customer returns the fluid to Cabot and it is reprocessed for use in subsequent well operations. Any fluid that is lost during use is paid for by the customer. The rates to be charged for the rental and any loss are negotiated and agreed to prior to the beginning of the job. Usually, approximately 15 percent of the cesium formate used in an operation is lost (SEC, 2006l).

Newpark Resources is a diversified oil and gas industry supplier with three operating segments, including fluid systems. Its customers are primarily major and independent oil and gas exploration and production (E&P) companies. During the year ended December 31, 2006, approximately 43 percent of Newpark's revenues were derived from its 20 largest customers. No one customer accounted for more than 10 percent of its consolidated revenues. Typically, Newpark performs services either under short-term standard contracts or under longer term service agreements. As most agreements with Newpark's customers are cancelable upon short notice, its backlog is not significant (SEC, 2006m).

Like other competitors, all of these companies have large research and development practices to continuously improve existing drilling fluids, and to produce new products that improve drilling efficiency and meet environmental regulations.

C. Industry Trends and Outlook

1. Trends

As noted by Newpark Resources in its recent annual SEC filing, several factors drive demand for services, including: (i) supply, demand and pricing of oil and gas commodities which drive E&P development activity; (ii) a trend toward deeper and otherwise more complex drilling that drives drilling fluid consumption and increasing technical requirements; (iii) the continued trend of E&P development into more environmentally sensitive areas; and (iv) the use of increasingly complex drilling techniques that tend to generate more waste. Demand for most services is related to the level, type, depth and complexity of oil and gas drilling (SEC, 2006m). The most widely accepted measure of activity is the Baker Hughes Rotary Rig Count, which as shown in Figure 4 has been rising since early 2002 in response to strengthening oil and gas prices. Figure 5, however, shows that drilling in the GOM has decreased in recent years.

In 2006, Newpark reported revenues from its fluid systems division of $481 million ($302 million from U.S. sales), up from $384 million in 2005. Newpark reported that the revenue growth was due to new market penetration and servicing of more complicated wells that generate higher revenues and improved margins (SEC, 2006m).

Halliburton's North America revenue for 2006 grew $1.6 billion compared to 2005. This growth was primarily led by production enhancement services, where it helps customers optimize the production rates from the wells by providing stimulation services. Despite having downsized its GOM operations due to its downturn in 2002-2003, Halliburton continues to have a significant presence in the region and is positioned to meet increasing customer demand. As a result, revenue from the Gulf of Mexico in 2006 was up 32 percent year-over-year, which contributed to a 152 percent increase in operating income in the Gulf of Mexico (SEC, 2006k).

Halliburton's Fluid Systems segment operating income increase compared to 2005 resulted from 54 percent growth from Baroid Fluid Services and 43 percent growth in operating income from cementing services. Baroid Fluid Services operating income benefited primarily from increased activity and improved pricing in the United States and increased activity in Asia. Cementing services results increased predominantly in the United States due to increased activity and new contracts along with increased activity in Europe (SEC, 2006k).

2. Hurricane Impacts

As in every other offshore drilling and production segment, the 2005 hurricanes affected the drilling muds industry due to well shut-ins and damaged infrastructure. In the case of Halliburton, the hurricane related delays cost about $33 million of lost operating income (Kelly, 2005). Much of the increased activity in 2006 was the result of repair work to existing wells, as well as new drilling operations in the GOM. Other drilling fluid companies were also impacted, but most are operating at or near pre-storm levels.

3. Outlook

As in other exploration and production-associated segments, the drilling fluids business is subject to the cyclical nature of the oil and gas industry as a whole. With current high oil and gas prices and the move to deepwater wells, the demand for drilling fluid business is great and, ever-tightening restrictions associated with OBM, WBM, and SBM intensify the search for better, more environmentally friendly muds.

In its 2008 SEC filing, Halliburton reviewed the downturn in drilling and production activities in North America. The filing discusses falling rig counts and cuts in capital expenditures (especially related to conventional and shallower drilling activity) (SEC, 2008a). Falling natural gas prices, excess equipment supply and customer requests for discounts on work are all signs of market weakness. Halliburton also expects “severe margin contraction to occur worldwide starting in the first quarter of 2009.”

Similarly, in a 2009 quarterly filing, Newpark Resources explained that the current economic environment, the instability of credit markets and declines in oil and gas prices have significantly impacted drilling activity. This decline has negatively impacted Newpark’s operating results. Newpark expects this trend to continue for the remainder of 2009 and 2010. In response to these declines in activity and increased price competition, Newpark has attempted to cut costs by reducing their workforce, capital expenditures, discretionary spending and salaries (including the temporary elimination of 401(k) matching for U.S. employees) (SEC, 2009c).

D. Chapter Resources

Atlantic Communication’s Gulf Coast Oil Directory
Includes a wide range of data from company name, address, web and email addresses to contact names with titles, direct phone numbers, and email addresses all organized alphabetically by industry categories. Also included is "Company Detail" information such as company size, revenue, areas operated in last 12 months, operations onshore or offshore, and stock information for publicly traded companies.
http://www.oilonline.com/store/directory.asp

U.S. Securities and Exchange Commission

Quarterly and annual reports of operations for publicly traded companies are filed with the Securities and Exchange Commission.

http://www.sec.gov/edgar/searchedgar/companysearch.html

IV. AIR TRANSPORT

A. Description of Industry and Services Provided

The offshore oil and gas industry depends on support from helicopter transportation services to move equipment and personnel. Helicopters can provide a cost effective method of transporting workers and supplies to and from specialized vessels, drilling rigs, production platforms and pipeline terminals. Generally used to reach platforms of intermediate to long distances from the shoreline, they are used for both routine excursions and time sensitive operations. Helicopters may also be tasked to patrol pipelines for signs of leaks or damage.

B. Industry Characteristics

1. Typical Facilities

Most service providers maintain a mix of small, medium and large sized aircrafts to meet the diverse needs of the offshore industry. A few people making a short, daytime trip in good weather to a small production site would need only a small helicopter carrying four to seven passengers, whereas shift change crews, trips to distant locations, bad weather, international markets or large loads would require the use of medium sized craft carrying up to 13 passengers or even larger ones holding up to twenty-five. As production activity moves ever farther offshore, into the deepwater of the Gulf of Mexico, the need for medium and large helicopters will continue (SEC, 2006b).

The following descriptions provide some examples of the helicopters available to service the Gulf. Unless otherwise noted, the pictures and descriptions of the following helicopters are from the PHI, Inc website (PHI, Inc., 2006).

Small-Sized Helicopters

Smaller sized helicopters include the **Boelkow BO-105** which have a range of 330 miles, an average cruise speed of 135 miles per hour and a capacity of four passengers and one pilot.

The **Bell 407** is also a smaller sized helicopter. It has a range of 375 miles and an average cruise speed of 150 miles per hour. It has a capacity of 1 passenger and one pilot.

Medium-Sized Helicopters

The **Sikorsky S-76** is medium sized helicopter with a range of 450 miles, an average speed of 160 miles per hour and a capacity of 12 passengers and two pilots.

The **Bell 412** is medium sized helicopter with a range of 335 miles, an average speed of 135 miles per hour and a capacity of 13 passengers and two pilots.

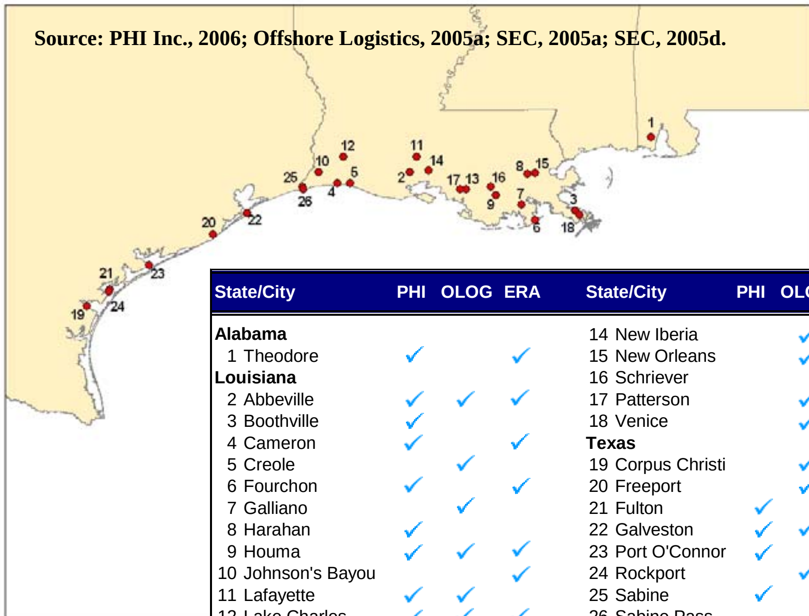
Large-Sized Helicopters

The **Bell 214-ST** is a large size helicopter. It has a range of 450 miles and an average cruise speed of 155 miles per hour. The Bell 214-ST has a capacity of 18 passengers and two pilots.

The **Sikorsky S-92** is a large size helicopter. It has a range of 516 miles, an average cruise speed of 175 miles per hour and a capacity of 19 to 24 passengers and two pilots.

2. Geographical Distribution

Helicopter service providers typically have large fleets that are geographically dispersed along the Gulf shore to allow for quick service to all locations in the Gulf. Figure 17 shows the locations in which the largest three providers operate. Almost any location in the Gulf of Mexico can be reached by any one of these locations.



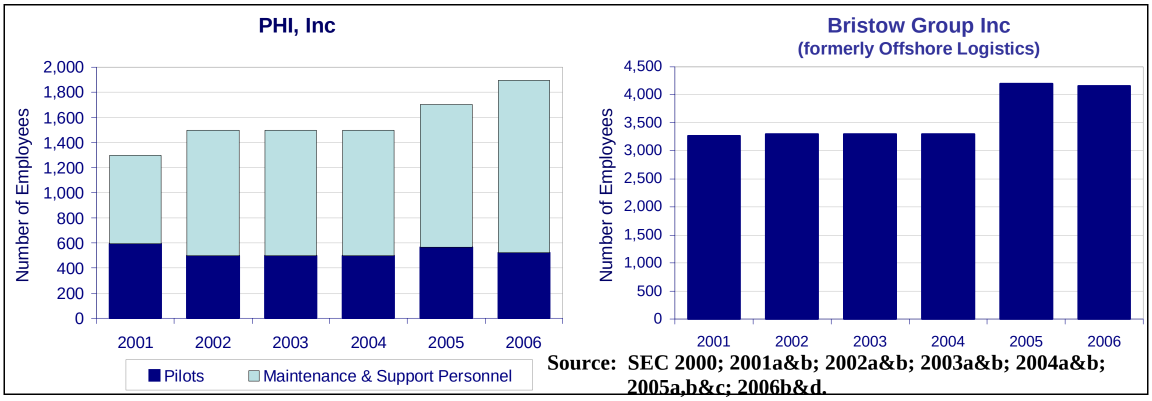
State/City	PHI	OLOG	ERA
Alabama			
1 Theodore	✓		✓
Louisiana			
2 Abbeville	✓	✓	✓
3 Boothville	✓		
4 Cameron	✓		✓
5 Creole		✓	
6 Fourchon	✓		✓
7 Galliano		✓	
8 Harahan	✓		
9 Houma	✓	✓	✓
10 Johnson's Bayou			✓
11 Lafayette	✓	✓	
12 Lake Charles	✓	✓	✓
13 Morgan City	✓		✓
14 New Iberia		✓	
15 New Orleans		✓	
16 Schriever			✓
17 Patterson		✓	
18 Venice		✓	✓
Texas			
19 Corpus Christi		✓	
20 Freeport		✓	
21 Fulton	✓		
22 Galveston	✓	✓	✓
23 Port O'Connor	✓		
24 Rockport		✓	
25 Sabine	✓		
26 Sabine Pass			✓

Figure 17. Locations of major helicopter service providers.

3. Labor Force

The Bureau of Labor Statistics includes labor information for helicopter pilots in the general category of “aircraft pilots and flight engineers.” This would include pilots for commercial airlines as well as those involved in other commercial tasks such as dusting crops, testing aircraft, flying passengers and cargo to areas not served by regular airlines, directing firefighting efforts, tracking criminals, monitoring traffic, and rescuing and evacuating injured persons. For our purposes this category of labor statistics is too broad.

We can, however, look at the last five years of employment by the Gulf region’s two largest helicopter service companies – PHI, Inc., and Bristow Group (formerly Offshore Logistics). As shown in Figure 18, employment at these companies has remained relatively stable. At the end of 2006, PHI, Inc. employed about 2,126 full-time employees. This includes approximately 525 pilots and 1,373 aircraft maintenance and support personnel (SEC, 2006d). Approximately 3,600 of Bristow Group’s 4,160 employees are employed in its Helicopter Services segment. About 300 of these are pilots in Bristow’s North American business unit (SEC, 2007a). Pilots employed by PHI and Bristow Group are represented by the Office & Professional Employees International Union.



Source: SEC 2000; 2001a&b; 2002a&b; 2003a&b; 2004a&b; 2005a,b&c; 2006b&d.

Figure 18. Number of employees at GOM helicopter service companies.

The helicopter service industry is very capital intensive and most providers express concern regarding maintaining a qualified staff which includes pilots and mechanics. As noted in Bristow Group's recent Form 10-K, "[o]ur ability to attract and retain qualified pilots, mechanics and other highly-trained personnel is an important factor in determining our future success. For example, many of our customers require pilots with very high levels of flight experience. The market for these experienced and highly-trained personnel is competitive and will become more competitive if oil and gas industry activity levels increase" (SEC, 2006b).

4. Labor Requirements

Unless otherwise indicated, the following information is from the Stan Grossman's article: Life of a Pilot Offshore Flying in the Gulf of Mexico (Grossman, 2004).

At a minimum, employment as helicopter pilot in the offshore industry requires an FAA Commercial Rotorcraft-Helicopter certificate with an Instrument rating in Helicopters and a Class 2 medical certificate. In addition, most operators require 1000-1500 flight hours as pilot in command (PIC) in helicopters. Additional flight experience, turbine time, and professional certifications such as airline transport pilot (ATP) increase the value of the pilot. Companies contracting for services may offer bonus pay for some of these qualifications.

Salaries and benefits for offshore helicopter operators are based on experience, the size of the craft, and the size of the company. The larger companies start new pilots in the upper $30,000 to mid $40,000 range. Top salary for most small ship pilots is around $65,000. Medium ship captains generally top from $75,000 to $85,000, or compensation may be per diem, with overtime pay for holidays and remaining overnight offshore. There is no single standard benefits package for this occupation, and initial contracts may include a training time with a required period of employment that follows.

5. Typical Firms

Industry consolidation has resulted in a small number of large helicopter service providers. The Gulf is served primarily by three large operators: Bristow Group (formerly Offshore Logistics); PHI, Inc. (formerly Petroleum Helicopters, Inc.); and Seacor (formerly ERA Aviation). These top three providers account for nearly 80 percent of the aircraft available in the Gulf. Figure 19 shows the estimated market share based on the number of aircraft available in the Gulf region. Other competitors in this region are smaller, privately-owned entities or subsidiaries of larger companies. This includes Evergreen, Houston Helicopters and Rotorcraft Technologies.

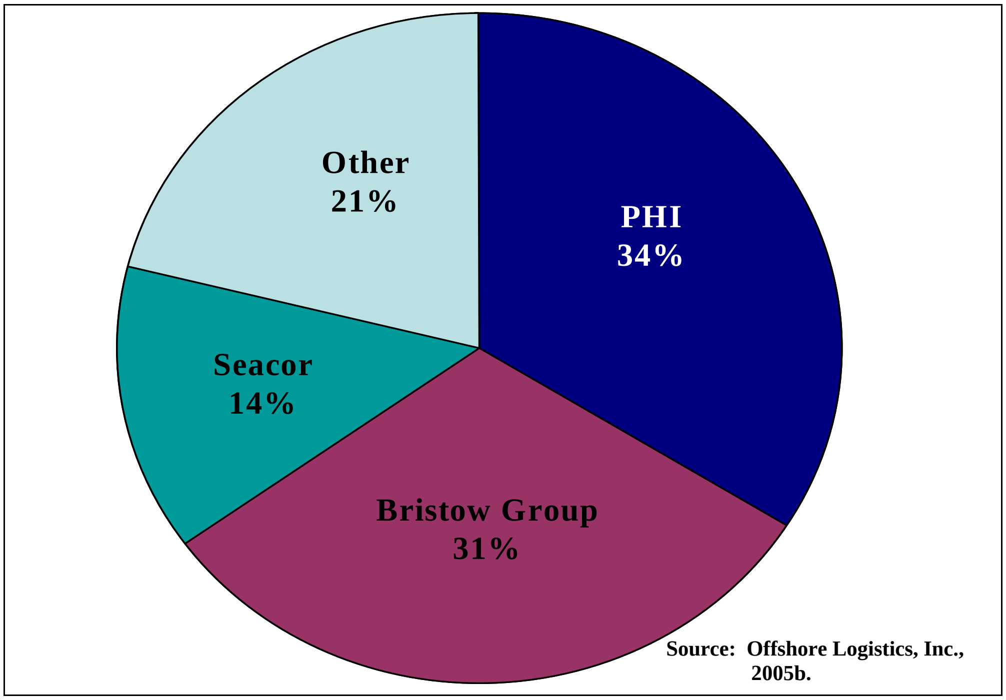


Figure 19. Market shares of major helicopter service providers in the Gulf.

Most service providers have a few companies that will make up a large share of their customer base as oil and gas companies tend to select one service provider for all of their Gulf Coast helicopter needs. For example, Bristow Group's annual report explains that 18 percent of their Helicopter Services' revenues were from Shell Oil Company in fiscal year 2007. During their fiscal year ending in March 2007, their top ten customers accounted for more than 55 percent of gross revenue (SEC, 2007a). PHI's largest customer provides the company with 17 percent of its operating revenues (SEC, 2006d). And, ERA Aviation's (now part of Seacor) ten largest customers account for 46 percent of its operating revenues (SEC, 2006c). The loss of any one customer could materially affect any company's operations.

In this highly competitive business, most contracts are awarded through competitive bidding (SEC, 2007a and 2006d). In addition, companies are selected for their services (in addition to rates) because of their ability to serve (number of helicopters in the fleet), their safety record, their reliability, and from past business relationships. Additional competitive pressure stems from most oil and gas companies' ability to provide their own aircraft services. But, in an effort to reduce costs in the previous era of lower oil prices, companies turned to outside contractors to provide the specialized services such as helicopter transportation.

The industry is both very concentrated and specialized. The specialization is recognized through revenues obtained from providing helicopter services to producers in the Gulf. For example, PHI operates approximately 152 owned, leased and customer-owned aircraft from several bases in the Gulf of Mexico region (SEC, 2006d). Approximately 60 percent of their 2006 operating revenue was attributable to helicopter support for offshore oil and gas exploration and production companies – particularly in the Gulf of Mexico (SEC, 2006d). As the Gulf has matured, helicopter service providers have attempted to diversify through additional industries as well as locating globally. Other services provided by most in the industry include: certain oil and gas support services, helicopter repair services, medical services, recreation/sightseeing tours, and firefighting and forestry services.

C. Industry Trends and Outlook

1. Trends

As in most oil and gas support service industries, demand for helicopter services is substantially dependent on activity levels and transportation needs in the offshore oil and gas industry. These companies' revenue and profitability are therefore largely dependent upon the levels of activity in oil and gas exploration, development and production.

To meet the demands of deepwater (travel farther and faster, carry more personnel, all-weather capabilities, and the need for lower operating costs), the offshore helicopter industry has purchased new helicopters over the past 5 years. For example, Bristow recently acquired fifteen new medium-sized helicopters from Sikorsky Aircraft Corporation. Of these fifteen, six were delivered in fiscal year 2004, four in fiscal year 2005, two in the first half of 2006 and one in 2007. In addition, the contract with Sikorsky was amended to acquire 32 additional medium sized helicopters between 2007 and 2013 (SEC, 2005a). PHI has also taken delivery of new aircraft. In 2008, PHI took delivery of one transport category aircraft, four medium aircraft and four light aircraft for service in its Oil and Gas segment. And, as of December 31, 2008, PHI had orders for five additional transport category aircraft (SEC, 2008b).

Oil and gas companies are continually seeking to implement measures aimed at greater cost savings, including efforts to improve cost efficiencies with respect to helicopter transportation services. For example, new technologies may permit companies to reduce staffing levels on both old and new installations. This would reduce the frequency of transportation of employees by increasing the length of shifts offshore. "The continued implementation of these kinds of measures could reduce the demand for helicopter services and have a material adverse effect on our business, financial condition and results of operations. The current global financial crisis and economic downturn could lead our customers to implement greater cost saving measures (SEC, 2009d)."

Despite these cost saving efforts, PHI's operating revenues for oil and gas over the past couple years has been steadily increasing. In 2005, operating revenues for domestic oil and gas were $39.5 million higher than in 2004. Revenues increased again in 2006 by $28.4 million (SEC, 2005c and 2006d). These increases were attributed to increases in flight hours in the GOM and an increase in contracted aircraft (SEC, 2005c and 2006d). The increased activity was directly related to increased exploration and production activity by customers in the GOM. Additional demand was also caused by the 2005 hurricanes as customers experienced logistical challenges repairing offshore facilities.

PHI's revenues increased again in 2008, by $63.1 million or 14 percent (over 2007). This was primarily due to an "increase in contracted medium and heavy aircraft, which primarily serve the Gulf of Mexico deepwater market and attract higher rates, increased flight hours, and also due to the adverse affect of the pilots' strike on 2007 operating revenues (SEC, 2008b).

2. Hurricane Impacts

All three GOM dominant offshore helicopter companies saw an increase in operations and revenues in the months after Hurricanes Katrina and Rita. In December 2005 and again in March 2006, Bristow Group stated that current activity levels in the GOM are at or near all-time highs and the Company believes that the impact of hurricanes Katrina and Rita will continue to result in higher activity levels as operators repair facilities and work to bring production back on line (SEC, 2005b and 2006b). Seacor's operating revenues in the GOM region increased $46 million as compared to the prior year's quarter. Demand for offshore support vessels was stronger, in response to both higher levels of exploration and production activity, and the continuing requirements for offshore support vessels to support the reconstruction of offshore installations damaged during the storms.

Impacts from the 2005 hurricanes resulted not only in increased hours for helicopter companies, but also in significant damage. Bristow Group suffered a total loss of its Venice, Louisiana shorebase facility due to Hurricane Katrina. And, Hurricane Rita severely damaged the Company's Creole, Louisiana base and flooded its Intracoastal City, Louisiana base. Bristow Group recorded a $0.2 million net gain ($2.8 million in probable insurance recoveries offset by $2.6 million of involuntary conversion losses) during fiscal year 2006 related to property damage to these facilities. The Company reopened its Intracoastal City, Louisiana base in December 2005, its Venice, Louisiana base in March 2006 and its Creole, Louisiana base in April 2006 (SEC, 2006b).

