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Basic Ship Types & Their Uses, Part 4

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Industrial workboats have been a primary type of vessel built in the U.S. for some time now. The offshore oil industry is a large user of these types of vessels, as well as the river transport industry. The construction of the thousands of offshore oil drilling and production platforms, pipelines, storage tanks, well heads, and other installations in and under the water since the late 1940's has given rise to a large number of different workboats. Likewise, the expansion of river cargo transportation over the same time has given rise to a large number of specialized vessels for this industry. This section will cover the offshore oil industry, with others later.

Offshore Oil and Gas Platform Support Vessels

Vessels involved in servicing offshore oil facilities include platform supply vessels (PSV's), crewboats, construction vessels, dredges, pipelaying barges, utility vessels, submarines, barges, and other types. A PSV has evolved from a simple floating pickup truck that carried pipe and supplies on the cargo deck aft of the deckhouse, to the 300+ foot (91+m) vessels of today.

They can carry as much as 5000 tons of various cargoes such as pipe, food, generators, machinery, fuel, water, methanol, liquid mud, dry bulk mud, and other things needed by the offshore oil rigs on a regular basis. They are also often set up to be able to fight fires, do oil spill cleanup, offload cargos and waste from the rigs, and many other utility jobs. They generally look like a tall deckhouse at the front of the ship, with a long low and flat cargo deck aft. There are thousands of these vessels operating all over the world, but unless you get to the industrial areas, you might not see one unless it has been converted to other uses, such as carrying cargo containers to and from local islands, or having a deckhouse added to make it an offshore gaming vessel. These PSV's sell for cheap money when they are 20-30 years old, and they are often converted to some other use. They generally are 12-knot vessels, and they work long and hard lives.

Figure 1: An Older Style Offshore Platform Supply Vessel

The older style American PSVs were generally about 160-200 feet long, 30 feet wide, and 9 foot draft, as they operated out of shallow ports in Louisiana and Texas. There are two arrangements of these, one with the exhaust stacks forward, aft of the deckhouse, and the other with small raised structures and exhaust stacks about 1/3 of the length forward of the stern as shown in Figure 1. The latter are disappearing as the older vessels are retired. As the business spread overseas, European builders began to produce larger, deeper draft vessels to suit local conditions, and as usual in the conservative American marine business, innovations lagged to the

point where European design firms now design the majority of these vessels, as exemplified by Figure 2.

Figure 2: Newer Style Offshore Platform Supply Vessel

Figure 3: Newer Style Platform Supply Vessel (courtesy of Eastern Shipbuilding Group)

Platform Construction Vessels

Construction vessels are often large versions of PSV's, with a huge crane mounted on the deck, a larger deckhouse with additional accommodations for the construction crews, and usually a helipad. They may function as a PSV when not employed for construction, but more often they are involved in the construction of offshore platforms. Like a PSV, they have a forward, tall deckhouse, and a long low cargo deck aft, but the crane sets them apart. The crane can often lift several hundred tons, and it is often taller than the rest of the ship. They may also carry a decompression chamber and dive support equipment, as well as remote-operated vehicles for unmanned underwater work. See below:

Figure 4: Platform Construction Vessel. Note large white crane on the aft deck and extra- large deckhouse for 72 crew and construction workers. The garage door on the side houses a remote operated vehicle. (courtesy of Eastern Shipbuilding Group)

Figure 5: Offshore Platform Construction Vessel

Anchor Handling and Towing/Supply Vessels

Figure 6: Anchor Handling Towing/Supply Vessel (courtesy of Eastern Shipbuilding Group)

Anchor Handling Towing/Supply vessels are a special type of PSV that has a large A-Frame on the stern to lift offshore drilling rig anchors, and large horizontal towing winch under the orange rescue boat. These are the ships that move the drilling rigs from one location to another for exploratory and production well drilling. They also have high power engines than a standard PSV.

Floating Oil Production Storage Ships (FPSO)

These were covered in Part 1, but they are repeated here because of their offshore oilfield connection. A Floating Production Storage Ship (FPSO) is a special form of tanker, often an old single-skin type, that has been converted to serve as floating oil production storage to take the oil produced by an offshore well, waiting for the pickup by a regular tanker. The OPA90 ship design regulations outlawed single skin tankers, so some of those ships in better condition were converted to storage use.