PHI, Inc. was also affected by both hurricanes. Hurricane Katrina caused substantial flooding at PHI's Boothville, Louisiana base. This facility was out of service until late 2006. Other PHI bases incurred some damage, most of which had been repaired as of December 31, 2005, and are back in service. Hurricane Rita destroyed PHI's base in Cameron, and caused flooding and wind damage at other bases. Most of this damage has been repaired and bases are back in service. PHI estimates that their insurance claim related to all damage will be approximately $8.5 million, and expects that substantially all costs incurred will be covered by insurance (SEC, 2006d).

3. Outlook

Although helicopter companies have been experiencing a growth in revenues due to increases in deepwater drilling and impacts of hurricanes offshore, the companies note that things may be slowing down. As stated by Bristow Group in its 2009 annual report, "our industry has historically been cyclical and is affected by the volatility of oil and gas price levels. There have been periods of high demand for our services, followed by periods of low demand for our services. Changes in commodity prices, including the approximate $100 decline in the spot price of crude oil at one point during fiscal year 2009, can have a dramatic effect on demand for our services, and periods of low activity intensify price competition in the industry and often result in our aircraft being idle for long periods of time (SEC, 2009d)."

Bristow Group also noted that "the U.S. Gulf of Mexico and the North Sea are mature exploration and production regions that have experienced substantial seismic survey and exploration activity for many years. Because a large number of oil and gas prospects in these regions have already been drilled, additional prospects of sufficient size and quality could be more difficult to identify. In addition, the U.S. government's exercise of authority under the Outer Continental Shelf Lands Act, as amended, to restrict the availability of offshore oil and gas leases could adversely impact exploration and production activity in the U.S. Gulf of Mexico. If activity in oil and gas exploration, development and production in either the U.S. Gulf of Mexico or the North Sea materially declines, our business, financial condition and results of operations could be materially and adversely affected. We cannot predict the levels of activity in these areas (SEC, 2009d)."

PHI has also noted that the GOM is a mature area "which may result in a continuing decrease in activity over time (SEC, 2008b)." And although PHI's revenues have been on the rise, in early 2009 PHI noted that oil and gas prices "declined substantially in the second half of 2008, and while we have not experienced any substantial adverse effect to date, we may in the future (SEC, 2008b)."

D. Chapter Resources

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U.S. Securities and Exchange Commission
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V. WATER TRANSPORTATION

A. Description of Industry and Services Provided

According to the Offshore Marine Service Association (OMSA), representing more than 250 member companies, including about 100 firms that own and operate marine service vessels, there are some 1,200 offshore supply vessels operating in the GOM. Of these vessels, some 850 are considered offshore supply vessels (OSVs), the subject of this chapter. These vessels provide every pipe, wrench, computer, barrel of fuel, and gallon of drinking water to rigs and platforms, and transport thousands of workers to and from the offshore facilities (Offshore Marine.org, 2007).

OSVs primarily serve exploratory and developmental drilling rigs and production facilities, and support offshore and subsea maintenance activities. Besides transporting deck cargo, OSVs also transport liquid mud, potable and drilling water, diesel fuel, dry bulk cement and personnel between shore bases and offshore rigs and facilities (SEC, 2006o).

Vessel operators employ roughly 12,000 crewmembers. "The transportation link provided by OMSA member vessels has helped make the offshore energy sector a major engine of the U.S. economy. According to one oil and gas industry study, offshore oil and gas activities help support some 6,000 companies and generate an estimated payroll of $1.2 billion (OffshoreMarine.org, 2007)."

Like all sectors of the GOM oil and gas production industry, the water transportation segment is dependent upon the business environment, in this case, the level of offshore exploration and drilling activities. The demand for water transportation services is also affected by present and future expectations of oil and gas commodity prices; customer assessments of offshore prospects compared to land-based opportunities; customer assessments of costs, geological opportunities and political stability; world-wide demand for oil and gas; ability of OPEC to set and maintain production levels and pricing; the level of production of non-OPEC countries; the relative exchange rates for the U.S. dollar; and various government policies regarding exploration and development of their oil and gas reserves. Demand for OSVs influences day-rates and utilization rates (SEC, 2006q).

B. Industry Characteristics

1. Typical Facilities

Offshore supply vessels are typically made up of six primary types of vessels: tug; marine platform supply vessel (PSV); anchor handling, towing, and supply vessel (AHTS); mini-supply vessel (MSV); fast support vessel (FSV); and liftboat. A seventh category, floating, production, storage and offloading (FPSO), is also included in this section because BOEMRE did approve the use of FPSOs in the GOM some four years ago. BOEMRE approved a conceptual plan to allow the use of FPSOs by a consortium of companies in late 2006.


Source: SeacorMarine.com, 2007.

Tugs are like tow trucks. These steel-hulled vessels can be 70 feet to 140 feet long and are small in stature when compared to large supply boats. However, they have powerful engines that allow the tug to tow and position non-self-propelled offshore equipment such as mobile offshore drilling units, barges and production platforms (OffshoreMarine.org, 2007).


Source: SeacorMarine.com, 2007.

Anchor handling, towing, and supply vessels (AHTSs) tow rigs from one location to another and are equipped with powerful winches which are used to lift and position the rig's anchors. Many also carry moderate amounts of supplies. Older AHTSs tend to range 80 feet to 300 feet long, while newer deepwater vessels tend to range from 250 feet to 600 feet.


Source: SeacorMarine.com, 2007.

Utility boats are typically used to support production operations, providing storage space, emergency standby, and transporting personnel between platforms. Utility boats range from 96 to 175 feet long and can have space for several hundred tons capacity. They also have a smaller passenger area for up to 36 offshore workers (OffshoreMarine.org, 2007).


Source: SeacorMarine.com, 2007.

Typical marine platform supply vessels (PSVs) range in length from 190 feet to over 300 feet. These vessels provide the support needed for deepwater drilling and production operations. They also have the capability of handling the more typical construction and maintenance tasks of standard offshore supply vessels (SeacorMarine.com, 2007).


Source: SeacorMarine.com, 2007.

Fast support vessels (FSVs) serve as crew boats and high volume cargo demands, including drilling mud, chemicals, and other deck cargos. FSVs range in length from 130 feet to 190 feet. Crewboats are the shuttle buses of the offshore oil industry, carrying workers to and from offshore facilities. A typical crewboat can carry 36 to 149 offshore workers (OffshoreMarine.org, 2007).

Source: Aries Marine Corporation, 2007.

Liftboats are the trucks of the offshore fleet. These self-elevating, self-propelled vessels are equipped with at least one crane and a large open deck space. Leg lengths greater than 100 feet make these ships ideal for shallow water production areas. Worldwide, the fleet consists of some 235 vessels of various sizes and capabilities (Liftboat.com, 2007).

Source: Conley Corporation, 2007.

The FPSOs are a type of floating tank system designed to take all of the oil or gas produced from a nearby deepwater platform, process it, and store it until the oil or gas can be offloaded onto waiting tankers, or sent through a pipeline. FPSOs are widely used around the world as an alternative to expensive pipelines.

2. Geographical Distribution

Virtually all of the water vessel transportation providers are located along the coast near producing regions, with senior offices often headquartered in Houston, and a few port facilities in east Texas. Louisiana shipyard/port facilities include Port Fourchon, Houma, Morgan City, Lake Charles, Patterson, Golden Meadow, Amelia, and Lafayette (see Figure 20). As operations continue to expand in deeper water, new port facilities will be needed (Figure 21).

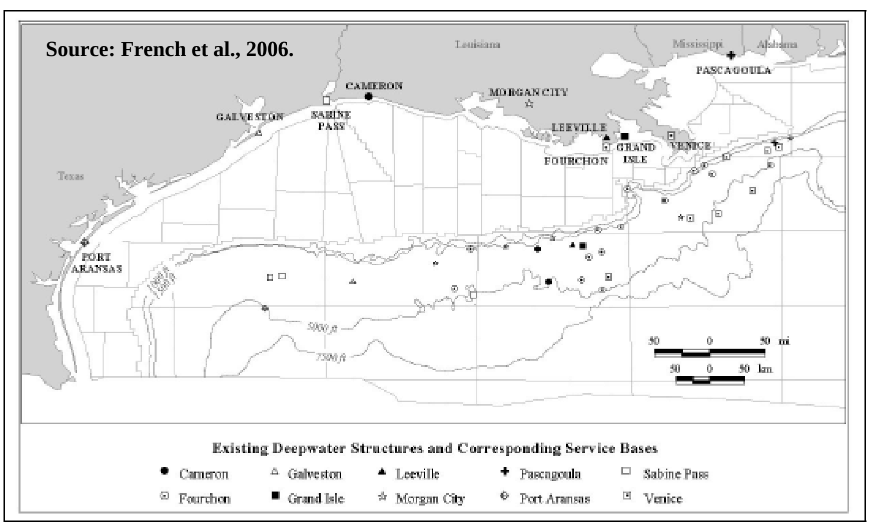


Figure 20. Existing deepwater structures and corresponding service bases.

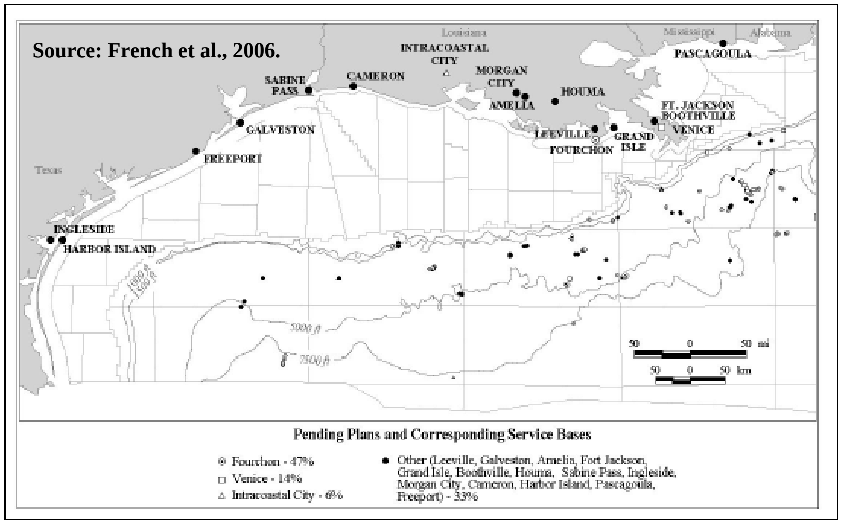


Figure 21. Pending plans and corresponding service bases.

3. Labor Force

The Bureau of Labor Statistics does not provide specific labor information for OSVs. There are ship captains, crew, cooks, and others occupations aboard ships, but current labor statistics do not have a category specific enough to include only the offshore industry. For our purposes this category of labor statistics is too broad. Most companies in this segment are not under collective bargaining agreements, though some maritime unions have targeted GOM employees.

Crew sizes range from three to more than a dozen workers, and include at least a captain, mate, and deckhand. Many vessels also have one or more engineers who are responsible for maintaining the engines as well as loading, transfer and discharge of bulk cargo, fuel and water. Able-bodied seamen assist with vessel operations and maintenance. According to the Offshore Marine Service Association there are some 12,000 workers associated with this segment (OffshoreMarine.org, 2007).

Mariners are required to complete significant training for all aspects of their jobs. However, new requirements were implemented in 1995 with the new amendments to Standards for Training, Certification, and Watchkeeping (STCW-95). All mariners working on vessels greater than 200 gross tons and candidates for licenses and documents must take courses, pass examinations, and demonstrate their skills aboard vessels (STCW, 2007).

Due to the hard work and long hours, turnover among mariners, especially at the lower levels, is high. Workers are typically paid by the day, and many work 12-hour shifts each day. Because of fatigue-related accidents the Coast Guard issued a policy letter in 2002 stating that mariners are not permitted to work more than 12 hours in a 24-hour period, except in an emergency (USDOT, Coast Guard, 2007).

4. Typical Firms

There are several competitors in this segment and the most important factors are pricing and equipment availability. Further, contracts tend to be short-term due to the nature of drilling activities. The largest companies in the GOM market include Seacor Holdings with 78 supply vessels operating in the GOM; Hercules Offshore, Inc operates 45 liftboats; Tidewater currently has 40 vessels in the GOM, six of which are deepwater; Trico Marine operates 11 supply vessels; and Hornbeck Offshore Services operates 42 new generation (i.e. deepwater) OSVs, one AHTS and one multi-purpose support vessel (SEC, 2008c, 2008d, 2009e, 2008e, and 2008f). In addition, Hornbeck has three multi-purpose support vessels on order for 2009 delivery (SEC, 2008f). Foreign competition is not allowed in the GOM as prohibited by the Jones Act. Under the Jones Act of 1920, any maritime vessel that is involved in coastwise trade in the U.S. must be U.S. built, U.S. owned, and U.S. crewed (Barrett, 2005).

Industry operational costs primarily depend upon the size and asset mix of the entire fleet. Costs are typically broken down into "daily running costs" and "fixed costs." Daily running costs are primar ily comprised of wages paid to marine personnel, maintenance and repairs and insurance. Two significant maintenance and repair costs are drydock and main engine overhaul costs. Drydockings are regularly performed in accordance with applicable regulations, and main engine overhauls are typically performed in accordance to planned maintenance programs (SEC, 2006e).

For boats to get work they must be certified seaworthy. Certification requires that older vessels be drydocked and inspected twice every five years (SEC, 2006o).

C. Industry Trends and Outlook

1. Trends

The oil and gas exploration and production business is cyclical, and is driven largely on the price of the commodities. In times of high prices there is typically a corresponding increase in drilling activity. Figure 22 shows the cyclical nature of the industry, and that the number of working vessels corresponds with the number of active rigs. As shown, the number of working vessels in the GOM peaked in early January 2001 and has steadily decreased until late 2004, when prices rose and the prospects for deepwater drilling became more concrete. When times are difficult, such as in the late '90s, industry consolidation occurs along with a significant amount of mergers.

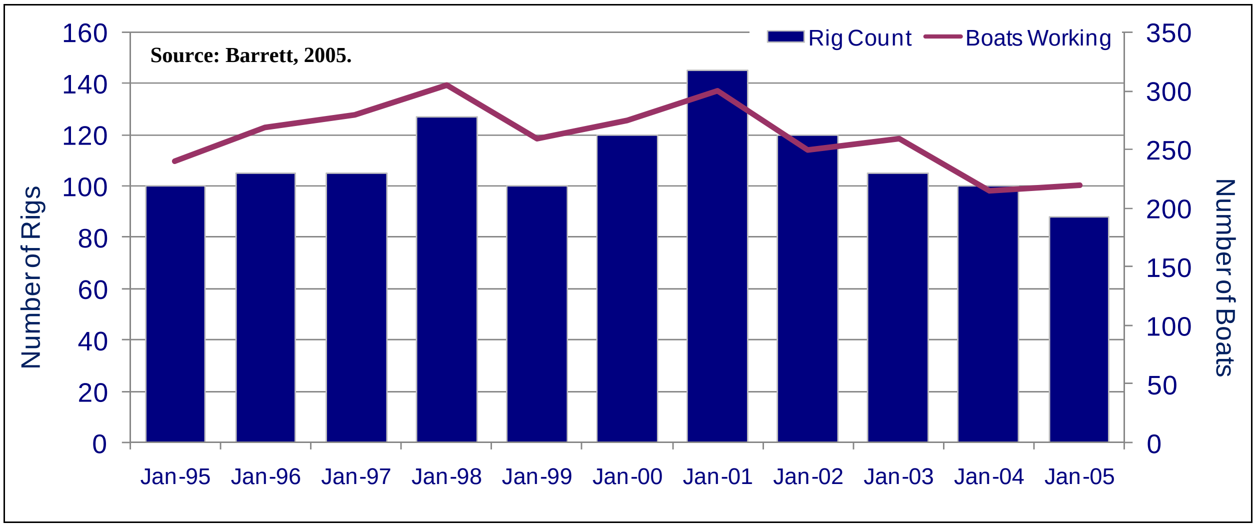


Figure 22. GOM rig and working boat counts, 1995 to 2004.

Figure 23 and Figure 24 show that day rates and utilization rates rose from mid-2004 to mid-2006, particularly for the larger AHTS and supply vessels – reflecting the move to deeper water. Day rates for AHTS vessels increased $9,450 in June 2004 to $60,000 in October 2005. These rates increased to their high of $75,000 in December 2006. Utilization rates increased from 75 percent to 99 percent over the same period.

Supply vessels over 200 feet saw average day rates jump from $3,875 in June 2004 to over $13,800 in June 2006. Similarly, utilization rates increased from 75 percent to 99 percent over the same period. Following the hurricanes of 2005 the utilization rates for all OSVs (large and small) were over 94 percent, while the day rates remained strong through 2006. At the end of 2008 however, day rates and utilization began to fall. For large supply vessels (over 200 feet), day rates have fallen from their high of $11,540 in November 2008 to $4,500 in June 2009. Utilization of these vessels has decreased from 99 percent to 86 percent over the same period.

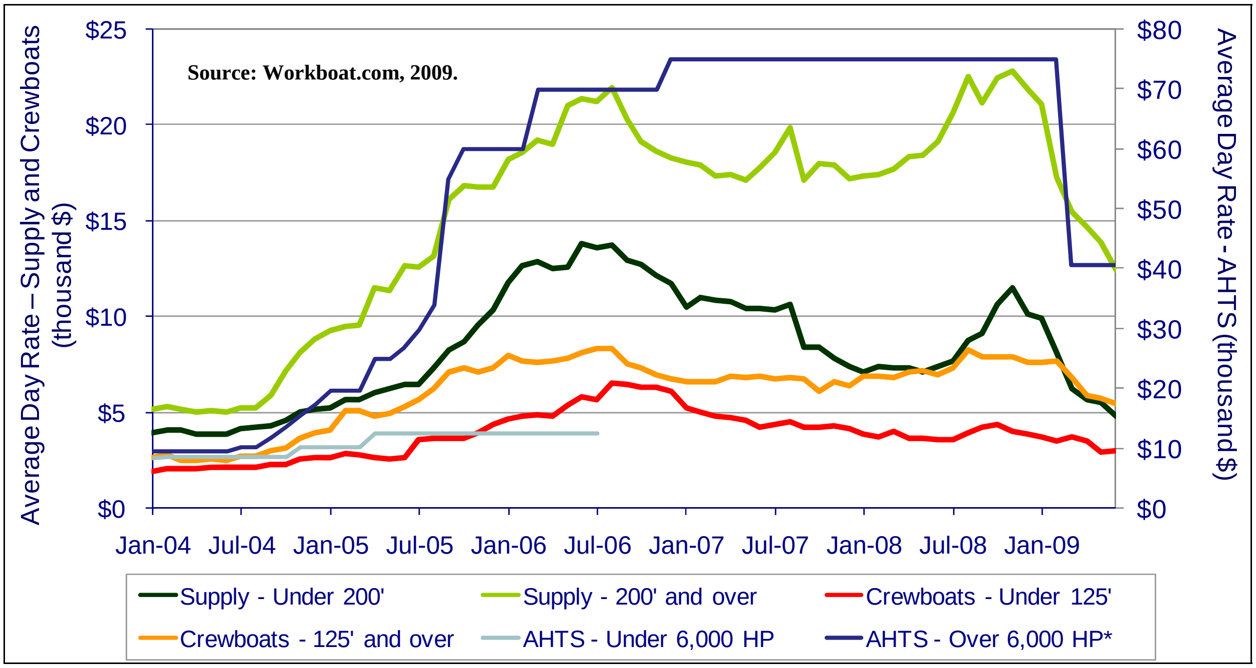


Figure 23. OSV day rates.

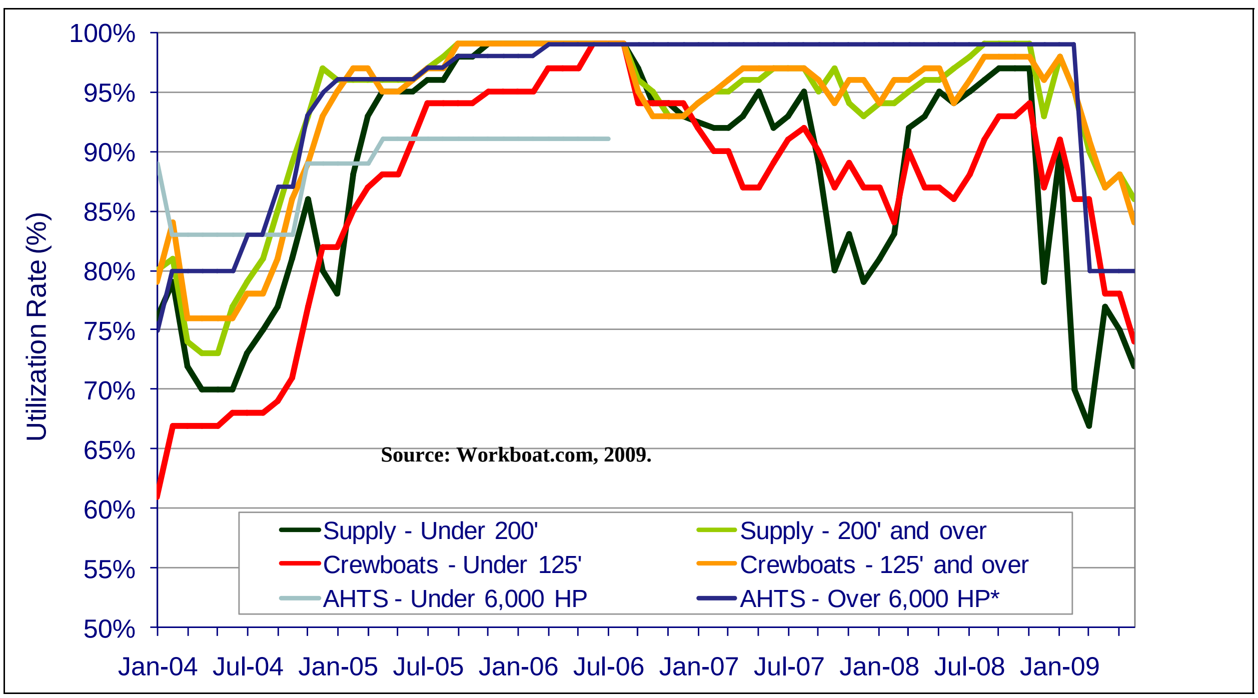


Figure 24. OSV fleet utilization rates.

Utilization rates for vessels are typically quite high. As seen in the figures above, utilization rates for the new generation, deepwater capable boats command higher day-rates, as well as being in greater demand. Newer vessels see utilization in the mid 90 percent range, whereas older vessels typically have utilization in the 70 percent range (Barrett, 2005).

Shallow well drilling activity in the Gulf of Mexico is typically more sensitive to fluctuations in commodity prices, particularly the price of natural gas. Accordingly, decreases in oil and natural gas prices (actual or anticipated) generally result in reduced offshore drilling activity and lower demand for the conventional 180 foot OSVs that serve the shallow well market. This causes a corresponding decline in OSV day-rates and utilization rates in that market (SEC, 2006o). In contrast, the larger capital commitments and longer lead times and investment horizons associated with deepwater developments make it less likely that an operator will abandon such projects in response to a short-term decline in oil or natural gas prices. Therefore, OSVs that serve the deepwater markets experience less volatility in their day-rates and utilization rates and are, therefore, generally less sensitive to short-term commodity price fluctuations (SEC, 2006o).

When the market softens, older OSVs are often taken out of commission, or cold-stacked, which allows them to be brought back on line relatively quickly. The cold-stacked vessels are almost exclusively the oldest vessels. Most of the replacement, or newer vessels, are new generation vessels capable of operating in both shallow and deepwater areas. Many of the cold-stacked vessels never make it back into operation and are either salvaged or used for parts for other vessels. So, while there are over 850 OSVs in the GOM region, at any given time (dependent upon market conditions) there may be anywhere from 200 to 350 actual OSVs operating (SEC, 2006o).

Further, U.S. Coast Guard regulations limit liftboat operations to seas of five feet or less, and offshore conditions from November to March each year negatively affect the utilization rates of some vessels, particularly liftboats (SEC, 2006o).

The Market for New Generation OSVs

The useful life of OSVs is considered to be 20 to 25 years. The average age of conventional (180 feet or less) OSVs was 26 years as of December, 2005, meaning that a significant transformation from older, smaller vessels to newer larger deepwater vessels is taking place (SEC, 2006o).

With the transition to deeper water operations, a new generation of all types of vessels began coming on line in 1999 (see Figure 25). Traditional OSVs typically are not larger than 180 feet and have limited capacity and range capabilities. Newer vessels are designed with larger capacities, including greater liquid mud and dry bulk cement capacities, as well as larger open deck areas (SEC, 2006o). Because deepwater projects are distant from shore-based support infrastructure, these features are essential to providing effective servicing.

OSVs operating in the deepwater markets are generally required to have dynamic positioning, or anchorless station-keeping capability, because most offshore facility's safety procedures preclude OSVs from tying up to deepwater installations. This also allows vessels to continue to operate in adverse weather conditions. These new generation vessels have advanced designs that allow for much quicker loading and unloading operations, and newer, more efficient, engines and controls result in greater fuel efficiency (SEC, 2006o).

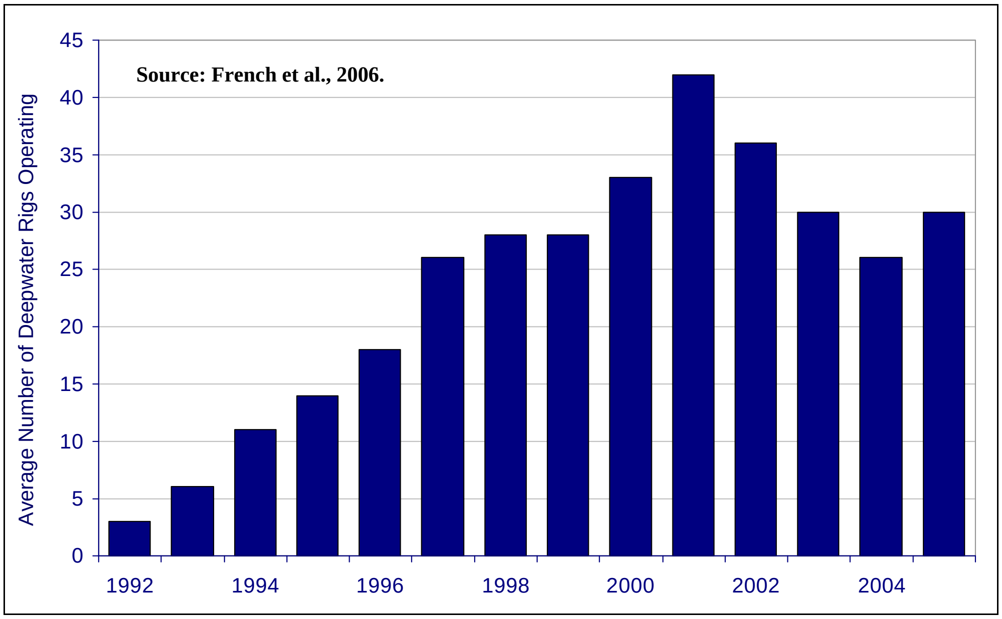


Figure 25. Average number of deepwater rigs operating.

The capabilities and capacities of larger new generation OSVs have resulted in average utilization rates for these OSVs working in the GOM of approximately 95 percent since 1999. In contrast, the average utilization rate for the conventional 180 foot OSV fleet over the same period has been approximately 63 percent. Additional utilization for new generation OSVs has come from increasing demand for these vessels in support of conventional shelf drilling projects. The average day rates for new generation OSVs were generally double the average day rates of conventional 180 foot OSVs, leading many to conclude that the demand for these newer vessels has outpaced the supply (SEC, 2006o).

2. Hurricane Impacts

The hurricanes of 2005 caused significant damage to a few port facilities along the Gulf coast. According to the BOEMRE, the hurricanes destroyed over 100 platforms and damaged a further 50. With much of the GOM production out of commission, supply vessels working repairs were kept very busy. In fact, some operators say that the recent strong demand for OSVs has been for construction needs. Most vessel operators believed it would take at least another year or two to repair all the damage from the hurricanes (Greenberg, 2007).

Trico Marine Services reported that for its GOM supply vessels, average day rates increased 71 percent for the year ended December 31, 2006, compared to the same period in 2005. Utilization also increased 6 percent for these vessels during the year ended December 31, 2006, compared to the same period in 2005, inclusive of their stacked vessel fleet. The increase in both day rates and utilization was a result of the increased demand due to decreased vessel supply and work related to assessment and repair of damage from hurricanes in 2005 (SEC, 2006p).

3. Outlook

Until the latter part of 2008, the offshore oil and gas industry was operating at high levels in response to higher oil and gas prices. However, the drop in oil and gas prices in late 2008 and 2009 has reduced offshore activity. As shown in Figure 23 and Figure 24, OSV companies have experienced significant declines in utilization and day rates in the GOM.

Revenues for Hercules Offshore's domestic liftboats decreased from $43.0 million or 31 percent in 2008. "This decrease resulted primarily from lower average dayrates, which contributed $34.5 million of the decrease, and fewer operating days, which contributed $8.5 million of the decrease. Operating days decreased to 10,343 in 2008 from 11,265 in 2007 due primarily to lower customer activity in the Gulf of Mexico in 2008 as compared to the 2007. Average utilization also declined to 65.5% in 2008 from 67.3% in 2007 (SEC, 2008d)."

Some OSV companies have responded to slowing market conditions by focusing more on international markets and mobilizing vessels to other regions with stronger exploration and production activity. Following the departure of drilling rigs to other regions, in 2007 Tidewater relocated 16 vessels to international locations where they would be contracted for longer-term work at higher rates. In 2008, the Company moved another seven vessels out of the GOM (SEC, 2009e). Similarly, Trico Marine redeployed a portion of its GOM fleet to other areas, primarily West Africa and Mexico where it entered into longer-term contracts albeit at marginally lower average day rates (SEC, 2008e).

Companies have also responded to the slowdown by reducing their supply of vessels. In 2009, Tidewater cold-stacked one of its 180 foot supply vessels (Greenberg, 2009). Seacor Holdings has cold-stacked 15 of its GOM vessels and will "continue to monitor market conditions and will cold-stack additional vessels as it deems appropriate … The number and type of vessels operated, their rates per day worked and their utilization levels are the key determinants of [Seacor's] operating results and cash flows. Unless a vessel is removed from operational service, there is little reduction in daily running costs and, consequently, operating margins are most sensitive to changes in rates per day worked and utilization (SEC, 2008c)."

Many OSV companies expect activity to decrease further in 2009 (SEC, 2008c, 2008f, 2009f). In its 2008 annual report, Hornbeck Offshore Services noted that "the expected weakness in the overall economy and any continued lack of liquidity in the credit markets is affecting the spending patterns of our customers and is likely to weaken demand for our services. The extent of such weakened demand and how long it may last is not known. In addition, lack of liquidity and low oil prices may impact the continued viability of projects contemplated by our customers. (SEC, 2008f)."

D. Chapter Resources

Atlantic Communication's Gulf Coast Oil Directory
Includes a wide range of data from company name, address, web and email addresses to contact names with titles, direct phone numbers, and email addresses all organized alphabetically by industry categories. Also included is "Company Detail" information such as company size,

revenue, areas operated in last 12 months, operations onshore or offshore, and stock information for publicly traded companies.
http://www.oilonline.com/store/directory.asp

U.S. Securities and Exchange Commission
Quarterly and annual reports of operations for publicly traded companies are filed with the Securities and Exchange Commission.
http://www.sec.gov/edgar/searchedgar/companysearch.html

Workboat.com
Provides daily news reports and a weekly newsletter for the commercial marine industry. It also provides historic industry statistics on day rates and fleet utilization.
http://www.workboat.com/

VI. GEOPHYSICAL SERVICES

A. Description of Industry and Services Provided

Offshore oil and gas activities are supported by a diverse and considerable array of geophysical service companies that range from small, one-man seismic brokers to large full-service companies offering a wide range of services. These services range from acquiring to processing to selling various types of seismic data, as well as conducting shallow hazard site surveys and providing reservoir seismic services. As described in further detail below, some of these services are performed offshore, while others are provided onshore at the geophysical service company's headquarters or satellite offices.

The majority of exploration and production companies used to have proprietary seismic databases. However, they have long since sold them to seismic data brokers (such as SEI) because their databases were small and didn't compare in coverage to the extensive regional group surveys of the 1990's which overshot areas with older data. Therefore, most major and independent oil and gas companies currently lack in-house seismic crews and instead rely on geophysical service companies to acquire seismic surveys.

Geophysical service companies levy a licensing fee on all E&P companies for access to the geophysical data they have procured – the E&P companies in essence 'buy' a licensing agreement with the geophysical service company through which they access geophysical data for their prospecting needs. These ownership rights are non-exclusive; more than one company can access the same data sets. The Bureau of Ocean Energy Management, Regulation and Enforcement requires that seismic acquisition companies submit copies of all offshore seismic data acquired on federal leases.

Seismic Surveys

2-Dimensional Surveys

Seismic data are images created from reflected seismic rays (sound waves). Sound waves are generated from a source, penetrate the earth's surface, are reflected from subsurface features such as faults or stratigraphy, and then travel back to receivers (such as hydrophone streamers being towed behind a marine vessel). The receivers record the sound wave's travel time, which is then used to estimate the depth of the feature that generated the reflection. This technique is called reflection seismology and depending on the arrangement of the sources and receivers, the data acquired is classified as either 2- or 3-dimensional seismic.

Begun in the 1960s, 2-dimensional (2-D) seismic data acquisition is defined by sources and receivers laid out in straight lines (see Figure 26). There are typically significant gaps of 1 kilometer or more between adjacent lines (Schlumberger, 2007). Overlapping lines allow inline-crossline tying of the data, necessary for interpreting the seismic data and mapping subsurface structures.

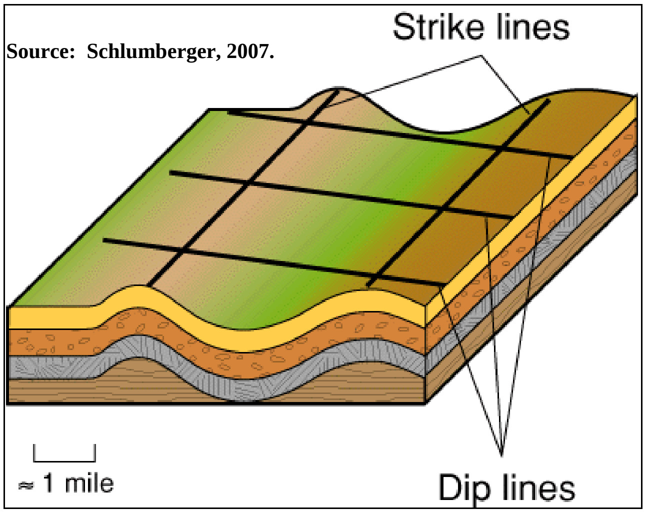


Figure 26. Two-dimensional seismic data set-pp.

The 2-D data is still used for general prospecting but 3-dimensional (3-D) data provides higher resolution. An example of a 2-D seismic line is shown in Figure 27 below.

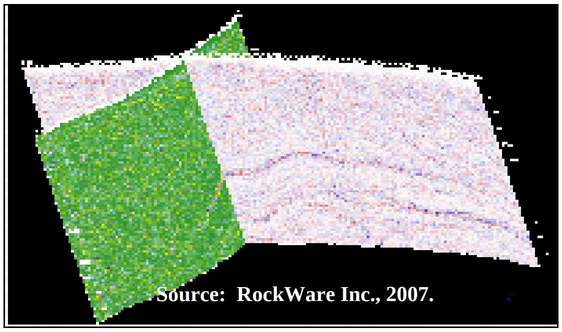


Figure 27. Two-dimensional seismic data.

In the Gulf of Mexico, geophysical service companies acquire 2-D surveys using large vessels that tow a single source array and streamers (seismic cables on which are located the receivers) behind it. Airguns, which use bubbles of compressed air to generate seismic waves, are used as the source (USDOI, GS, 2007). More details will be provided later in this chapter.

It is no longer common for geophysical service companies to acquire large 2-D 'speculative' seismic surveys, known in the industry as 'spec' surveys, and sell by them to interested parties. With the advent of 3-D seismic, 2-D seismic has become old technology and its utility is limited.

3-Dimensional Surveys

The advent of 3-D seismic surveys in the 1970s was a revolution in seismic technology. Energy propagates outward spherically, not in straight lines, so by designing a survey such that receivers are located all around the source, a 3-D subsurface volume is acquired. The concept was not new to geophysics, but its implementation was limited by computing power and costs until the first 3-D survey in 1967 (SPE, 1999).

The 3-D seismic surveys are more expensive than 2-dimensional seismic but yield much higher quality results. The 3-D image is more accurate, provides denser spatial coverage, and any desired vertical-section or horizontal slice such as Figure 28 below can be extracted from the 3-D volume for various analyses.

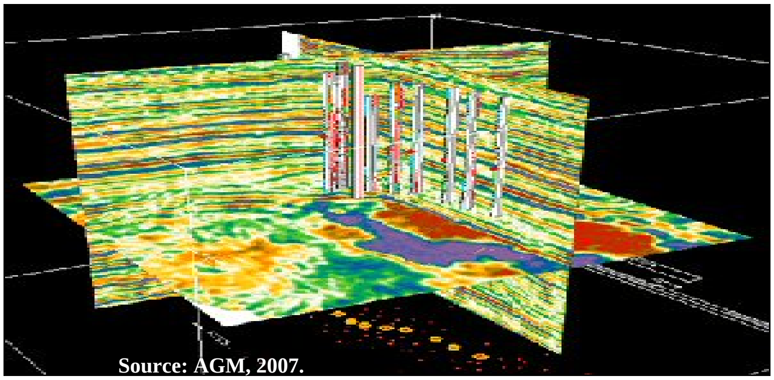


Figure 28. Interactive 3-D volume slicing of seismic data.

The 3-D seismic data greatly enhances the value of seismic data as a tool for exploration, development, and production functions. Slicing the 3-D volume is important not only for stratigraphic mapping, as shown in Figure 28, but for providing greater understanding of a reservoir's fault networks. Besides increased mapping utilities, 3-D data also allows for imaging to characterize and model the reservoir (see Figure 29 below). This 3-D visualization adds visual cues such as transparency, opacity, shading, perspective, and discontinuity, all of which enable 3-D seismic interpretation to be more accurate, efficient, and complete (SPE, 1999). With 3-D visualization, critical information is more easily communicated between team members and to upper management in an exploration and production company.

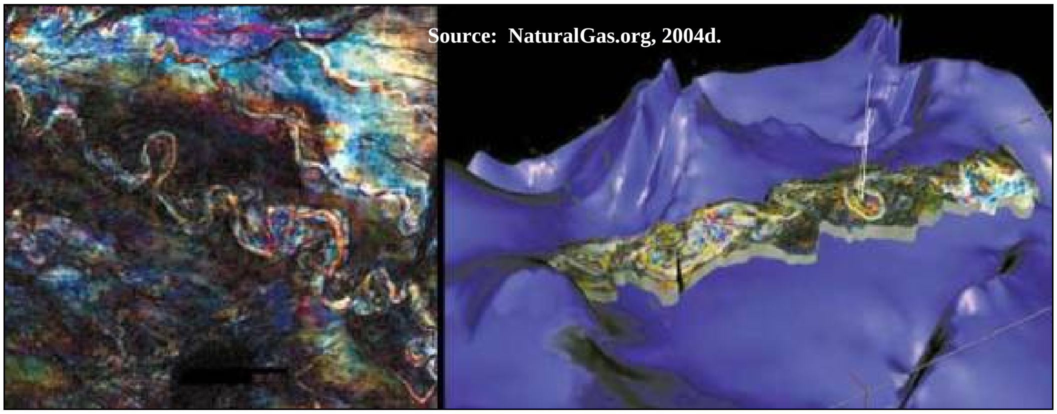


Figure 29. 3-D visualization using 3-D seismic data.

4-D ('Time-Lapse') Surveys

The 4-dimensional (4-D) surveys allow geoscientists to monitor production-related changes within the field, such as reservoir fluid flow, pore fluid pressure changes, reservoir saturation changes, and temperature changes. This type of reservoir surveillance results in effective field management by reducing operating costs and maximizing recovery rates. Better decisions can be made for infill drilling locations, draining bypassed reserves, and establishing optimal waterflood patterns. Differences between predicted and actual field performance are used to continually update the reservoir model and revise depletion rates (AAPG, 2004d).

Shallow Hazard Site Surveys

Shallow hazard site surveys are conducted within offshore lease blocks to detect and map potential hazards at seabed installation or drilling rig sites, and along pipeline and cable corridors. Hazards can be mapped using a variety of techniques such as echosounder, side scan sonar, magnetometer, sub-bottom profiler, and high resolution seismic data (Geo-Marine Technology, 2007). The BOEMRE requires these surveys for drilling in all offshore lease blocks.

Seafloor geologic hazards include fault scarps, gas vents, unstable slopes, and reefs. Subsurface geologic hazards include faults, gas-charged sediments, abnormal pressure zones, and buried channels. Man made hazards include pipelines, wellheads, shipwrecks, ordnance, communication cables, and debris from previous oil and gas activities (USDOI, MMS, 1998). Shallow hazard site surveys are important in mitigating potential problems such as shallow blowouts and lost circulation.

Vertical Seismic Profile (VSP) Surveys

The VSP surveys are measurements taken inside a wellbore using geophones or receivers inside the wellbore and a seismic source at the surface near the well (Schlumberger, 2007). In marine environments, this source is generally an airgun. VSP's can provide detailed information regarding the subsurface area near the wellbore, as geophones are very closely spaced on the downhole arrays. VSP's are typically used to create velocity models needed for seismic re-processing. They can also be integrated with 3-D seismic data for time-depth correlation that enables detailed descriptions of formation properties in the wellbore's vicinity (Baker Hughes, 2007c).

Seismic Data Processing

Seismic Data Processing involves using a variety of complicated algorithms to improve the overall quality, or signal to noise ratio, of the seismic data. Seismic data is collected in time and in most cases, must be converted accurately to depth. There are a variety of processing methods available from geophysical service companies. These include, but are not limited to: velocity modeling, pre-stack time migration, pre-stack depth migration, post-stack migration, AVO (amplitude variation with offset) processing, post-stack inversion, and full wave processing (Ion, 2007; TGS-NOPEC, 2007). Clients choose their processing preference based upon their objectives. Processing times can vary from several weeks to several months, depending on the size of the survey being processed and the techniques required to process it. Most geophysical service companies that offer these types of services have high-end computer processing facilities onsite and periodically meet with the client at these facilities during the processing period to exchange ideas and information.

Petroleum Geo-Services (PGS), a large geophysical firm, provides seismic data processing services for its own acquisition operations and also for third parties. Generally, PGS will compete for data processing contracts on a competitive bid basis. These contracts typically provide for the customer to pay a set fee per square kilometer processed for a prescribed set of processing procedures.

Seismic While Drilling

Seismic While Drilling (SWD) is a new technology that allows seismic data to be collected at the bit while drilling. The SWD tool uses a conventional seismic source (in offshore environments, an airgun is mounted on a drilling rig or a boat) and the signal is received by a downhole LWD (logging while drilling) tool equipped with geophone receivers. The geophones are in communication with a MWD (measurement while drilling) mud system that transmits the waveform data to the surface. It isn't yet possible to send this data uphole in real-time due to bandwidth and transmission speed limitations; however, scientists are working to overcome this obstacle (AAPG, 2004a).

B. Industry Characteristics

1. Typical Facilities

Seismic surveys are conducted using large seismic exploration vessels. An increasing number of seismic surveys are conducted further from shore, in deeper waters and potentially rougher seas such as the Gulf of Mexico and the North Sea. Industry has responded by equipping vessels with different types of proprietary technologies, such as WesternGeco's Q-Marine technology and Petroleum Geo-Services' Ramform technology. Marine surveys can take several months or up to half a year to conduct. PGS's Ramform vessels can acquire anywhere between 50-100 sq km in a single day (PGS, 2007).

The geophysical industry's largest players own and operate their own seismic acquisition vessels. In general, fleet size is small and even large companies such as PGS own 11 3-D vessels at most. PGS owns and operates the most modern fleet in the geophysical services industry. According to its 2006 Annual Report, the company holds virtually every streamer towing record in the world. Their 12-vessel fleet consists of 5 classic streamer vessels capable of towing 4 to 8 streamers and 6 Ramform vessels capable of towing 20 streamers spaced 37 to 50 meters apart. The operational efficiency of the Ramforms means that PGS is one of the only companies that regularly offer 12 or more streamers as a standard acquisition configuration (PGS, 2006).

Recently, on January 15, 2007, two of the largest firms, Veritas DGC and Compagnie Generale de Geophysique (CGG), merged to form CGGVeritas. The merger created a company with the largest fleet of 20 seismic vessels in the industry. The variety of vessels offers flexibility in terms of streamer capacity and acquisition configurations (CGGVeritas, 2007).

One of the remaining major firms, WesternGeco, has a fleet size on the order of 7 vessels (SEC, 2006u). WesternGeco owns and operates 7 Q-Marine seismic vessels such as the one depicted in Figure 30 below (SEC, 2006u). The newest vessel was launched in 2007, and will begin work immediately with a high-specification 4-D survey in the North Sea (Rigzone, 2007).

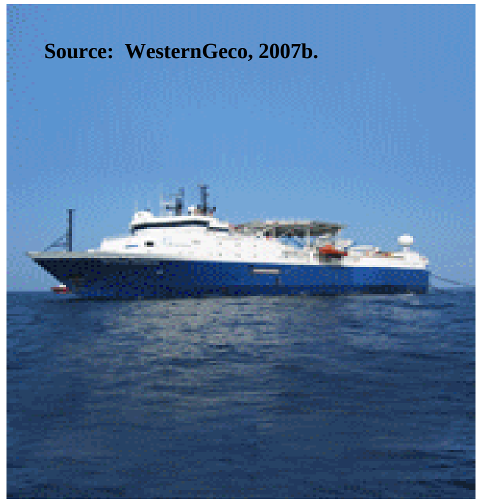


Figure 30. Q-Marine seismic vessel.

Onshore Processing Centers

After acquisition, seismic data is processed onshore at a company's high end processing facilities. Most firms have anywhere from 5 to 15 data processing centers located worldwide. Typically a firm will have a larger number of smaller processing centers scattered around the globe anchored by a few major processing centers in energy hubs such as Houston, southeast Asia, and the UK. For example, PGS owns and operates 17 seismic data processing centers worldwide, with the major processing centers located in Houston, London, Lysaker, Cairo, Rio de Janeiro, and Perth (PGS, 2006).

Now that CGG and Veritas have merged, they have an advantage of having the largest number of processing centers of their competitors. They operate 29 local centers, 15 of which are dedicated centers that bring processing facilities within their client's premises. They also operate four visualization centers that allow large volumes of 3-D data to be viewed and interpreted. Their reservoir teams mainly operate from Houston, London and France. Six of their processing centers are internationally located, and they recently built a hub in Southeast Asia (SEC, 2006t).

Another major firm, WesternGeco, operates the world's most extensive seismic data processing center in Houston. The center was recently expanded and houses the most advanced seismic technology (SEi Companies, 2004).

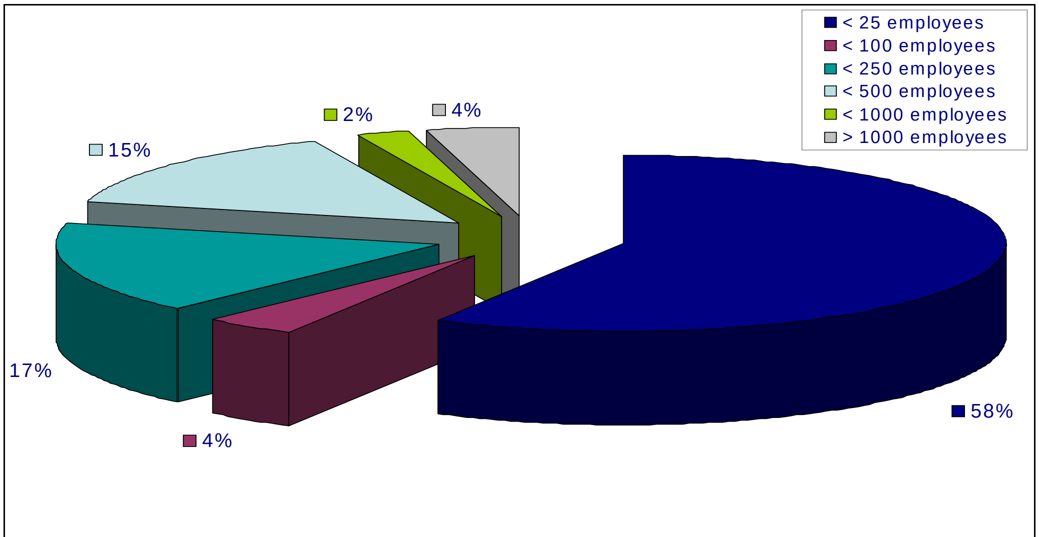
2. Geographical Distribution

According to Atlantic Communication's Gulf Coast Oil Directory, there are 254 geophysical and seismograph service companies registered with operating bases in a Gulf of Mexico state. All of these companies, with the exception of one, are located in Texas or Louisiana. Texas is home to 93 percent of these registrations. Sixty-five percent of the companies based in Texas are located in Houston, partially indicating the impact the industry has within this city.

3. Labor Force

The U.S. Department of Labor's Bureau of Labor Statistics (BLS) provides labor statistics for the generalized category of 'environmental scientists and geoscientists.' However, this category does not provide a breakdown that includes geophysicists, geophysical data processors, and seismic crew employees of geophysical service companies working aboard seismic vessels, and no specific BLS employment characteristics for geophysicists exist (U.S. Dept. of Labor, BLS, 2007c).

According to Atlantic Communication's Gulf Coast Oil Directory, of the 254 registered geophysical and seismograph service companies operating in the Gulf of Mexico region, of the firms reporting labor statistics, the majority are small companies with 25 employees or less. Figure 31 displays this labor breakdown for Gulf of Mexico geophysical service companies. Only a very small percentage of firms employ more than 1,000 people. Of the five GOM states, Texas has the largest concentration of labor associated with the geophysical services industry by far; 100 percent of the companies with greater than 100 employees are located in Texas, the majority of those in Houston (Atlantic Communications, 2006).



Source: Atlantic Communications, 2006.

Figure 31. Distribution of labor among geophysical service companies registered within the five GOM states.

According to Table 6 below, in September 2007, there were a total of 24 seismic crews operating in the Gulf Coast region, with 12 of those 24 located offshore (World Oil Magazine, 2007).

Table 6

U.S. Geophysical Activity in Terms of Active Seismic Crews

Regions	U.S. Geophysical Activity Seismic Crews Working Sept. 2007	Aug-07	Sept. 2006
Rocky Mountains	7	6	9
Mid-Continent	22	20	15
Southwest	11	12	12
Gulf Coast	12	12	9
Offshore	12	12	7
Others	9	8	11
Total	**73**	**70**	**63**

Source: World Oil Magazine, 2007.

Large companies such as PGS and CGG Veritas are capable of sustaining large workforces. Typically, these workforces are mobile and spread worldwide, in basins with high oil and gas activity. In 2006, PGS employed 3,168 people, using 8 to 11 crews in its offshore operations (PGS, 2006). According to the CGG Veritas 2006 Form 20-F, CGG had more than 4,500 employees in 2006, up from 3,600 in 2004, and Veritas employed an average of about 2,800 people (SEC, 2006t).

Many companies such as PGS also have one seafloor seismic crew that uses a cable laying vessel, a source vessel, and a receiving vessel to perform seafloor seismic or ocean bottom cable acquisition where conventional streamer seismic is impossible to acquire (SEC, 2006t). Factors limiting the acquisition of conventional streamer seismic data range from economic limitations to access limitations.

4. Typical Firms

The geophysical services industry consists of hundreds of small firms and several major global players. The latter include Compagnie Generale de Geophysique Veritas (CGGVeritas), WesternGeco, Petroleum Geo-Services (PGS), Input/Output, and TGS-NOPEC Geophysical Company. Most of these companies have worldwide operations with offices in key energy hubs such as Oslo, London, Houston, and Singapore.

Marine seismic acquisition services are provided on a contract basis as well as a multi-client basis, however it is typical for the majority of a seismic fleet's active vessel time to be allocated to contract work (SEC, 2006t). This proved true for Veritas DCG in 2005, when the majority of the increase in its revenues resulted from contract marine shoots. Furthermore, the majority of Veritas DCG's revenues came from activity within the Gulf of Mexico (as opposed to the North Sea, offshore Brazil, and West Africa), underscoring the basin's excellent exploration potential and drilling advances within the exploration and production industry in general (SEC, 2006v). As of 2006, Veritas had shot 6,300 sq km of 2-D seismic data and 93,700 sq km of 3-D seismic data in the Gulf of Mexico, highlighting the significance of the Gulf of Mexico as a multi-client market (SEC, 2006v).

WesternGeco, which, as of April 2006, is owned 100 percent by Schlumberger, is by far the most dominant player in the industry. WesternGeco boasts the most extensive seismic crews and data processing centers, as well as the world's largest multi-client seismic library. WesternGeco's activity has been increasing as the industry has recently experienced a resurgence, a growth that Schlumberger expects to continue. Their revenues have increased significantly since 2005, due to the increase in exploration activities needed by oil companies, and from increasing acceptance of the company's proprietary Q-Technology (SEC, 2006u).

PGS, another dominant player, also holds a large market share in the industry, exceeding 25 percent (PGS, 2006). In 2004, CGG gained market share in depth imaging for the Gulf of Mexico based on its proprietary WaveVista depth migration technology that is suited for complex wavefronts associated with high velocity layers, such as salt in the Gulf of Mexico (CGG, 2004). It should be noted that the global nature of large firms such as WesternGeco and CGGVeritas translates into a revenue mix derived from both domestic and international operations.

The large firms all have extensive multi-client libraries of offshore 2-D and 3-D seismic data available for purchase on a non-exclusive basis. In 2006, PGS had the world's largest multi-client library, and they had just been rewarded a contract within the Gulf of Mexico to survey an area covering 9,345 sq km (PGS, 2006). After the beginning of 2007, with their merger, CGGVeritas boasts 293,700 km of 2-D seismic data and 315,000 sq km of 3-D seismic data (CGGVeritas, 2007). Their recent merger allows them to cover greater breadth of area. For instance, CGG's library covered the Central and Eastern Gulf of Mexico, while Veritas' data was positioned in the Western and Central Gulf. In their 2006 Annual Report, the company stated that they plan to further develop their library to increase their competitive presence and to provide opportunities for future sales (SEC, 2006t).

C. Industry Trends and Outlook

1. Trends

The geophysical services industry provides services directly for the exploration and production companies, and as such, is dependent upon oil and gas activity in the Gulf of Mexico. The industry is influenced by many factors, the most significant being drilling activity, current and projected oil and gas prices, technological advances, reserve replacement rates, and government regulations.

One well known indicator of industry activity is the Seismic Crew Survey produced by the World Geophysical News (WGN). Figure 32 shows that the index has been increased steadily between 2003 and mid-2008. And, although the total number of seismic crews has continued to increase through 2008 and 2009, the number of crews actually working has decreased. In August 2009, the seismic crew count in the U.S. was 60 crews working and 23 available (totaling 83 crews). This is a decrease from the previous year when there were 72 crews working and only 7 available (SEC, 2009).

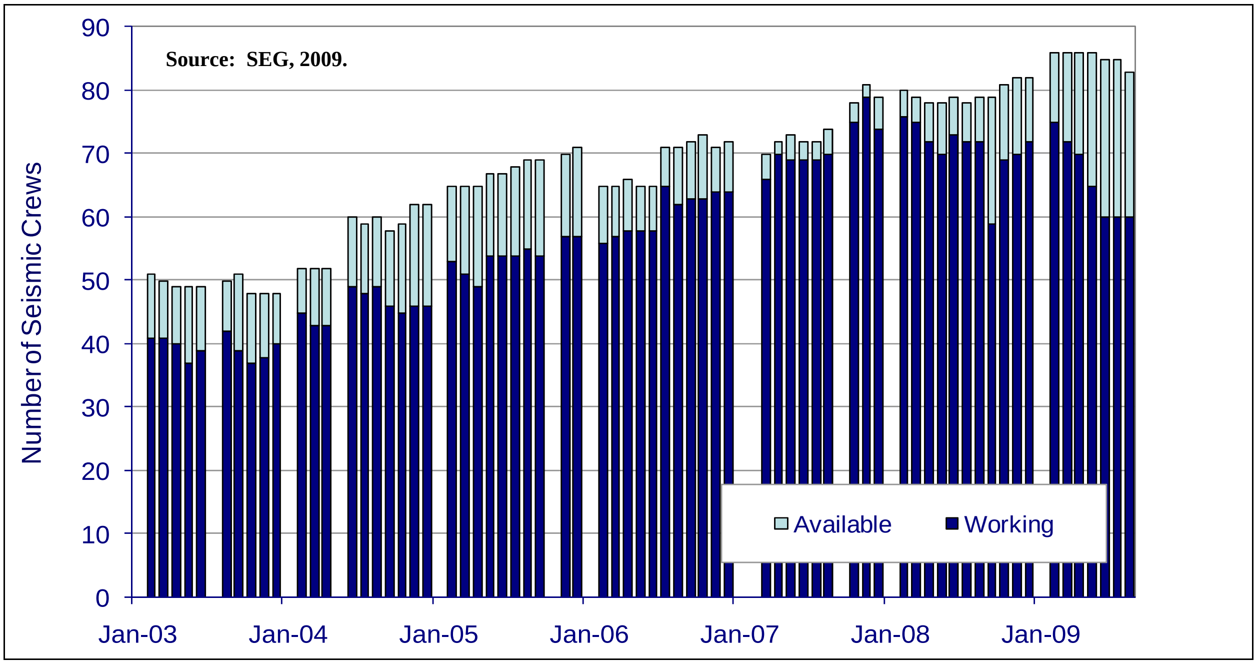


Figure 32. Seismic crew survey.

Marine seismic surveys fall into one of two categories: surveys performed for a client on a contractural basis, or multi-client surveys, where the geophysical service company may license the data to multiple clients. The majority of data acquisition costs are tied to logistical issues such as positioning and moving streamer cables (AAPG, 2004b).

The seismic industry relies heavily upon technology, therefore any firm that can distinguish itself with new advancements gains an edge over the competition. One of the recent trends have been toward Controlled Seismic Electromagnetic Imaging (CSEMI), a tool with the ability to distinguish between hydrocarbon and water filled reservoirs, as hydrocarbons have more resistivity. PGS recently went public with their development of a marine vibrator as an alternative to using the conventional airgun. Vessels are continually changing as well, with Veritas CGG and PGS among other strong companies trending toward using solid streamers. A revolutionary project is being carried out by Fairfield at the Atlantis field in the Gulf of Mexico. The new surveying technology, called the Z 3000 system, is perfect for the niche market of difficult geology such as the subsalt environment in the Gulf of Mexico. It can be used for 4-D time-lapse surveys, and has nodes depth-rated to 3000m typically distributed about 400m apart, which is a much larger distance than typical receiver spacing on OBC operations (McBarnet, 2006).

The industry is trending towards more vertical integration as it realizes the value-add association with delivering not only high quality acquisition services, but also high quality processing and imaging. Geophysical companies used to simply collect the data; now they acquire data, process data, and provide reservoir imaging services such as Amplitude Variation with Offset (AVO) and Hybrid Inversion to assist E&P companies in hydrocarbon exploration (WesternGeco, 2007b).

2. Hurricane Impacts

The 2005 hurricanes did not have much physical impact on the geophysical services industry. With the majority of work done in offices and data centers, there were no reports of company assets or properties being damaged or destroyed. None of the major geophysical service companies reported any impact from the hurricanes. However, with the increase in work received by most GOM service companies in the clean-up and aftermath of Hurricanes Katrina and Rita, no doubt the geophysical services felt the increase as well.

3. Outlook

The geophysical service industry is a key component within the energy economy at a time when there is increasing exploration in deep and complex environments requiring high quality and high-resolution seismic images. The industry is a cyclical one, driven by many factors, among them the exploration opportunities in deepwater basins such as the Gulf of Mexico, deepwater drilling technology improvements allowing E&P companies access to even deeper waters, the capital expenditures of E&P companies for new seismic data, and continually improving processing algorithms through focused R&D work.

In the very recent past, the industry has experienced tough times, such as the 1998 price crash, from which it has slowly rebounded. Geophysical service companies worldwide have been experiencing improvements in pricing and demand since 2004. Large firms such as PGS expect seismic contract prices to increase due to the high industry capacity utilization of seismic fleets worldwide. In their 2007 2nd Quarter Report, CGGVeritas stated the industry will be driven by high-resolution 3D seismic offshore exploration as the oil industry moves to deeper-water areas (SEC, 2007b). In 2005, Veritas Chairman and CEO Thierry Pilenko commented:

> "Sustained strong demand combined with relativity low reserve replacement continues to support increased geophysical activity and pricing worldwide. This is particularly evident in contract marine acquisition, which drove our solid performance for the third fiscal quarter. Looking ahead to fiscal 2006, we believe that the market conditions will remain buoyant and are feeling good as we enter our planning process for our next fiscal year (Veritas DGC, 2005)."

While company CEO's and industry analysts expect the industry to continue these improvements, many believe the industry will improve greatly in the U.S. Gulf of Mexico, particularly in the Outer Continental Shelf, in deeper waters, where the BOEMRE and industry believe lie the largest remaining reserves (AAPG, 2004c).

D. Chapter Resources

Atlantic Communication's Gulf Coast Oil Directory
Includes a wide range of data from company name, address, web and email addresses to contact names with titles, and email addresses all organized alphabetically by industry categories. Also included is "Company Detail" information such as company size, revenue, areas operated in last 12 months, operations onshore or offshore, and stock information for publicly traded companies.
http://www.oilonline.com/store/directory.asp

Securities and Exchange Commission
Quarterly and annual reports of operations for publicly traded companies are filed with the Securities and Exchange Commission.
http://www.sec.gov/edgar/searchedgar/companysearch.html

VII. DREDGING

A. Description of Industry and Services Provided

Dredging is the removal of sediments shoals from navigation channels, and is the primary activity that assures safe and efficient navigation. Proper depth in navigation channels allows ships to move safely through harbors and provides turning basins and adequate water depth alongside terminal facilities. To maintain this depth, several hundred million cubic yards of sand, gravel and silt must be dredged from waterways and harbors each year. However, this maintenance and improvement process is challenging and controversial because ports are located in or near some of the nation's most environmentally-sensitive areas – valuable wetlands, estuaries and fisheries. And dredging may release toxins from sediments to the water column. Other reasons for dredging include coastal and beach restoration, environmental remediation, land reclamation, pipeline trenching and even equipment recovery.

B. Industry Characteristics

1. Vessels and Methods

According to one dredging company, "the U.S. dredging market consists of three primary types of work: capital, beach nourishment, and maintenance (SEC, 2006s)." Most of the dredging projects that are undertaken in the U.S. are associated with federal navigation projects (classified as maintenance or capital) that are carried out by the U.S. Army Corps of Engineers (USACE) and cost is shared with a local sponsor, most often the local port authority.

Capital dredging is dedicated primarily to port expansion, specifically for the purpose of deepening channels for larger ships and supplying land fill for additional facilities. Other purposes include dredging for marine structures such as jetties and trench digging for pipes, tunnels, and cables (SEC, 2006s).

When substantial shoreline assets are threatened by shoreline erosion, beach nourishment projects are often implemented. Beach nourishment is fundamentally the transporting of ocean floor sands to the shoreline. These projects usually occur in the fall and winter months to minimize environmental impacts and are generally a more acceptable solution to jetties or the relocation of assets (SEC, 2006s).

Maintenance dredging is essentially the re-dredging of existing waterways that have accumulated sediments. In order to sustain the same level of navigability, maintenance drilling is usually required every one to three years to deal with natural sedimentation (SEC, 2006s).

There are two primary types of dredging techniques used by the industry: mechanical and hydraulic. States generally have not included preferred dredging techniques and or best management practices in their formal policies; however, there are specific techniques and practices for some. Requirements are generally formulated on an individual item basis given the techniques' dependence on hydrology, chemical composition of sediments, and the type of species that inhabit the area (Lukens, 2000).

Mechanical dredging involves the use of heavy equipment at the shoreline and may or may not involve draining a lake (see Figure 33). Several types of mechanical dredges are used. Dipper dredges and clam shell dredges are the two most common. Mechanical dredges are rugged and capable of removing hard-packed materials or debris. They can be worked in tight areas and are efficient when large barges are used for long-haul disposal. Mechanical dredges have difficulty retaining loose, fine materials in buckets, do not dredge continuously like pipeline dredges, and may need added controls when handling contaminated sediments. Mechanical dredges place the material into barges for transport to the placement location (SEC, 2006s).

Figure 33. Mechanical dredge.

Hydraulic dredging involves a dredge that floats on the water and pumps the material through a temporary pipeline to an off-site location, often several thousand feet away (see Figure 34). This dredge acts like a giant floating vacuum removing sediment very precisely (Dredge America, 2007). Both dredges are used to deepen and widen channels filled with sediment and deposit the sediment in an approved location. Mechanical dredges shovel or scoop up bottom materials and place them on a barge or scow. Hydraulic dredges use pumps to remove a mixture of water and sediment ("slurry") from the channel bottom. The Hopper Dredge is an ocean-going vessel used to dredge sediment from the bottom of a deepwater channel or coastal harbor. Dredged material is stored in "hopper bins" inside the ship before disposal in the open sea or other location (SEC, 2006s).

Figure 34. Hydraulic dredge.

Vessels commonly used to dredge sediment from the bottom of shallow rivers or calm coastal waters are called pipeline dredges. Dredged material is pumped from the river or ocean bottom and through a floating pipeline to shore. This dredged material is often used to restore eroded beaches (USEPA, 2007a).

There are a number of federal and state agencies involved in overseeing dredging activities in the United States. Under the Clean Water Act (Section 404) the USACE manages the program that directs dredging and disposal of dredged material from navigation improvement and maintenance programs (USACE, 2007). The USACE is responsible for developing and maintaining Federal navigation channels. Through the Water Resources Development Act biennial legislation, the USACE continues to be responsible for maintaining 25,000 miles of navigation channels throughout the U.S. There are 400 major and minor ports in the U.S. that rely on these navigation channels. Annual maintenance performed by the USACE on these channels results in the removal of 300 million cubic yards of material annually on average (Lukens, 2000). An additional 100 million cubic yards are removed annually by private entities (Lukens, 2000).

The USACE is also responsible for permitting non-federal dredging activities under Section 404 of the Clean Water Act, Section 103 of the Marine Protection, Research and Sanctuaries Act (MPRSA), and the River and Harbors Act (RHA).

The U.S. Environmental Protection Agency (USEPA) oversees and develops the environmental criteria by which the USACE evaluates proposed disposal of dredged material. The USEPA also designates and monitors ocean-dredged material disposal sites. A USACE permit is required when dredged sediments are disposed of in the ocean, inland, or near-coastal waters. If dredged material is disposed of on land various Federal, state and local regulations may apply (USEPA, 2007b).

The Federal government's actions are closely intertwined with state actions concerning dredging. For instance, Section 307 of the Coastal Zone Management Act (CZMA) provides states with federally approved coastal management programs, the authority to review all federal activities that affect any land or water use or natural resource of the coastal zone for consistency with state Coastal Management Plan (CMP) enforceable policies. This federal consistency provision applies to all federally authorized navigation projects and to private dredging projects that require certain permits. The net result is that all federal and private dredging projects must address state coastal management policies in their project development, design and permitting process. Only states with coastal management plans fall under this requirement, which includes 34 states and territories (Lukens, 2000).

The driving force behind dredging has been recreation and commerce, though post-2005 hurricane studies have found that restoring beaches, wetlands and barrier islands can play a pivotal role in deflecting the most devastating effects of large storms. Ports that want to grow and expand their capabilities look to deepen their navigational channels that connect them to the sea so that deeper draft vessels carrying more cargo can make their way to the port. In terms of the GOM oil and gas industry the move towards deeper drilling requires larger vessels, thus dredging is essential for the existing ports servicing the oil and gas industry. As the size of a vessel increases, it can handle more cargo and the costs of transporting commodities decrease (Lukens, 2000).

Beneficial Uses of Dredged Material

Dredged materials have traditionally been viewed as a waste and are for the most part are disposed of in facilities similar to landfills. At the same time, sand was "mined" or dredged from offshore sites for the sole purpose of beach nourishment and erosion control. "Beneficial use, or re-use as some may refer to it, is the practice of taking material dredged from a channel to maintain its depth or deepen it, and then using that material for another purpose, such as beach nourishment or wetlands creation (Lukens, 2000)."

Dredged sediment represents one of the most important resources for building wetlands. Beneficial use is any use which would protect, enhance, or provide a platform for the restoration of vegetated wetlands. Such uses could include the impacting of some vegetated wetlands if the long-term result is the protection or net gain of vegetated wetlands. Where applicable, dredged sediment is re-deposited in areas to restore wetlands and beaches (Lukens, 2000).

The State of Louisiana requires that dredged material resources be used for beneficial programs and it is required for permitting activities. Some states have different definitions of beneficial use. For example, Louisiana's definition is aimed at wetland creation/protection. Mississippi's definition includes beach replenishment, construction, sanitary landfill, and agricultural soil improvement (Lukens, 2000).

It has been the policy of the USACE that, as long as the effort to achieve beneficial use is within the project's base plan or Federal standard costs, the USACE can and will make beneficial use of dredge material resources. If, however, the cost exceeds the federal standard or base plan, beneficial use will not be made unless additional funding from some other authority and/or source can be found to cover those costs which exceed the base plan costs (LCWC, 1998).

Beneficial use of dredged material is vital in the restoration of beaches and wetlands following major storms, and is particularly important to the State of Louisiana, whose low-lying beaches, wetlands and barrier islands offer dwindling protection against these storms as millions of tons of materials are annually lost due to weather (see Figure 35). Storms drive high wave energy and overwash events that erode and breach the barrier shoreline, which result in the deterioration of dunes and damage or destroy coastal navigation, protection, and restoration projects (LCWC, 1998).

Source: Navarre Beach, 2007.

Figure 35. Beach restoration project.

Louisiana loses about 25 square miles of coastal wetlands each year; or the equivalent to one acre every 25 minutes (LA Coast.gov, 2009). Scientists estimate that the state will lose another 700 square miles in the next 50 years (USACE, 2004a).

In Louisiana, on an annual basis, 60-90 million cubic yards of material are removed from federally maintained navigation channels. To date, approximately 7,500 acres of vegetated wetlands have been created by beneficial placement of dredged material resources. According to the Coast 2050 report it is estimated that up to 6 square miles of subaerial wetlands could be created each year off the coast of Louisiana out of dredged material, compared to the approximate annual loss of 30 square miles each year (LCWC, 1998).

The USACE and state of Louisiana have used dredged material resources to create over 7,000 acres of subaerial land which has become vegetated wetlands. This usage has occurred in conjunction with maintenance dredging of federally maintained navigation channels, as well as through jointly-funded efforts utilizing USACE authorities matched by the state (LCWC, 1998).

The state of Louisiana has stated its policy with respect to beneficial use of dredged material resources to be “the Secretary of the Department of Natural Resources shall insure that whenever use or activity requires that dredging or disposal of 500,000 cubic yards or more of any water bottom or wetland within the coastal zone, the dredged material shall be used for the beneficial purposes of wetland protection, creation, enhancement or combination thereof.” R.S. 49:214:32(F) (LCWC, 1998).

The Louisiana Coastal Plan has implemented a program plan recommending the authorization of $100 million in additional funding needed to make up the difference between the Federal standard costs and the actual costs of using dredged materials for beneficial use. Based on the request, and a 10-year period of implementation, the program goals will create, restore, nourish and provide protection to coastal wetlands and coastal wetland features (USACE, 2006).

Following the devastating hurricanes of 2005 the Louisiana Legislature passed Senate Bill 71, which became known as Act 8 following the governor's signature. This Act created the Coastal Protection and Restoration Authority (CPRA) and charged it with coordinating the efforts of local, state and federal agencies to achieve long-term, comprehensive coastal restoration and hurricane protection. Along with this effort, Congress directed the ACE to develop its own Louisiana Coastal Protection and Restoration report (CPRA, 2007).

The CPRA report listed several recommendations that rely heavily on the beneficial use of dredged materials, among those include continued navigation channel dredging, marsh restoration, barrier shoreline restoration, ridge habitat restoration, and shoreline stabilization (CPRA, 2007).

The report warns that if sustainability is not restored to the coastal ecosystem that land will continue to be lost at a rapid rate, and critical infrastructure will be damaged or destroyed. Pipelines, offshore support centers, and other facilities constructed for inland conditions will be subject to the open water of the GOM. Shipping will be similarly affected. As wetlands become waterlogged and disappear, storm surges will batter south Louisiana's waterways and ports, disrupting commerce and increasing maintenance costs (CPRA, 2007).

2. Geographical Distribution

Virtually every port must be dredged for maintenance purposes, including offshore oil and gas supply ports. Most of the shipyards and ports for the oil and gas industry are found in East Texas and along the Louisiana coasts, including Port Fourchon, Houma, Morgan City, Lake Charles, Patterson, Golden Meadow, Amelia, and Lafayette (see Figure 36).

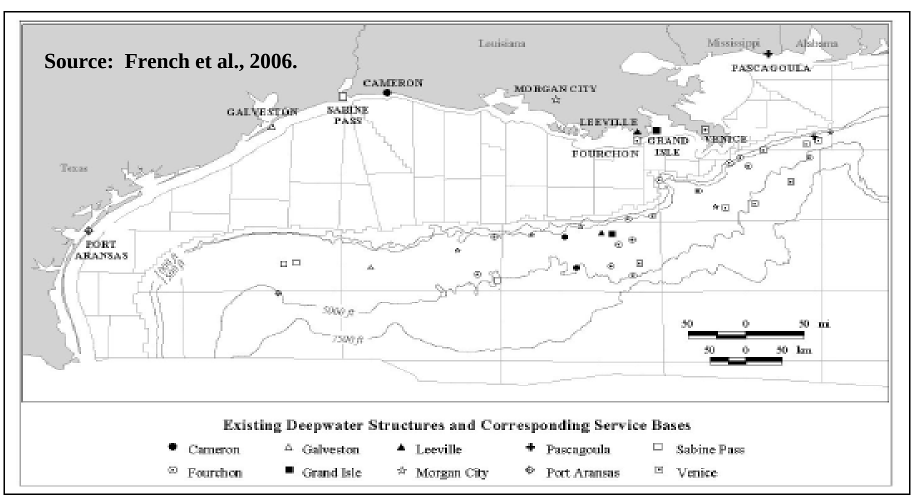


Figure 36. Existing deepwater oil and gas supply ports.

As operations continue to expand to deeper water, new port facilities will be needed, and older facilities will require significant dredging to remain competitive (see Figure 37).

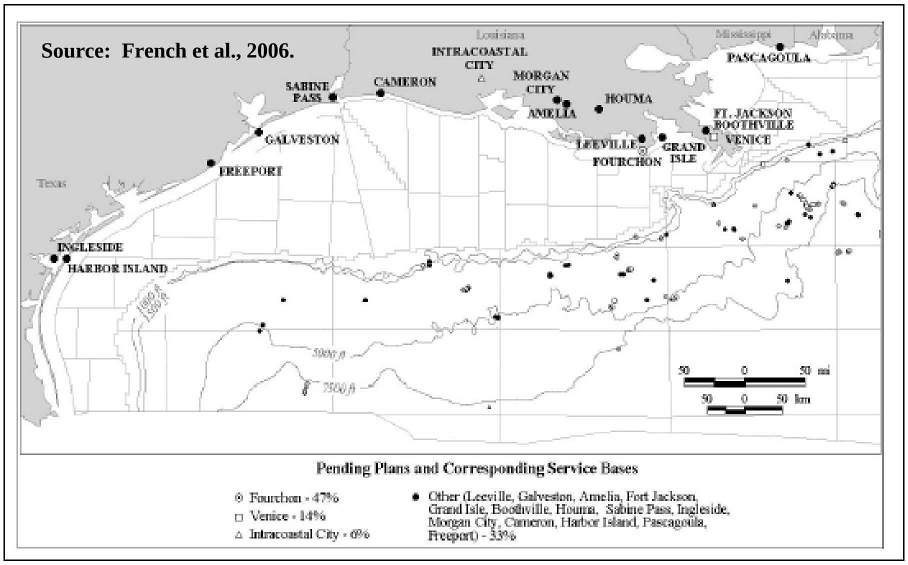


Figure 37. Proposed deepwater oil and gas supply ports.

3. Labor Force

Dredging labor statistics for GOM oil and gas falls within the classification of “All Other Heavy Construction” within the North America Industry Classification System (NAICS), which represented 140,202 employees in 2002. The Gulf States’ total number of employees in 2002 for this classification was 21,027. Louisiana and Texas contributed to more than 80% of that figure (USDOC, Bureau of the Census, 2002d).

Dredging projects involve ship captains, crew, engineers, welders, heavy equipment operators and others. Dredge operators alone make up more than 1900 employees in the United States. Within the industry classification of “Other Heavy Construction,” dredging operators represented 370 employees. Louisiana was identified as one of the top five states with the highest concentration of workers in this classification (USDOC, Bureau of the Census, 2002d).

Most dredging companies are not under collective bargaining agreements, though some are, and maritime unions have targeted others. Dredges fall under most Coast Guard regulations and are therefore required to complete significant training for all aspects of their jobs. However, new requirements were implemented in 1995 with the new amendments to Standards for Training, Certification, and Watchkeeping. All mariners working on vessels greater than 200 gross tons and candidates for licenses and documents must take courses, pass examinations, and demonstrate their skills aboard vessels (STCW, 2007).

Due to the hard work and long hours, turnover among mariners, especially at the lower levels, is high. Workers are typically paid by the day, and many work 12-hour shifts each day. Because of fatigue-related accidents the Coast Guard issued a policy letter in 2002 stating that mariners are not permitted to work more than 12 hours in a 24-hour period, except in an emergency (USDOT, Coast Guard, 2007).

4. Typical Firms

U.S. dredging operations are dominated by four companies with Great Lakes Dredge & Dock Company (with 27 dredges), C.F. Bean, Baltimore Dredge Enterprises, and Weeks Marine being the largest. There are numerous smaller companies. Great Lakes is the industry leader in the U.S. with 36 percent market share (SEC, 2006s). Weeks Marine is the largest provider of dredging services in the Gulf of Mexico, where two-thirds of all U.S. dredging occurs. The company moves more sediment annually than any other U.S. dredging contractor (Weeks Marine, 2007). C.F. Bean is the U.S. subsidiary of Royal Boskalis Westminster, the largest dredging organization in the world.

The largest dredge manufacturer in the U.S. is Baltimore Dredge Enterprises and its operating entity Ellicott Dredges, which has designed and manufactured over 1,300 dredges, and has served customers in over 70 countries (Ellicott, 2007).

The typical dredging company is made up of a fleet of dredges and support ships and the largest companies in the U.S. are usually headquartered along the Northeastern coast and Great Lakes. With operations throughout the U.S. and, in many cases, around the world, these companies' dredges are found wherever the work is. The USACE is the largest user of dredges, and competitively bids the work.

Dredging contracts are most often obtained through competitive bidding and the terms are specified by the company soliciting the bid. The nature of the project or services will dictate the type of equipment, labor and material that will be needed. All of these inputs will affect the cost of the contract (SEC, 2006s).

The dredging industry operates under the control of several relevant laws and statutes, including the Dredging Act, the Jones Act, and the Shipping Act, which provide a significant barrier to entry with respect to foreign competition. Together they prohibit foreign-built, chartered or operated vessels from competing in the U.S. Other laws and regulations include environmental rulings such as the Clean Water Act, Clean Air Act, and others. The Marine Protection, Research, and Sanctuaries Act (also called the Ocean Dumping Act) governs transportation of dredged material for the purpose of disposal into ocean waters. Section 404 of the Clean Water Act (CWA), governs the discharge of dredged or fill material into U.S. waters (USEPA, 2007b).

Many projects, such as beach nourishment projects with offshore sand borrow sites, dredging projects in exposed entrance channels, and dredging projects with offshore disposal areas, are restricted by federal regulations to be performed only by dredges or scows that have U.S. Coast Guard certification and a load line established by the American Bureau of Shipping. The certifications indicate that the dredge is structurally capable of operating in open waters.

As with all industries there are legal issues that can hamper business greatly. One of the many legal challenges stemming from Hurricane Katrina includes class action suits alleging that dredging of the Mississippi River Gulf Outlet in New Orleans caused the destruction of the Louisiana wetlands, which had provided a natural barrier against storms and hurricanes. The suits allege that the loss of these natural barriers contributed to the failure of levees. Virtually all of the dredging companies who conducted work in the area were included in these lawsuits.

C. Industry Trends and Outlook

1. Trends

In 1994, over 30 percent of the U.S. Gross Domestic Product (GDP) was comprised of foreign trade, 95 percent of which passed through U.S. ports (USDOT, Maritime Administration, 1994). International trade now accounts for 25 percent of GDP and U.S. ports are responsible for 99 percent of the country's overseas cargo. Imports and exports are valued at $5.5 billion that move through U.S. ports every day (AAPA, 2006). Consumers are benefiting from the amount of goods being imported, with lower inventory costs, more efficient shipping costs and cheaper foreign prices. In the last 20 years, inventory costs alone dropped from 25 percent to only 14 percent. In 2006, the port-related jobs accounted for 8.4 million workers, who earned and spent $314.5 billion. By the year 2020, U.S. foreign trade in goods may grow to reach as much as one-third of the GDP (AAPA, 2006). All of these factors make shipping and navigation a top priority for the U.S. government and private interests.

Improving and maintaining navigation channels is critical to sustaining the rapidly growing marine transport industry. Bottlenecks can occur when channels are not deep enough for ships to safely navigate and dock at berths. Unless ports are dredged, cargo cannot move in the most cost effective way through the intermodal transportation chain. Also, as ship sizes and volumes of cargo increase, so must the intermodal transfer operations to foreign ports.

The depth at federal channels was rated below average by 42 percent of the strategic ports. Fully 50 percent of the strategic ports also rated the depth of private channels and berths below average. Conditions at non-strategic ports were ranked better by two and 12 percent, respectively. Maintenance dredging of federal channels was ranked below average by nine percent of the strategic ports and 30 percent of the non-strategic ports (USDOT, Maritime Administration, 2005a).

Below average depths at our deepwater ports have the potential to have a dramatic impact on shipping in the U.S. As the larger container ships currently being built enter into service over the next 4-5 years, the scope of the problem could widen to affect even more deepwater ports. Potentially, insufficient depth and dredging of all our deepwater ports can cause overcrowding at the deepest ports while shallower ports are under-utilized. The 2004 Infrastructure Report's evaluation of depth, including dredging, confirmed this finding when it stated, "Lack of adequate deepwater capacity could result in newest generation container ships making primary calls at foreign ports. U.S. ports would then either be served after ships have been partially discharged abroad or by feeder. This would result in added time/cost to inter-regional shipments and could reduce the overall efficiency of import/export shipping to the rest of the U.S. (USDOT, Maritime Administration, 2005a)."

Maintenance dredging is one of the most important infrastructure challenges for many ports. Several ports expressed concern that the USACE has not received adequate funding to handle needed (and congressionally-authorized) maintenance and improvement dredging projects. For example, the Gulf Intracoastal Waterway System was specifically mentioned as an area needing attention. Some U.S. ports are already operating at maximum draft levels. At least one port in the U.S. South Atlantic has limited berthing hours to high tide. To maintain navigation in 2003, the Corps removed approximately 250 million cubic yards (190 M cubic meters) for a total cost of $900 million (USACE, 2004b). However, the USACE is faced with a growing backlog of projects.

Capital expenditures on dredging were 13.3 percent of total port expenditures in the U.S. for 2006, the second highest expenditure category behind Specialized General Cargo facilities. The Gulf Coast region accounted for 28 percent of dredging expenditures, exceeded only by the South Atlantic which was 33.2 percent of dredging expenditures. The North Atlantic region accounted for 21.1 percent (USDOT, Maritime Administration, 2009). Projected expenditures for dredging are expected to drop to just over 10 percent for 2007 through 2011 (USDOT, Maritime Administration, 2009).

Table 7

Public Port Capital Dredging Expenditures by Region, 2006

	Improvement	Maintenance	Total	Percent of Total (%)
	------ (thousand $) ------			
North Atlantic	$ 2,816	$ 27,630	$ 30,446	21.1%
South Atlantic	$ 32,978	$ 14,804	$ 47,782	33.2%
Gulf	$ 11,969	$ 28,340	$ 40,309	28.0%
South Pacific	$ 13,499	$ 2,980	$ 16,479	11.4%
North Pacific	$ 1,018	$ 8,032	$ 9,050	6.3%
Total	$ 62,280	$ 81,786	$ 144,066	100.0%
Percent of Total	43.2%	56.8%	100.0%	

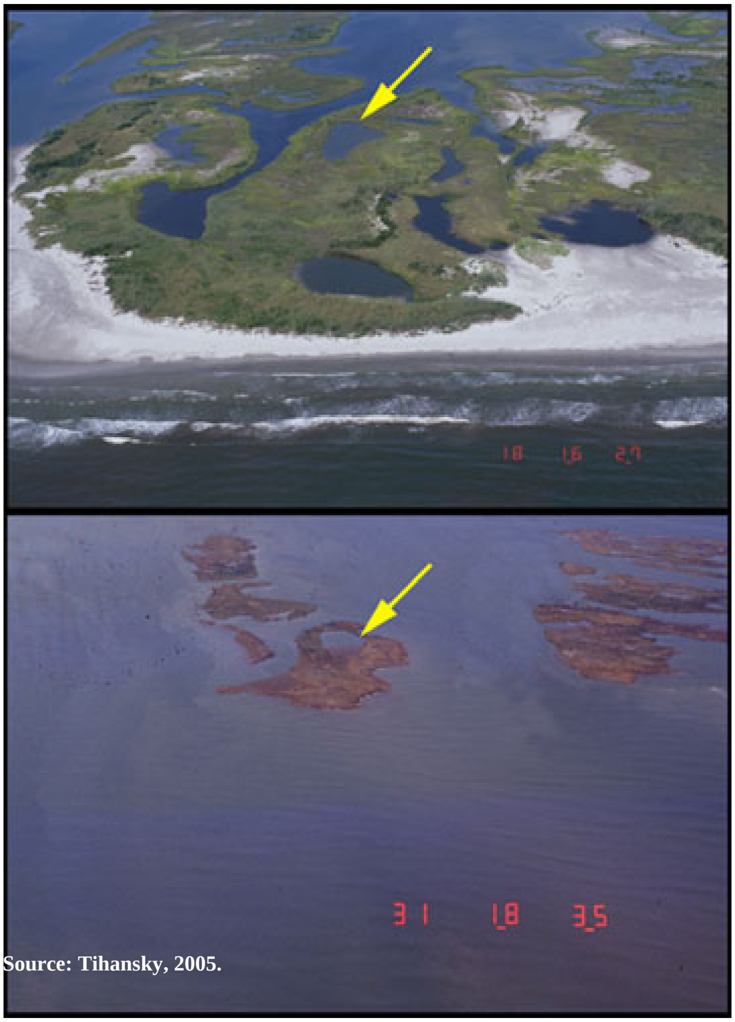
Source: USDOT, Maritime Administration, 2009.

2. Hurricane Impacts

Storms and hurricanes take a tremendous toll on shorelines, wetlands, and barrier islands each year. Barrier islands in particular play a vital role in protecting the Gulf coast's shoreline, particularly in Louisiana where millions of tons of materials are annually lost due to weather. Storms drive high wave energy and overwash events that erode and breach the barrier shoreline, which result in the deterioration of dunes (see Figure 38). Coastal navigation, protection, and restoration projects are damaged or destroyed during these storms.

Scientists and engineers continue to study the effects of large storms and hurricanes and look for ways to rebuild or restore these areas in a manner that is more permanent and environmentally responsible. Dredging is the primary method of restoring beaches, wetlands and barrier islands and will continue to play a very important role in restoring and strengthening at-risk structures.

Hurricanes often displace sediment requiring the re-dredging of ship channels. Hurricane Rita deposited approximately 8 million cubic yards of sediment into the Galveston ship channels, costing $17.3 million to remove. Port Fourchon was operating with a 21-foot draft after sustaining severe damage. Sunken vessels were not immediately removed unless they blocked a vital channel. The Corps of Engineers determined what restrictions applied when channel depths did not meet previous standards, and often resolution was found on a case-by-case basis. (USACE, 2008).



Source: Tihansky, 2005.

Figure 38. Before and after photo of Katrina damage to Chandeleur Islands off coast of Louisiana.

3. Outlook

The future for dredging companies appears to be secure for a number of reasons. First of all, the newest generation of cargo ships is much larger than ever, forcing most U.S. ports to upgrade and deepen port facilities, which includes significant dredging. This holds true for offshore oil and gas supply ports, as deepwater drilling requires larger support ships. This is especially true along the GOM. Second, due to natural sedimentation, active navigation channels require maintenance dredging every one to three years, thus creating a recurring source of dredging that is often non-deferrable. Third, there is a substantial need for beach nourishment as beach erosion is a continuous problem, and there is a growing awareness as to the importance of beachfront property to the tourism industry. Beach nourishment projects are typically funded by federal, state and local monies. With the intensity of the GOM storms over the last few years the beach nourishment segment of dredging is expected to continue to grow. For instance, the Louisiana Coastal Area Ecosystem Restoration Study estimates that for the island chain of Isle Derniere, about 0.5 million cubic yards of sand will be needed for maintenance per year if the chain is restored (USACE, 2004b). Finally, the renewed interest in LNG provides significant opportunities for dredging as well, particularly with private companies who are developing LNG properties.

The positive outlook for the industry has to be tempered with negative funding developments regarding the USACE, the largest employer of contracted dredging services. Due to budget constraints, and new regulations, the Corps has been hampered in getting projects out to bid.

D. Chapter Resources

Atlantic Communication's Gulf Coast Oil Directory
Includes a wide range of data from company name, address, web and email addresses to contact names with titles, direct phone numbers, and email addresses all organized alphabetically by industry categories. Also included is "Company Detail" information such as company size, revenue, areas operated in last 12 months, operations onshore or offshore, and stock information for publicly traded companies.
http://www.oilonline.com/store/directory.asp

U.S. Securities and Exchange Commission
Quarterly and annual reports of operations for publicly traded companies are filed with the Securities and Exchange Commission.
http://www.sec.gov/edgar/searchedgar/companysearch.html

VIII. CATERING AND PERSONAL SUPPORT SERVICES

A. Description of Industry and Services Provided

There are over 4,000 offshore Gulf of Mexico oil and gas structures, with over 800 of them permanently manned – all depending upon support from a variety of service companies for their provisions (USDOI, MMS, 2007a). Provisions include all of the supplies necessary for continuing operations. This section will focus on a broad definition of provisions that includes food management (i.e. procurement, storage, preparation, and cleanup); accommodation management (housekeeping and laundry); as well as other related services such as security, medical services, potable water, waste management, entertainment and more. Some companies provide all of these services, while others may specialize in one or two. Some provision companies have a worldwide presence and have thousands of employees, while others are very small, and may operate only in one region with a handful of employees. The larger companies tend to be publicly-traded and have many divisions covering the entire range of products and services required in the offshore industry. Most, however, are privately-held.

While no region-specific sales data is publicly-available, Sodexho estimates that facilities' management (including catering, laundry, etc.) for remote sites is a $14 billion/year business worldwide (SEC, 2006n). Daily operating costs vary greatly among the manned platforms in the GOM, depending upon the number of workers present. Larger facilities have a full service kitchen (see photo).

Most offshore platforms are built to be in operation for 20 to 25 years, so it is imperative that safety and comfort needs are met, and kept up-to-date (Barrett, 2005). Good food and accommodations also serve as an enticing recruitment for an industry beset by substantial skilled labor shortage and its cyclical nature.

Many provision companies provide the all-important "way in" to the offshore oil and gas industry by offering entry-level opportunities. Some of the most experienced industry employees got their start working for a provision company.

B. Industry Characteristics

1. Typical Facilities

Food Management

Everyone has to eat, and providing good meals to very remote areas is of paramount concern for all companies operating in the offshore oil and gas industry. Often one of the primary benefits (and recruiting tools) of working long shifts away from one's family is the reputation of good food served aboard offshore facilities. Companies operating facilities in the GOM are responsible for providing living accommodations and meals to its workers. These companies often contract with onshore supply companies to provide all of the provisions used offshore, including potable water (see Figure 39).

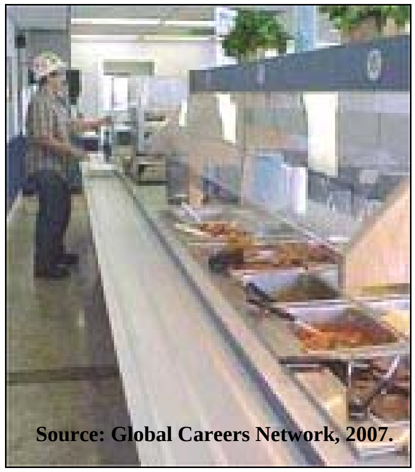


Figure 39. Typical kitchen facility on large offshore platform.

Rig catering departments are composed of various positions, mainly utility, galley hands, cooks, stewards, etc. and are led by a camp boss. The number on board each rig or vessel depends on its size, and can range from two or three to several dozen people.

However, older offshore supply vessels (OSVs) which deliver supplies to the facilities rarely have cooks and the crews often rely on their provisions, though some contracts require an on-board cook. Newer generation OSVs, especially deepwater vessels, usually have galleys.

The Camp Boss and cooks normally are responsible for ordering provisions, which is done primarily by computer. The order is filled at the onshore facility and delivered by truck to the OSVs, which deliver the provisions on a weekly, or more often, basis.

Food is brought to the rigs via ships, which, on average, re-supply the vessels weekly. Provisions are typically ordered well in advance, and in most cases, arrive in bulk. During transportation supplies are stored in refrigeration and freezer units, as needed. Food is prepared on site, usually via two 12-hour shifts, though work schedules vary from company to company (USDOI, MMS, 2004b).

According to 46 U.S.C. 10303(a), “seamen shall be served at least three meals a day that total at least 3,100 calories, including adequate water and adequate protein, vitamins and minerals in accordance with the United States Recommended Daily Allowance (U.S. Code, 2006).”

Personnel working offshore on floating platforms are considered mariners, or seamen, and thus fall under the above regulation. This provision is most often easily met as meals prepared offshore are comparable to fine quality restaurants in many cases.

Accommodation Management

Research has shown that the physical and social environment of offshore accommodations can make an important contribution to the quality of life and stress levels of offshore workers. Two factors appear to be especially important – privacy and recreational facilities. Many offshore facilities provide small, shared quarters with up to eight people to a room, while some companies provide two person quarters. By nature, cabins are small, with few luxuries. However, a concentrated effort by many companies to provide recreational facilities such as gyms, tv/computer rooms, and other facilities has taken place (Shrimpton and Storey, 2001).

The shortage of skilled labor has also forced energy companies to improve living conditions. Facilities have evolved from drafty trailers and communal showers to more worker-friendly housing. Of course, accommodations vary from company to company and location to location. Offshore companies provide all accommodations and services while employees are working. Some of the newer, larger facilities include gyms and other entertainment opportunities. The larger facilities often have a separate hotel platform (or Floatel) (Carroll, 2007a and 2007b).

Accommodation management includes laundry and housekeeping services, including maintenance of living quarters. Several companies, such as Taylors International Services, Inc., also offers clients consultation services on the design and layout of galley and living quarters. Since space on offshore facilities is always at a premium it is important to make the most efficient use of the available space. These modern accommodations drive operating costs up substantially, but the industry has no choice as new safety regulations and labor shortages require the investment.

Figure 40 shows a two-person cabin aboard the “Offshore Olympia” accommodation barge. The 500-person floatel can be moored alongside a deepwater production facility. Gymnasiums and other entertainment offerings are often found aboard such vessels.


Source: Barges.com, 2007.

Figure 40. Offshore accommodations.

Figure 41 shows another picture of the deepwater accommodation barge “Offshore Olympia,” which is positioned next to a deepwater production facility. In the event of an approaching storm the barge can be moved quickly out of the way.

Figure 41. Offshore floating accommodations (Floatel).

Other Management Services

Other services often provided by provision companies include security, medical services, waste management, entertainment, and others. One of the most critical services provided is that of potable water transportation and waste management.

Abundance of potable water is a serious issue in the offshore industry, and most employers maintain robust supplies, especially bottled water. However, the great majority of the potable water is transported in tanks aboard the OSVs, which lack of inspections and lax oversight has resulted in communication of diseases. In 2004 Congress passed the Coast Guard and Maritime Transportation Act, which included a section (214) on Potable Water which amended 46 U.S. Code 3305(a) to read "the inspection process shall ensure that a vessel subject to inspection . . . has an adequate supply of potable water for drinking and washing by passengers and crew." This Act also mandated that the nation's 5,200 towing vessels be inspected (U.S. Congress, 2004).

Many platforms and some OSVs do install water purification equipment to ensure the safety of drinking water. Additionally, some facilities may have desalinization equipment on board. However, many older, smaller OSVs (including tugs and barges) do not provide such equipment. Water tanks aboard OSVs are most often filled with potable water from public sources and the water is potable and safe. Problems are most often incurred as the result of water stored in tanks that may not be regularly cleaned or inspected.[4]

The Environmental Protection Agency also has authority to establish regulations to protect human health from contaminants in drinking water under the Safe Drinking Water Act (SDWA) (Bryant, 2005).

[4] Note: Mobile platforms and jackup rigs are considered to be vessels, which means that on-board personnel are considered mariners when underway, and are under the jurisdiction of the U.S. Coast Guard, which places additional requirements such as licenses and more training on crews.

Waste disposal is also of paramount concern as several federal and state laws require the safe disposal of offshore wastes that are returned to land for disposal. Many of the offshore supply companies transport the wastes in special tanks on OSVs from the offshore site to onshore transfer facilities. From there the wastes are transferred to another transportation mode and sent to a final point of disposition (USDOI, MMS, 2004a).

Wastes from offshore facilities include solids (such as drill cuttings, pipe scale, produced sand, etc.), drilling muds (oil and water-based), fluids, naturally-occurring radioactive materials (tank bottoms, pipe scale, etc.), industrial hazardous wastes (solvents and other chemicals), machine oil, diesel, and municipal solid waste (USDOI, MMS, 2004a).

Under certain conditions wastes may be discharged into the sea, but must be virtually free of hydrocarbons and any other chemicals that could be harmful to marine life. Produced water is the most abundant waste stream and can be discharged after appropriate treatment measures have been taken. Water-based drilling muds that are made from clean barite, without certain chemical additives, and have not encountered hydrocarbons are also dischargeable under proposed regulations. And, under most circumstances, once domestic and sanitary sewage from rig employees has been treated, it can also be discharged into the sea (USDOI, MMS, 2004a).

2. Geographical Distribution

Along the coast there are many onshore facilities that support the offshore industry. Exploration and production in the GOM are concentrated in three areas: Western, Central and Eastern Gulf regions. Located adjacent to these regions are hundreds of contractors operating ports, crew bases, and other supporting industries. Provision providers typically have offices in all offshore port and service facilities along the Gulf coast, with largest facilities found in Port Fourchon, New Iberia, Lafayette and Houston areas (see Figure 42).

The Port of Iberia is the Gulf Coast's largest shallow water draft port, with more than 100 companies housed at the port that employ over 5,000 workers (Port of Iberia, 2007). Port Fourchon, Louisiana, is the most significant deepwater port and houses over 250 companies. In addition to its huge domestic hydrocarbon significance, Port Fourchon is land base for the Louisiana Offshore Oil Port (LOOP), which handles about 13 to 15 percent of the nation's foreign oil and is connected to 50 percent of U.S. refining capacity. LOOP is the only U.S. deepwater port capable of offloading very large crude carriers (VLCCs) and ultra large crude carriers (ULCCs). The Bureau of Ocean Energy Management, Regulation and Enforcement projects that the Port will service 47 percent of pending deepwater projects, and no other port is currently servicing more than 14 percent.

As deepwater exploration and production escalates more supply bases will emerge, and those facilities capable of meeting deepwater needs (i.e., facilities with deepwater port capabilities) will benefit from the expansion (see Figure 43).

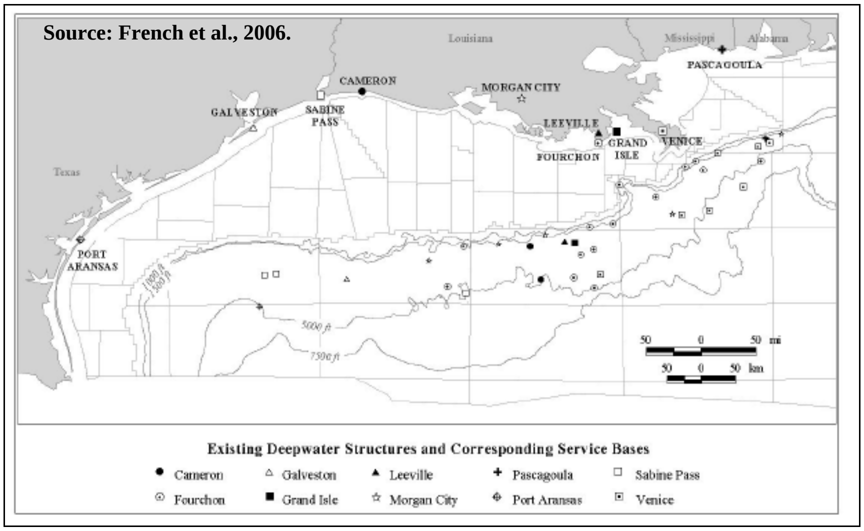


Figure 42. GOM existing supply bases and ports.

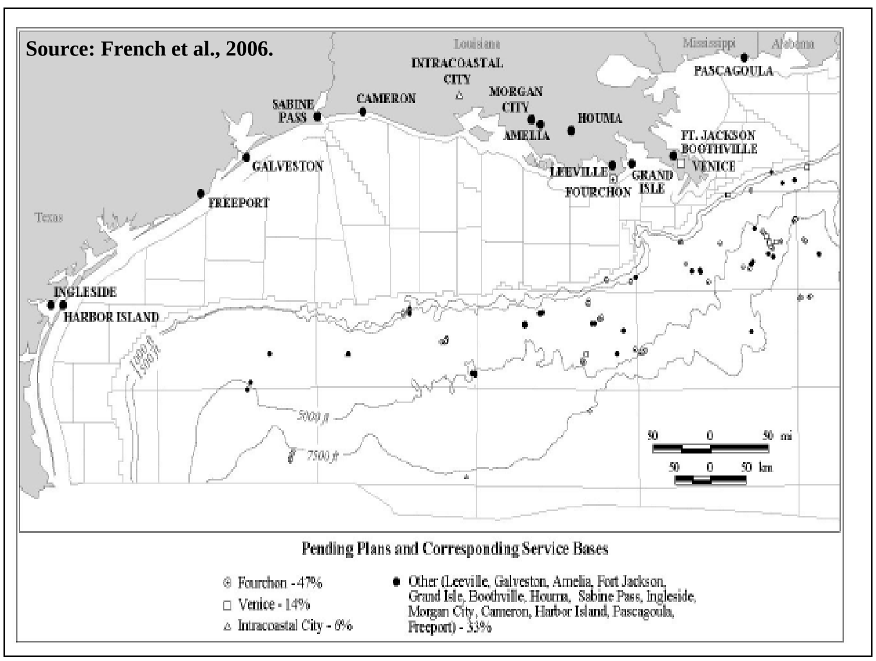


Figure 43. Future sites of GOM supply bases and ports.

3. Labor Force

Rig catering departments are often composed of various positions, mainly utility, galley hands, day and night cooks, head cooks and a camp boss. The number of catering staff on the rig usually depends on the size of the vessel and can range from 2 to 3 people to several dozen.

Wages have risen since highly-skilled workers are in short supply during times of high oil and gas prices, and the remoteness of many facilities. Service workers (catering & service personnel etc.) earn approximately $290 to $320/day ($38,500 to $42,500/year). Workers normally work seven 12-hour shifts per week. The employer supplies working clothes and board, food, laundry, etc. are all free within the installation. Food is of international standard and American A-type (i.e., an abundance of meat dishes, fruits, etc.), though with more workplace diversity, other types of food are prepared. Accommodations facilities meet hotel standards, taking in consideration available conditions (Global Careers Network, 2007).

The catering crew is made up of a Steward, which typically assists in the kitchen, cleans living accommodations and provides laundry services. This is typically an entry-level position. Entry-level positions start at $700 to $1,000 per week. Dishwashers and BR hands (who wash dishes, sweep and mop floors, put up inventory and do general house-cleaning in the living quarters) earn $700 per week (Global Careers Network, 2007).

The key member of the team is the Cook/Baker, many of which have culinary training today. Some companies consider cooks, particularly night cooks, as an entry-level position. General duties include serving the meals, preparing baked goods, cleanup and maintaining the galley. The average annual salary for cooks ranges from $39,000 to $45,000 (Global Careers Network, 2007).

The Camp Boss is responsible for the overall job performance of the catering company while on site. The general duties of the Steward usually consists of cooking, controlling inventory, food and labor costs, ordering groceries, providing customer satisfaction, and managing personnel. This person is often responsible for conducting safety meetings for the catering staff. The average annual salary for a Camp Boss is $55,500 (Global Careers Network, 2007).

4. Typical Firms

There are 23 catering companies listed in Atlantic Communications' Gulf Coast Oil Directory. Some of the largest food management companies with operations in the GOM include Delta Catering, Sodexho Alliance (via Delta Catering, and Energy Catering Services, Inc.), the Craig Group, Compass Group (via Eurest Support Services), Sunoco, Trinity Catering, and Taylor's International. All have offices, or affiliates, working in the GOM.

The Catering and Marine Division of the Craig Group serves all facets of the offshore and onshore industries supplying more than 50 percent of the offshore installation in the North Sea, with operations in 116 countries, including offices in Houston and New Iberia, Louisiana.

Delta Catering, of Harahan, Louisiana, works exclusively in the Gulf of Mexico region and focuses its efforts on servicing a small number of customers. Delta, along with Energy Catering Services, Inc., is now part of Sodexho Alliance, a $14 billion worldwide company. One of their biggest clients is ConocoPhillips, which operates the Magnolia Blossoms deepwater rig that houses 92 people. The company provides meals, as well as laundry and cleaning services. The Sodexho crew consists of 12 cooks, galley hands, and others.

Other firms include Eurest Support Services, Sunoco, and Taylor's International. Eurest Support Services, a division of the Compass Group, is the leading provider of specialist foodservice and related support services in the offshore industry. Sunoco, of Houma, Louisiana, is a private company that provides catering, housekeeping and grocery sales exclusively for the offshore industry. Taylor's International, of Lafayette, Louisiana, is an international company with over 10,000 employees in 25 countries (Offshore Guides, 2007).

C. Industry Trends and Outlook

1. Trends

Like most offshore service industries, the catering business tends to be cyclical, depending upon the price of oil and gas, which drives exploration efforts, and the extent of economic growth, which drives consumption through changes in the construction market. Trends are influenced by factors such as the local population, wholesale food costs, and fuel costs. Population proves to be of major importance paying particular attention to potential worker shortages as a result of hurricanes (Papillon, written communication, 2008).

2. Hurricane Impacts

As with all offshore workers, provision workers are removed from the platforms before storms approach the area. Onshore supply bases are occasionally struck by hurricanes and operations may be affected, but are restarted as soon as possible, or are moved to other locations. After Hurricane Katrina, the Louisiana Restaurant Association reported substantial increases in food costs, water, electricity, and insurance. This service industry met these challenges while attempting to keep menu items at an affordable price (Papillon, written communication, 2008). A few of the onshore facilities were damaged during Hurricanes Rita and Katrina, but were back in operation shortly. As with other supply-based industries revenues increased in the months following the hurricanes as many workers were employed in reconstruction efforts.

3. Outlook

As in most all oil and gas support service industries, demand for provisions is substantially dependent on activity levels in the offshore oil and gas industry. During slow times provision staffs may be cut, but will not be entirely eliminated. Wherever there are workers present there will be a need for provisions, and it is unlikely - given the harsh working conditions, remoteness, and employee and employer needs - that food and accommodation quality will suffer. However, due to high operating costs and competitiveness of the provision industry, it is likely that larger companies will continue to expand and diversify their operations by buying smaller provision companies. Also, larger companies have the ability to negotiate lower prices for bulk goods.

As deepwater exploration and production expands, and new supply bases are built in and around ports with deepwater capabilities, the provisions industry will expand as well.

D. Chapter Resources

Atlantic Communication's Gulf Coast Oil Directory

Includes a wide range of data from company name, address, web and email addresses to contact names with titles, direct phone numbers, and email addresses all organized alphabetically by industry categories. Also included is "Company Detail" information such as company size, revenue, areas operated in last 12 months, operations onshore or offshore, and stock information for publicly traded companies.

http://www.oilonline.com/store/directory.asp

U.S. Securities and Exchange Commission

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http://www.sec.gov/edgar/searchedgar/companysearch.html

IX. WORKOVER SERVICES

A. Description of Industry and Services Provided

Quite often producing wells need to be repaired or stimulated to restore, prolong or enhance the production of hydrocarbons. The process of performing major maintenance or remedial treatments to an oil or gas well is known as a workover. There are six general types of problems that may call for a service or workover contractor:

Unless otherwise noted, the following descriptions are taken from Van Dyke (1997).

Excessive gas production. In wells with a gas-cap drive, the natural gas expands as liquids flow out. At first perforations in the casing are far below the gas cap, but over time the gas cap expands below the perforations. When this happens the well starts producing a lot of gas with the liquids. This excessive gas production depletes the gas, driving the oil out of the reservoir.

Excessive water production. In reservoirs with water drive, water is abundant, and it can bypass the oil as it moves to the wellbore. As the hydrocarbons are pumped out, the water level rises and will reach the perforations in the bottom of the wellbore – much in the same way the gas cap reaches down to the perforations. Both these conditions result in a well that produces a lot of water and little oil. Ideally, a production well is to have a water-oil ratio of zero – meaning that no water is produced with the oil. As the water-oil ratio increases, the cost of producing the well rises. For the most part, excessive water production occurs because of fingering, fractures, or a poor cementing job around the production casing. Fingering occurs when the water moves through sections of the reservoir in “fingers” because of differing permeabilities in the reservoir. Fractures may also provide natural channels from a water-saturated reservoir to an oil-producing reservoir.

Poor Production Rate. There are a number of problems that can cause a well to produce below its full potential. Some are natural, such as reservoirs that have low permeability, low water-drive or gas-drive pressures, or oil that is too viscous to flow easily. Problems can also be created during the drilling and completion phase of the well. Sometimes drilling fluid can make the formation impermeable next to the wellbore. Or, perforations can plug with casing debris, cement, and clay from the drilling mud and reduce the producing rate.

Production of Sand. Wells drilled through sandstone in which the sand grains are not fully cemented produce sand with hydrocarbons. Those that produce sand most often are the unconsolidated reservoirs, buried in basins adjacent to the Gulf of Mexico and the Pacific Coast. Since this is a major production area, sand production is one of the major reasons for workovers, particularly offshore. Sand causes severe problems in a well because it can block almost any point in the flow stream. It can also destroy production equipment through abrasion. The amount of damage generally depends on the flow rate – the faster the reservoir fluid flows, the more sand it can carry and the more damage the sand will inflict, like sandblasting paint off a wall.

Equipment Failure. Mechanical failures of well equipment are common. Equipment failures can be divided into two groups: equipment malfunctions, and equipment leaks. Malfunctions mostly occur in artificial-lift equipment such as beam pumps, submersible pumps, and gas-lift valves. Pumps and valves can wear out from prolonged use, and need to be replaced periodically. Downhole equipment leaks usually occur in the tubing, the casing, or the packer. Natural gas often contains carbon dioxide and compounds of sulfur, such as hydrogen sulfide. These compounds combine with water to form acids that are highly corrosive to metal and rubber. Corrosive fluids can eat holes in the tubing, casing, or packer seal. In addition, tubing can develop a leak as the sucker rod string moves up and down inside it. Rod couplings, which are the widest part of the string, may rub against the side of the tubing.

When a well's production slows or stops, the oil company, or lease operator, analyzes the well to decide the best course of action. The right decision can save a company millions of dollars. There are three possible courses of action: (1) work on the well; (2) abandon the well; or (3) do nothing. An investigation includes a study of the well's mechanical history, geologic data and reservoir conditions, past performance, and well servicing and workover histories (Van Dyke, 1997).

B. Industry Characteristics

Before the 1950s, a permanent derrick was built at each well for drilling and maintenance of the well throughout its life. Today's rigs however, are moved to a new site when drilling is finished. The well is left with only a wellhead and sometimes a pump. Service and workover companies must bring the equipment they need to work in the well. The amount and type of equipment they need depends on the job. One job may require a light-duty rig and a couple of workers. Another may need a somewhat larger rig with a tall mast and a crew of several workers (Van Dyke, 1997).

1. Typical Facilities

Unless otherwise noted, the following descriptions are taken from Van Dyke (1997).

Offshore wells drilled by mobile rigs that have moved on require ships or barges to deliver service and workover rigs to the well. Some workover barge rigs have carefully designed hulls to support light-duty drilling machinery (Van Dyke, 1997).

The surface of a fixed offshore platform, which sits above the water, provides the foundation for a platform rig. The platform either stands on the ocean floor or is a moored floating structure. Platform rigs are built on the fixed platform. Drilling, well servicing, and workover machinery modules are transported to the platform, where the rig is assembled and installed (SEC, 2005e).

A jack-up rig is a mobile drilling and workover platform capable of elevating or lowering itself to the ocean floor. Its legs are lowered to the ocean floor to serve as a temporary foundation until the proper support structure can sustain the hull, which holds drilling or workover equipment, crew quarters, loading facilities, storage areas, the helicopter landing, etc. (SEC, 2005e). Jack-up rigs are generally subject to a maximum water depth of approximately 200 to 300 feet; although some may drill in water depths exceeding 400 feet. The length of the rig's legs and the operating environment determine the water depth limit of a particular rig. Jack-ups generally operate with crews of 15 to 40 persons (SEC, 2005f). The hull can be lowered into the water, where it floats, and its legs are jacked vertically in order for the hull to be towed to another drilling site (SEC, 2005e).

Many jack-up rigs can perform drilling or workover operations over a preexisting structure by way of the cantilever design (see Figure 44), which extends the platform further out from the hull. Slot-type jack-up rigs, primarily used for exploratory drilling, designate a slot in the hull for drilling operations (SEC, 2005f).

Source: Pride International, Inc., 2006.

Figure 44. Cantilever jack-up rigs: Pride Kansas, Pride Mississippi and Pride Missouri.

2. Geographical Distribution

Workover and well servicing rigs are located all over the world, wherever oil and gas wells are producing. In addition, most workover and well servicing rigs can be moved between well sites and between geographic areas of operation.

There are 88 companies listed in the Workover & Well Services section of The Atlantic Communications' Gulf Coast Oil Directory. Of these, 25 report operations or involvement in the offshore GOM region. The locations of these 25 companies are displayed in Figure 45.

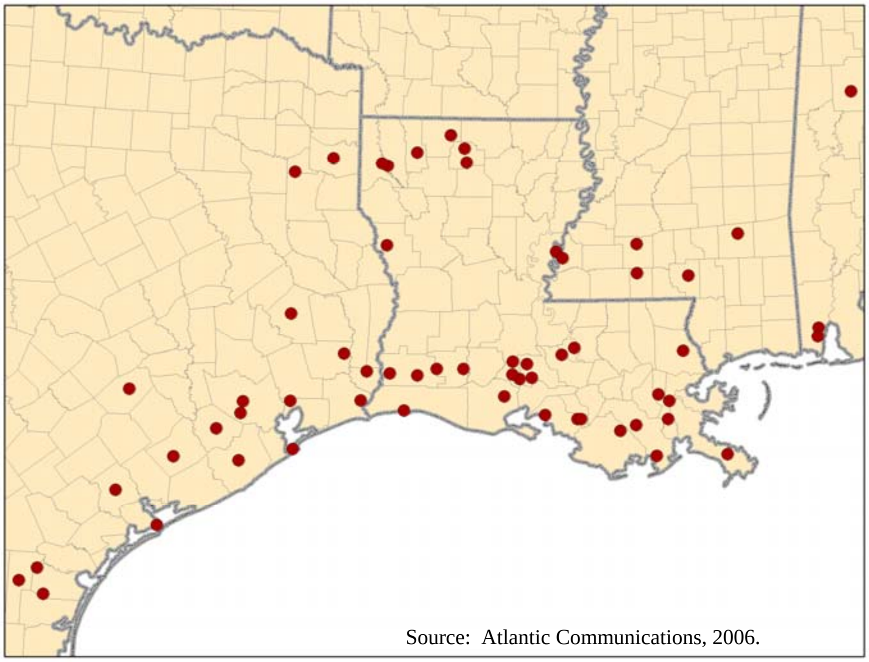

Figure 45. Locations of workover and well services companies.

3. Labor Force

As discussed in the Drilling Contractor chapter, the number of jobs in oil and gas drilling can be measured by the "Oil and Gas Extraction" series as measured by the Bureau of Labor Statistics. As shown in Figure 46, employment in the U.S. oil and gas drilling industry has been decreasing. Since its peak in 1982 of 264.5 thousand jobs, employment has fallen over 50 percent, to an average of 136 thousand jobs in 2005 (U.S. Dept. of Labor, BLS, 2007a). Some of this decline can be attributed to industry consolidation, the decline of offshore drilling, and increasing competition. However, a good portion of this change is attributable to increased labor productivity in oil and gas production activities.

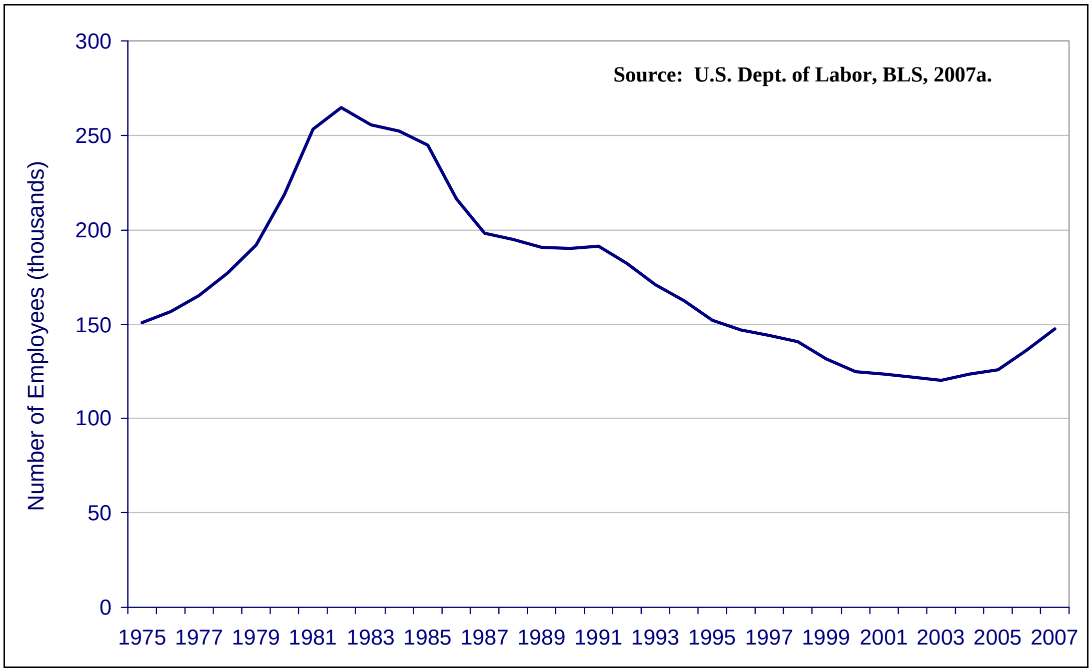

Figure 46. Number of employees, oil and gas extraction.

A typical service or workover crew is led by a rig operator or crew chief, who is in charge of one or two floor hands and a derrickhand. The floorhands work on the rig floor. The derrickhand handles the upper end of the tubing or work string as it is being hoisted out of or lowered into the hole (Van Dyke, 1997).

4. Typical Firms

Companies providing workover service range from large international companies like Halliburton and Pride International offering a wide range of drilling and other oilfield services to smaller locally owned companies such as Hydraulic Well Control LLC of Houma, Louisiana and Owl Creek Well Service Inc. of Dubach, Louisiana.

Drilling companies compete primarily on a regional basis, and competition may vary significantly for region to region. Most workover and well servicing rigs can be moved from one region to another in response to changes in levels of activity, and this can result in an oversupply of rigs in an area. In many markets, the number of rigs available for use exceeds the demand for rigs, resulting in price competition. Most drilling and workover contracts are awarded on the basis of competitive bids, which also results in price competition. The land drilling market is generally more competitive than the offshore drilling market simply because there are larger numbers of rigs and competitors (SEC, 2005e).

Drilling companies report that price and availability and condition of equipment are the most significant factors in determining which contractor is awarded the job. Other factors include the availability of trained personnel possessing the required specialized skills; the overall quality of service and safety record; and domestically, the ability to offer ancillary services. In international markets, experience operating in certain environments and customer alliances also have been factors in contractor selection (SEC, 2005e).

One company, Nabors Industries, Ltd. is the largest land drilling contractor in the world. They are also one of the largest land well-servicing and workover contractors in the U.S. and are a leading provider of offshore platform workover and drilling rigs in the U.S. Nabors' customers include major oil and gas companies, foreign national oil and gas companies and independent oil and gas companies. Nabors reports that beginning in late 2004 and throughout 2005, as a result of increasing demand for drilling services, its customers began to enter into longer term contracts with durations ranging from one to three years. Under these contracts rigs are committed to one customer over that term. Increasingly, these contracts are been signed for three-year terms for newly constructed rigs. Contracts relating to offshore drilling and land drilling in Alaska and international markets generally provide for longer terms, usually from one to five years. Offshore workover projects are often on a single-well basis. Drilling contracts are generally awarded through competitive bidding, although contracts are occasionally entered into by direct negotiation. The contract terms and rates may differ depending on a variety of factors, including competitive conditions, the geographical area, the geological formation to be drilled, the equipment and services to be supplied, the on-site drilling conditions and the anticipated duration of the work to be performed (SEC, 2006f).

In recent years, most drilling contracts have been daywork contracts. A daywork contract generally provides for a basic rate per day when drilling (the dayrate for providing a rig and crew) and for lower rates when the rig is moving, or when drilling operations are interrupted or restricted by equipment breakdowns, adverse weather conditions or other conditions beyond the company's control. In addition, daywork contracts may provide for a lump sum fee for the mobilization and demobilization of the rig, which in most cases approximates our incurred costs. A daywork contract differs from a footage contract (in which the drilling contractor is paid on the basis of a rate per foot drilled) and a turnkey contract (in which the drilling contractor is paid for drilling a well to a specified depth for a fixed price) (SEC, 2006f).

C. Industry Trends and Outlook

1. Trends

As with drilling contractors, the market for workover rigs is highly cyclical. Operating results are impacted by the level of energy industry spending and the level of industry spending is affected by price, company expectations about products, government regulations and many other factors (SEC, 2005f). The workover and well servicing industry is one measure of the overall health of the oil and gas industry. The workover rig count is a measure of the industry's investment in the maintenance of its oil and gas wells. A low level of workover activity can be indicative of deferred maintenance. The situation is similar to the aging apartment building that no longer justifies major renovations and is milked as long as it produces a positive cash flow. When operators are in a weak cash position workovers are delayed as long as possible (WTRG Economics, 2006).

The most recent workover rig count indicates a steady increase in the employment of the workover rig and well servicing industry. As shown in Figure 47, the rig count for workover rigs in the Gulf of Mexico and Southeast U.S. has been steadily increasing. The total U.S. workover rig count has increased 60 percent since its 2002 low and 22 percent since the beginning of 2005. Workover rig counts for the Gulf of Mexico and Southeast have increased 77 percent since March of 2002. These rigs have increased 6 percent since the beginning of 2005.

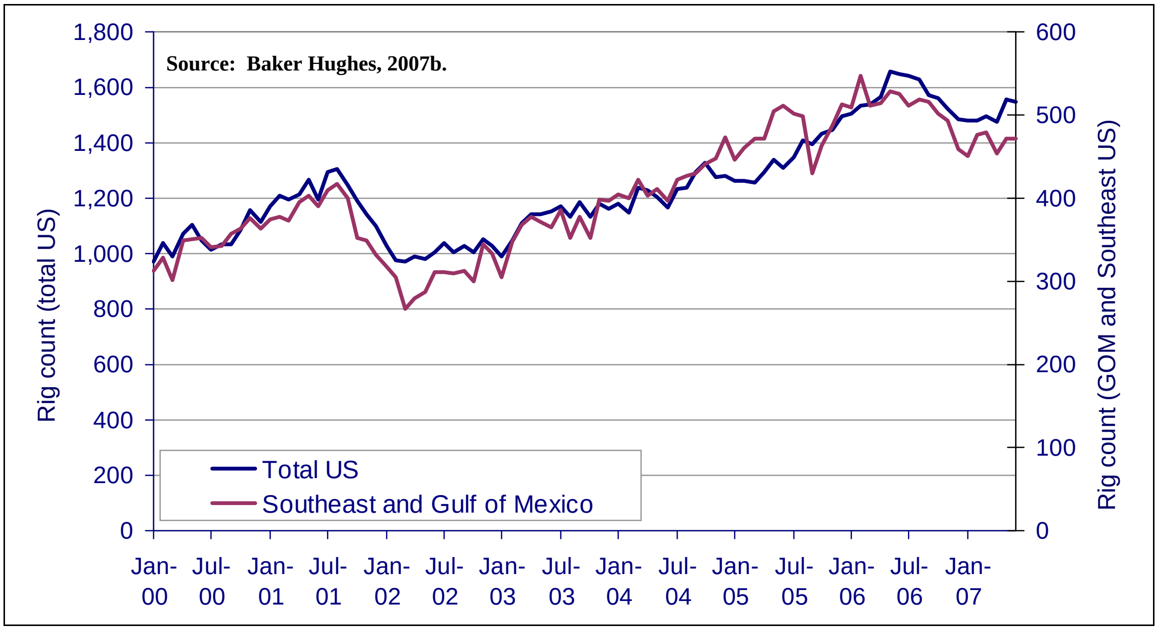

Figure 47. Gulf of Mexico and Southeast workover rig count (2000 to present).

Figure 48 shows that in recent years, the total U.S. workover rig count has maintained its growth, increasing about 10 percent per year between 2003, 2004 and 2005. In 2006, the rig count was even higher, 16 percent higher than the 2005 annual average. Rig counts for the first half of 2007 however, were lower (approximately four percent lower than the 2006 average). A similar trend is also reflected in Figure 49, which shows the workover rig counts for the Southeastern U.S. and Gulf of Mexico. Here, the number of workover rigs in 2006 is almost 70 percent higher than the beginning of 2003. The more recent count for the first half of 2007 is lower than 2006 as well as 2005.

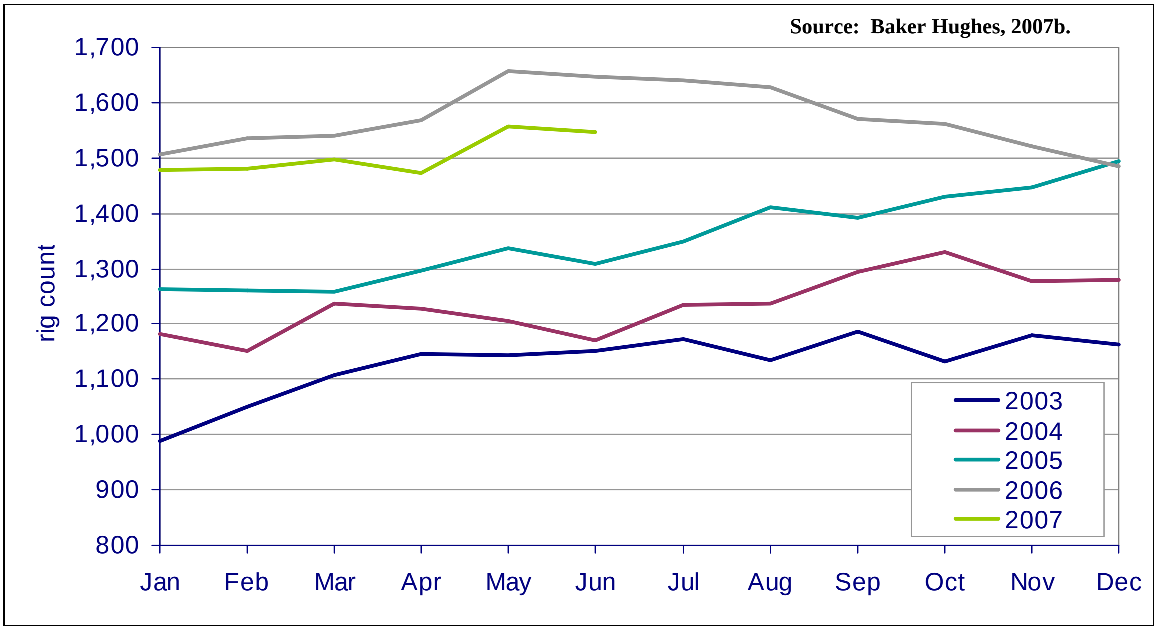

Figure 48. Total U.S. workover rig count (2003 to present).

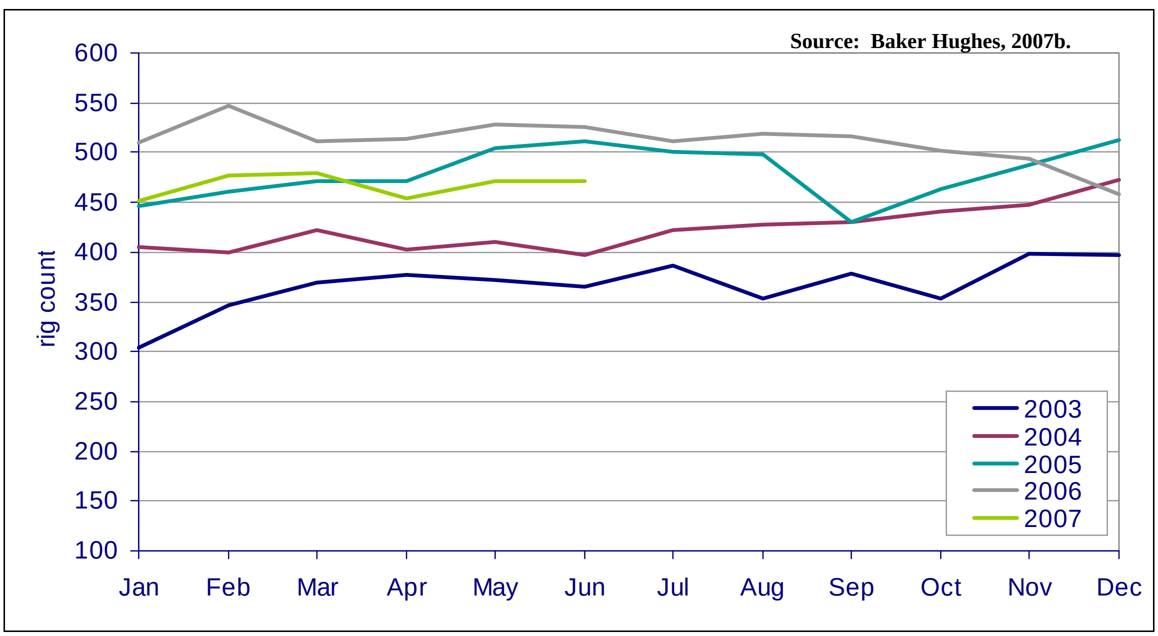

Figure 49. Gulf Coast workover rig count (2003 to present).

2. Hurricane Impacts

Hurricane Ivan in 2004 and Hurricanes Katrina and Rita in 2005 destroyed and damaged a large number of production platforms in the GOM. One of Nabors Super Sundowner platform workover rigs was significantly damaged during Hurricane Katrina (SEC, 2005e). Pride International did not report damage to any specific rigs, but does report that after the terrorist attacks on September 11, 2001, and the hurricanes in the Gulf of Mexico in 2004 and 2005, insurance underwriters have increased insurance premiums for many of the coverages historically maintained and have issued general notices of cancellation and significant changes for a wide variety of insurance coverages. The oil and natural gas industry in the Gulf of Mexico suffered extensive damage from those hurricanes and as a result, insurance costs will increase significantly as current policies end. In addition, underwriters have imposed an aggregate limit for damage due to named wind storms in the U.S. Gulf of Mexico (SEC, 2005f).

Also as a result of the hurricanes, in May 2006, the BOEMRE issued interim guidelines for jackup rig fitness requirements for the 2006 hurricane season, effectively imposing new requirements on the offshore oil and natural gas industry in an attempt to increase the likelihood of survival of jackup rigs and other offshore drilling units during a hurricane (SEC, 2005f). The new BOEMRE requirements have resulted in some jackup rigs operating in the U.S. Gulf of Mexico being required to operate with a higher air gap during hurricane season, which reduces the water depth in which they can operate. The guidelines also provide for enhanced information and data requirements from oil and natural gas companies operating properties in the U.S. Gulf of Mexico. Implementation of new BOEMRE guidelines or regulations can increase costs and limit the operational capabilities of offshore rigs (SEC, 2005f).

3. Outlook

Expectations about future prices have historically been a key driver for drilling demand; however, the availability of quality drilling prospects, exploration success, relative production costs, the stage of reservoir development and political and regulatory environments will affect oil and gas company drilling programs (SEC, 2006g). The decline in natural gas and oil prices has impacted companies spending plans for exploration and production which in turn, affects the drilling companies. Nabors Industries' U.S. offshore operating revenues decreased 13 percent in the first half of 2009 as compared to the first half of 2008 (SEC, 2009g). The company noted that activity levels and decreased demand has decreased substantially due to uncertainty in financial markets and the decline in prices (SEC, 2009g).

Volatile energy prices lead to fluctuations in oil and gas company spending for drilling services. However, variations in these markets impact drilling companies differently depending on the length of contracts. For example, contracts in the shallow waters of the GOM are shorter term, so a decline in market conditions will impact revenues and cash flows for those operations. Contracts in deepwater and in international markets are longer term, so changes in market conditions will have a delayed impact (SEC, 2008g).

Pride International expects "the decline in crude oil prices that began in late 2008, following the onset of the global financial crisis, deteriorating global economic fundamentals and the resulting decline in crude oil demand in a number of the world's largest oil consuming nations, is expected to have a negative impact on 2009 offshore activity (SEC, 2008g)." Lower prices have resulted in companies reducing their expenditures for drilling activity. However this decline is expected to be more pronounced in exploration activities, which are shorter term projects (SEC, 2008g). Deepwater drilling however, is expected to be more stable, particularly for projects that are already under development. Pride International noted in its 2008 annual report that "typically, utilization for the industry's deepwater fleet has remained high even during market downturns due to the advanced technical features of the rigs and the limited supply of rigs capable of addressing the increasingly complex drilling projects of our clients (SEC, 2008g).

D. Chapter Resources

Atlantic Communication's Gulf Coast Oil Directory
Includes a wide range of data from company name, address, web and email addresses to contact names with titles, direct phone numbers, and email addresses all organized alphabetically by industry categories. Also included is "Company Detail" information such as company size, revenue, areas operated in last 12 months, operations onshore or offshore, and stock information for publicly traded companies.
http://www.oilonline.com/store/directory.asp

Baker Hughes Rig Counts
North American workover rig counts are updated monthly by region.
http://www.bakerhughes.com/investor/rig/index.htm

U.S. Securities and Exchange Commission
Quarterly and annual reports of operations for publicly traded companies are filed with the Securities and Exchange Commission.
http://www.sec.gov/edgar/searchedgar/companysearch.html

U.S. Department of Labor, Bureau of Labor Statistics
The Current Employment Statistics survey provides monthly employment statistics for major industrial categories (including oil and gas extraction). These data are available for statewide and metro area.
http://www.bls.gov/data/home.htm

X. ENVIRONMENTAL CONSULTING AND MITIGATION

A. Description of Industry and Services Provided

The environmental consulting industry is comprised of companies that provide advice and technical assistance to businesses, government agencies and other organizations regarding environmental issues. These companies typically identify problems, measure and evaluate risks, and recommend solutions on environmental issues ranging from the control of environmental contaminants to site remediation and environmental engineering services (USDOC, Bureau of the Census, 2002a).

These firms advise clients on how to efficiently control emissions, clean up contaminated sites, establish recycling programs and comply with government environmental laws and regulations. A real estate developer, for example, might hire an environmental consulting firm to help design and develop property without damaging natural habitats, such as wetlands. A manufacturing or utilities firm might hire environmental consultants to assess whether the firm is meeting government emissions standards. Government agencies contract work out to environmental consulting firms to assess contamination in a particular geographic area or to evaluate the costs and benefits of new regulations. In the oil and gas industry, environmental consulting firms may be contracted to perform environmental impact assessments, consult on pipeline design, assist with permitting and/or regulatory compliance, monitor air emissions or respond to oil spills. The services of an offshore environmental consultant are required in the case of a sale of a lease, platform or other assets, to determine the environmental status of each site.

A typical consulting assignment in the offshore production industry may consist of an environmental impact study concerning the concentration of cuttings found at the base of platforms. In early offshore oil and gas development, drilling wastes were generally discharged from the platforms directly to the ocean. However, during the 1970s and 1980s, evidence began to mount that some of these discharges could have damaging effects on local ecology, particularly in shallow water. Limited environmental damage was likely to occur from water-based drilling muds (WBMs), but when operators were using oil-based drilling muds (OBMs) on deeper sections of wells, the resulting cuttings piles created impaired zones beneath and adjacent to the platforms. Piles of these oil-based cuttings can affect the local ecosystem by (1) smothering organisms; (2) direct toxic effect of the drilling waste; and (3) anoxic conditions caused by microbial degradation of the organic components in the waste (USDOE, DWMIS, 2007a). The current regulations lessen impacts of permitted discharges. Although WBMs and limited amounts of synthetic-based drilling muds (SBMs) retained on cuttings can still be discharged, discharges of OBMs have been outlawed completely (USDOE, DWMIS, 2007a).

Usually, the most affected area is the seafloor immediately below the rig. The impacts are short-term (a few years) as the accumulated drill cuttings break-up and spread out with time, while components of drilling fluids, such as mineral oil, can decompose and dissipate in the environment (CNSOPB, 1998).

Once released into the water, fine particles from the discharges become suspended and move with the water, following the currents. The farther the discharge moves, the more dilute and less harmful it becomes. Studies examining the effects of exploratory drilling on the U.S. portion of Georges Bank found that small amounts of some drilling muds (in particular the weighting agent barite) had been transported as much as 60 km from the well site (CNSOPB, 1998). Sea scallops and other filter feeding organisms are particularly sensitive to fine particles and mineral oil from drilling muds (CNSOPB, 1998) (see Figure 50).

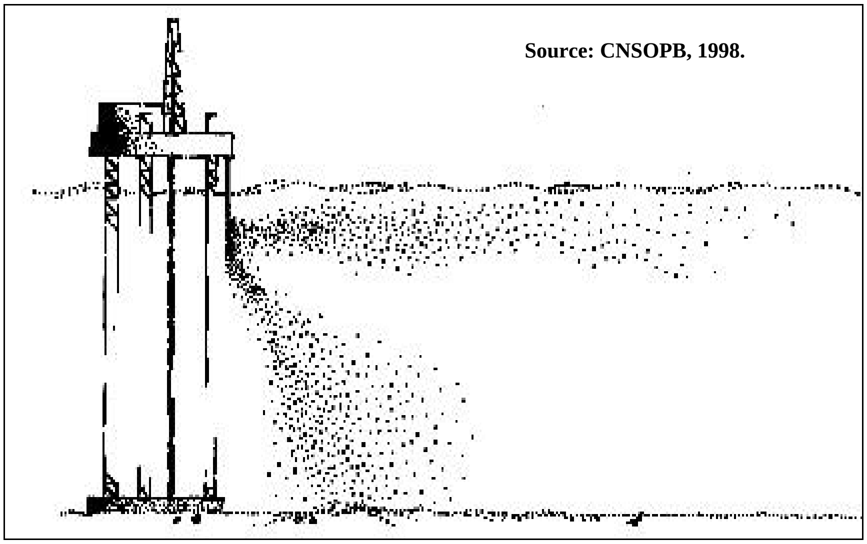

Figure 50. Typical dispersion of cuttings from drilling operations.

Typically hired by a prospective buyer of a property, environmental consultants conduct an audit of the property during the due diligence process. The audit typically consists of a search of the site's records of state and federal regulations compliance, and, if necessary, hires divers to investigate the underwater conditions near the platform. In cases where the audits find situations that were not reported, or were under-reported, they tend to be used by the buyer to negotiate price and any cleanup procedures that must be completed prior to sale. Of particular concern are the waste management practices of the offshore company, including disposal of hazardous wastes. Due to the high costs of transporting wastes to shore (in some cases as high as $4,000 per drum), one of the primary jobs of some environmental consultants is to devise a plan to properly dispose of the wastes and ensure that the plan is implemented properly.

Another primary task is to devise, implement and oversee the platform's Oil Spill Prevention, Control, and Countermeasure, or SPCC Plans, as required by the Oil Pollution Act (OPA) of 1990. This plan lists all of the arrangements (including names and contact information of companies specializing in oil spill recovery) that the owner of the platform must have in the case of an oil spill, from recovery of the oil to equipment required on board (USEPA, 2007c).

Other duties of environmental consultants include the monitoring of BOEMRE Incident of Non-Compliance (INCs) reports, permitting, air and water regulatory compliance, as well as working on a diverse range of projects many of which include measuring an environment's physical and biological attributes, studying the design of structures built for the marine environment, environmental management and planning, discharge strategies, environmental impact studies, rehabilitation projects, environmental audits, and resource inventories. Environmental monitoring is becoming mandatory for developments, therefore consultants are generally required to design and implement monitoring studies and need to have skills necessary to design cost-effective and statistically valid programs. Also, knowledge of law, conventions and liabilities relating to coastal and offshore areas is becoming increasingly important with the increase in demand for environmental consultants in government bodies (AMSA, 2007).

B. Industry Characteristics

1. Typical Facilities

Environmental consulting firms are characterized by a core group of experienced environmental professionals who are well trained, and who keep abreast of the latest technologies, government regulations, and management and production techniques. Organizations generally hire these consultants as a cost effective alternative to developing in-house expertise.

The environmental consulting industry is dominated by a small number of large firms (and their subsidiaries). However, most individual consulting offices are small shops employing only a handful of people, sometimes fewer than 10 individuals (ECO, 2007). Many of these smaller firms are pursuing niche markets with more defined areas of expertise and experience. These may include wetlands delineation, ecological restoration, and geographic information systems.

2. Geographical Distribution

Figure 51 shows the geographic distribution of environmental consulting companies in the United States. The number of environmental consulting companies generally mimics the underlying population of the United States. California, New York and Texas firms comprise the bulk of the domestic companies. Many of the offshore environmental consultants have offices near offshore production areas such as Houston, Lafayette, New Orleans, Lake Charles, and Baton Rouge, though it is not uncommon for offices to be located further inland. The greatest concentration in Louisiana tends to be found in New Orleans and Lafayette.

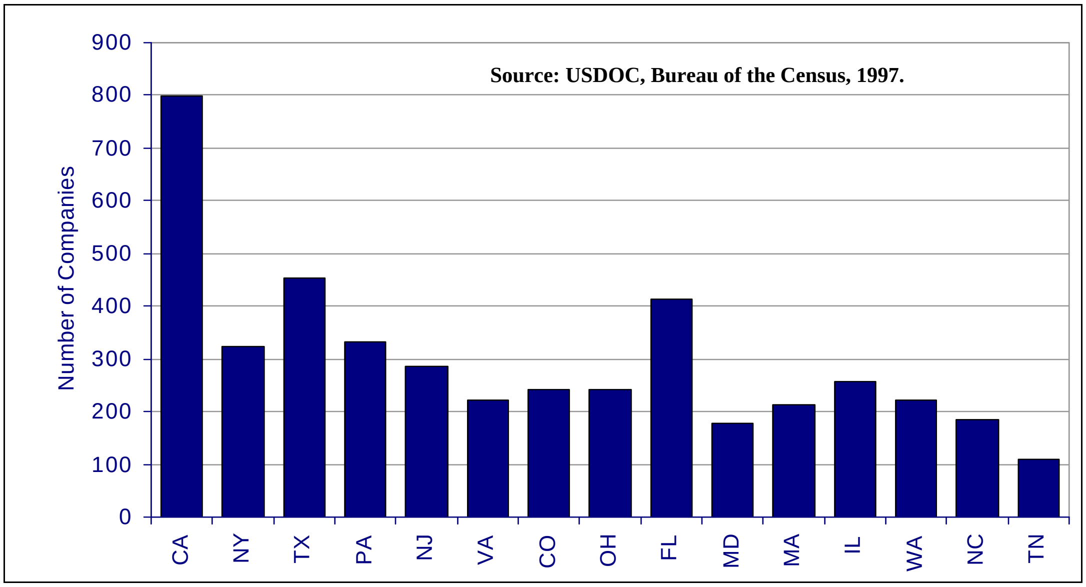

Figure 51. Geographic distribution of environmental consulting firms in the U.S.

3. Labor Force

According to the Bureau of Labor Statistics (BLS), environmental scientists held approximately 73,000 jobs in the U.S. in 2004. About 44 percent of these scientists were employed by state and local governments, 15 percent in management, scientific, and technical consulting services, 14 percent in architectural, engineering and related services and 8 percent in the Federal Government. About 4,000 were self-employed (U.S. Dept. of Labor, BLS, 2007c).

Many environmental scientists earn degrees in life science, chemistry, geology, geophysics, atmospheric science, or physics and then, either through further education or through their research interests and work experience, apply their education to environmental areas. Others earn a degree in environmental science. A bachelor's degree in environmental science offers an interdisciplinary approach to the natural sciences, with an emphasis on biology, chemistry, and geology (U.S. Dept. of Labor, BLS, 2007c).

According to the BLS, the median annual earnings of environmental scientists were $51,080 in 2004. The middle 50 percent earned between $39,100 and $67,360. The highest 10 percent of earns more than $94,460.

The BLS expects that overall employment of environmental scientists will grow faster than the average for all occupations through 2012. Job growth will be driven by public policy, which forces companies and organizations to comply with environmental laws and regulations, particularly those regarding ground-water contamination, clean air, and flood control.

4. Typical Firms

According to the 2002 Economic Census, there are 8,536 environmental consulting firms in the U.S. This is a 27 percent increase since the last census in 1997. These firms earned over $6.9 billion in revenue in 2002, over a 45 percent increase since 1997 (USDOC, Bureau of the Census, 2002b). As shown in Table 8, the majority of environmental consulting firms have only one to four employees. New firms can enter the industry quite easily. Licensing, certification, and large capital outlays seldom are necessary for an individual to become a consultant, and the work can be quite lucrative for those with the right education, experience, and contacts. As a result, many wage and salaried environmental consultants eventually leave established firms to go into business for themselves and also develop more specialized methods to environmental problems.

Table 8

Environmental Consulting Firms by Employment (2002)

Size of Establishment	Establishments (Number)	Establishments (Percent of total)	Paid Employees	Annual Payroll (thousand $)
No employees	30	0.4%	-	$ 5,154
1 to 4 employees	3,791	44.4%	7,854	$ 305,302
5 to 9 employees	1,302	15.3%	8,586	$ 365,501
10 to 19 employees	810	9.5%	10,785	$ 478,633
20 to 99 employees	594	7.0%	21,735	$ 1,089,234
100 to 400 employees	40	0.5%	6,379	$ 292,073
not operated for entire year	1,969	23.1%	1,880	$ 134,745
All Establishments	**8,536**	**100.0%**	**57,219**	**$ 2,670,642**

Source: USDOC, Bureau of the Census, 2002c.

The Atlantic Communications' Gulf Coast Oil Directory lists a total of 251 companies in the Environmental Services section of its directory. Some of these companies, however, provide more environmental services rather than consulting. Of these, only 52 report a range for their number of employees. As shown in Figure 52, the majority of these companies in the GOM area are smaller with a range of 1 to 25 employees. Sixteen companies reported having less than 250 employees, one was between 250 and 500 and 6 companies have more than 1,000 employees. These larger companies are mostly more diversified, integrated companies like Newpark Resources. The environmental service provided by Newpark is the processing and disposal of exploration and production waste (SEC, 2006m).

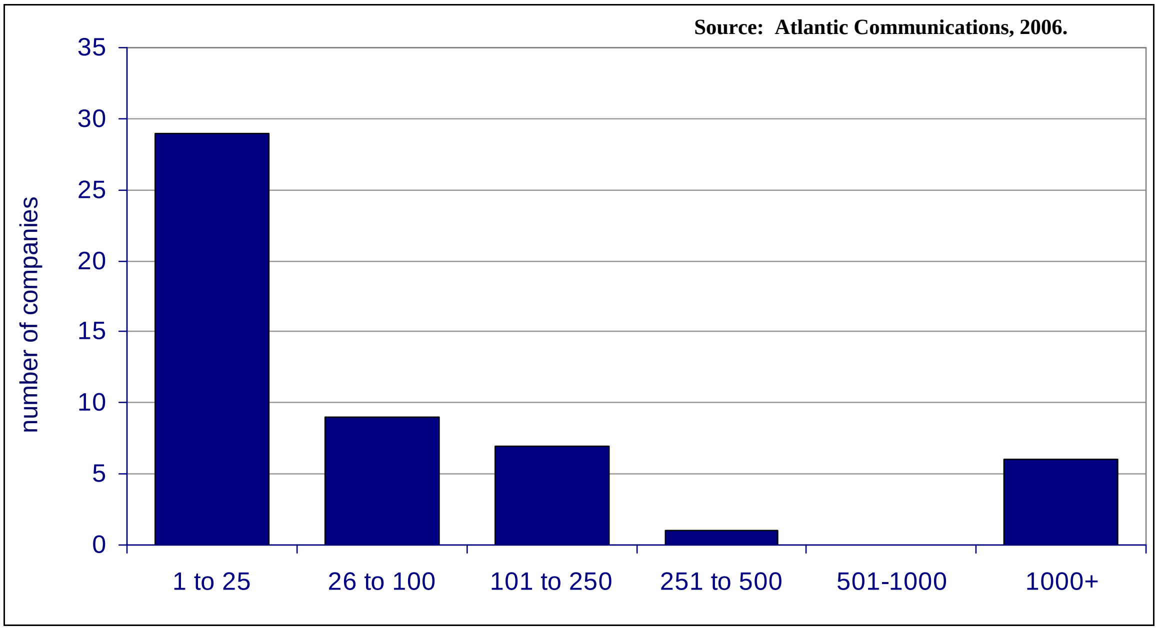

Figure 52. Number of employees at environmental services companies.

There are numerous consulting and engineering firms that offer many of the same services. These firms range in size from small local companies, to large national firms with integrated and diversified services (SEC, 2006w). Environmental consulting and services is a highly competitive industry, but no one company dominates the market. Competitive factors include reputation, performance, price, geographic location and availability of skilled technical personnel (SEC, 2006w). In addition, firms may face competition from the use by their clients of in-house staff.

C. Industry Trends and Outlook

1. Trends

Background

"The environmental industry in the United States began with municipal management of water systems, sanitary engineering, and waste collection during the late 1800s. The main impetus for these functions was the need for basic environmental infrastructure and a growing popular demand for the protection of public health (Berg et al., 1998)." However, the environmental consulting industry, as it stands today, began to take shape as recently as the 1970s with a host of new environmental compliance legislation.

In 1970, the U.S. Environmental Protection Agency (USEPA) and the Council for Environmental Quality were created as part of the National Environmental Policy Act. Additional legislation, such as the Clean Air Act and Clean Water Act stimulated demand for environmental consulting services. Initial clients for these firms were mainly municipalities concerned with landfills and sewage problems as well as manufacturers concerned with complying with government air pollution standards. These problems were usually solved through large-scale public sector projects, most notably, the designation of “Superfund” sites designed to remediate areas deemed extremely hazardous to public health (Berg et al., 1998).

In the 1980s, the passage of the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Resource Compensation and Liability Act (CERCLA) launched a new era of environmental policy development focused on pervasive yet unseen toxic and hazardous waste. Policies and regulations under these new laws attempted to impose a “polluter pays” approach by assigning a clearer chain of liability for pollution and contamination. This system depended on private-sector industries to acquire the products and services needed for regulatory compliance (Berg et al., 1998). “This stimulated tremendous growth in the demand for environmental products and services, and more revenues for the emerging environmental industry, as companies sought to avoid fines, shutdowns, and the wrath of environmentally sensitive consumers and public officials” (Berg et al., 1998).

The primary regulation that drove much of the growth of the industry was in response to the National Oil and Hazardous Substances Pollution Contingency Plan, more commonly known as the National Contingency Plan (NCP), which is the Federal Government’s blueprint for responding to oil spills and hazardous substance releases (USEPA, 2007b).

The first National Contingency Plan was developed and published in 1968. This NCP was arose in response to a massive oil spill from an oil tanker off the coast of England. More than 37 million gallons of crude oil were spilled into the water, causing massive environmental damage. U.S. officials developed the NCP as a coordinated approach to cope with potential spills in U.S. waters. This was the first comprehensive system of accident reporting, spill containment, and cleanup. It also established a response headquarters, a national reaction team, and regional reaction teams (USEPA, 2007e).

Over the years, Congress has broadened the scope of the NCP. The Clean Water Act of 1972 required a revision to include a framework for responding to hazardous substance spills as well as oil discharges. Superfund legislation passed in 1980 required another broadening of the NCP to cover releases at hazardous waste sites requiring emergency removal actions. Additional revisions have been made to the NCP to keep pace with the enactment of legislation. The most recent were finalized in 1994 to reflect the oil spill provisions of the Oil Pollution Act of 1990 (USEPA, 2007e).

The *Exxon Valdez* oil tanker spill in Alaska in March, 1989 led to the Oil Pollution Act (OPA) of 1990, which streamlined and strengthened USEPA’s ability to prevent and respond to catastrophic oil spills. An oil tax finances a trust fund to provide the finances clean up spills when the responsible party is incapable or unwilling to do so. The OPA also requires oil storage facilities and vessels to submit plans detailing how they will respond to large discharges. Just as the USEPA has published regulations for aboveground storage facilities, the Coast Guard has done so for oil tankers. Area Contingency Plans are also required to prepare and plan for oil spill response on a regional scale (USEPA, 2007d). Many firms, especially smaller, boutique companies resulted from the OPA, though the overall rate of growth of the industry continued to decline.

Recent Trends

According to the Environmental Business Journal, the U.S. environmental consulting and engineering industry had one of its best years in a decade in 2006. And although growth slowed marginally from 8 percent to 7.2 percent in 2006, it would have qualified for the best growth rate since 1990 if not for the 8.0 percent growth in 2005. However, despite a third consecutive year of relative prosperity, executives are somewhat more cautious about the prospects for sustained growth for 2007, with real estate markets, federal spending and the economy overall as principle factors of concern. Certain practice areas seem to be immune, but executives are advised to view markets cautiously when considering long-range plans (Environmental Business Journal, 2007).

2. Hurricane Impacts

More than 193,000 barrels of oil spilled along the Louisiana coastline in August 2005 from the impacts of Hurricane Katrina (PBS.org, 2005). This was the largest oil spill in the state's history and the biggest since the *Exxon Valdez* crashed off the coast of Alaska in 1989. "The oil, released from ruptured pipelines, sunken boats and disabled refineries, along with toxic chemicals from industrial plants, bacteria from damaged sewage systems and small amounts of lead and arsenic, flowed into ground water, drinking water and the Gulf of Mexico (PBS.org, 2005)."

The storm flooded five Superfund sites in Louisiana, Mississippi and Alabama. The flooding of these severely polluted industrial sites scheduled for federal cleanup, released some of the nation's worst toxic materials. The industrial corridor along the Mississippi River between New Orleans and Baton Rouge also flooded. This led to speculation about the number and types of toxic chemicals that may have been leaked by hundreds of industrial facilities in the area. The true environmental impact on the Gulf Coast from Hurricane Katrina has yet to be determined (PBS.org, 2005).

Environmental consulting and service companies were called upon for most of the clean-up efforts. Revenue for one company, CH2M HILL increased $239.9 million or 20.7 percent for the year ended December 31, 2006 compared to 2005. This increase in revenue was primarily due to work associated with the Hurricane Katrina relief and cleanup efforts (SEC, 2006x). USESGRoup/U.S. Environmental Services a 24-hour emergency environmental cleanup company specializing in excavating contaminated soils and hazardous waste management, reported a 64 percent leap in its 2006 revenue. The company, based in New Orleans, posted $108 million in 2006, compared to $66 million in 2005 and $35.8 million in 2004 (Penix, 2007).

3. Outlook

A substantial portion of environmental consulting and services business is generated either directly or indirectly as a result of federal, state, local and foreign laws and regulations related to environmental matters. Changes in environmental regulations could affect the consulting business more significantly than they would affect some other engineering firms. Accordingly, a reduction in the number or scope of these laws and regulations, or changes in government policies regarding the funding, implementation or enforcement of such laws and regulations, could significantly reduce the size of the consulting market and limit opportunities for growth.

In addition, any significant effort by government agencies to reduce the role of private contractors in regulatory programs, including environmental compliance projects, could have the same adverse effects (SEC, 2006x).

Activity relative to the oil and gas industry will be driven primarily by the economy, continued demand for energy (domestic and imports), and the additional infrastructure build-outs necessary to support the market. A large portion of the environmental consulting work over the next several years will be a function of the development of pipeline and storage assets. These assets were initially being developed to support offshore GOM activities. However, a considerable amount of activity during the 2004-2007 time period was associated with support activities for LNG regasification terminals. This activity began to slow significantly in 2007.

However, additional pipeline and storage activity has occurred from 2005 to current in the onshore areas of Texas and Louisiana. These activities were associated with bringing new gas production from the Barnett Shale eastward. This activity should continue with the development of resources discovered in the Haynesville Shale area of north Louisiana. Environmental consulting firms will be called upon to assist in a wide range of permitting and mitigation activities. The entire infrastructure under development, or proposed to be developed will need a wide range of environmental land use, as well as air and water permits.

Demand for environmental services is driven by a combination of regulatory requirements and economic factors. There is much new regulatory focus on emissions, climate change and air quality. Climate change initiatives at the state level, and ultimately the federal level, will sustain market growth for air services beyond the mid-term (SEC, 2006w).

D. Chapter Resources

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http://www.oilonline.com/store/directory.asp

Environmental Business Journal
Annual review of the U.S. environmental consulting and engineering industry. Includes revenue and growth statistics, company profiles and executive perspectives. This is a subscription based publication.
http://environmental-industry.com/ebanreofuenc.html

U.S. Census Bureau, Economic Census
The Economic Census profiles American business every 5 years and provides industry statistics by state or NAICS category.
http://www.census.gov/econ/census02/

U.S. Department of Labor, Bureau of Labor Statistics

The Current Employment Statistics survey provides monthly employment statistics for major industrial categories (including oil and gas extraction). These data are available for statewide and metro area.

http://www.bls.gov/data/home.htm

U.S. Securities and Exchange Commission

Quarterly and annual reports of operations for publicly traded companies are filed with the Securities and Exchange Commission.

http://www.sec.gov/edgar/searchedgar/companysearch.html

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