Figure 7: A tanker converted to an FPSO ship. An FPSO ship is similar to a tanker but it has additional piping and equipment on deck.

Windfarm Construction Vessels

These are a relatively new type of ship, primarily used in Europe where windmill farms have been in service since the early 2000's. The U.S. is just starting to build these here, and

continues to face protests by various groups, including the environmentalists(!). But offshore leases are starting to be written, and with the drop in offshore oil production due to lower costs fracking on land, these are the next wave of the offshore industry.

Figure 8: German Windfarm Construction Vessel. The blue part is the hull, and the crew can set the feet of the tall cylinder legs on the sea bottom and jack the vessel up the legs so it is above the sea. Note the worker accommodations to the left, a helipad on top, and a very large crane on the deck.

Windfarm Support Vessels (WSV)

Windfarm Support Vessels are similar to oilfield crewboats in that they are high-speed vessels that transport crews to windfarm towers to perform maintenance. Many of them do not carry cargo on the aft deck like oilfield crewboats.

Figure 9. European Catamaran Windfarm Support Vessel. Note the wave piercing bow bulbs and raised foredeck crew transfer platform.

Heavy Lift Ships

These were covered in Part 1, but they are repeated here because of their offshore oilfield connection. Specialized heavy lift ships look quite peculiar, since they can either self-load with cranes or submerge the cargo deck to float on yachts, small ships, offshore construction assemblies, and various really large items. They have a tall deckhouse forward, a deep cargo deck aft, and they are the pickup trucks of the sea. See them below:

Figure 10: A heavy lift crane ship that carries large loads on deck. This cargo is the leg of a jack-up offshore oil rig.

Figure 11: This is a semi-submersible heavy lift ship. Unlike the ship in Figure 10, this ship floods the ballast tanks in the hull so that the main deck is deep enough underwater for the

cargo to float onto it, upon which they pump out the ballast water and the ship rises to the level in the picture.

Figure 12: Another semi-submersible type carrying large container cranes to a port as cargo. How do they keep this from rolling over? See the course on Intact Stability to find out!

Crewboats

Crewboats are the high-speed ferries that carry the offshore platform crews and gotta-have-it-now light cargoes to the offshore platforms and back. These vary in size from about 45 feet (14m) to 140 feet (42.5m). The large ones carry over 100 workers, have 6 engines, and often do over 25 knots while carrying about 50-100 tons of cargo. Crewboats have a distinctive look to them-a low deckhouse forward, a single-level passenger deckhouse behind it, and a cargo deck at the aft end. Over the years these vessels have evolved to be more like small, faster supply boats. Most of the American crewboats are built by a few shipyards in Louisiana and Texas, so they share a resemblance. The crewboats can be discerned from the fast supply boats by the extra

windows like a ferry on the main deck level; the accommodations on the main deck of the fast supply boats do not have as many windows.

Figure 13: Asian Offshore Oilfield Crewboat

Figure 14: Breaux Brothers American Fast Supply Boat

Figure 15: Breaux Brothers American Crewboat

Accommodation Vessels

Accommodation Vessels are floating hotels for the offshore workers. These vessels are a central place for the workers to come and go to many production platforms in a producing field or one under construction.

Figure 16: Accommodation Barge

Seagoing Tugs

Seagoing tugs are workhorses of the marine industry. They rescue disabled vessels, tow barges loaded with bulk and container cargo, and push larger vessels around when their own ability to maneuver is limited.

Figure 17: Seagoing Tug. Note the wide rubber padded bow for pushing, the high hull freeboard forward, the tires alongside for side towing and docking, the crane on the aft deck, and there is a large horizontal winch at the aft end of the superstructure (Courtesy of Eastern Shipbuilding Group)

River and Harbor Tugboats

River and Harbor tugboats look similar to seagoing tugs, but are generally smaller in overall size, they have lower freeboard forward and often have a steeper slope on the foredeck. But like a seagoing tug the aft deck is low so that the towing cable will contact the rail around the upper edge of the hull as little as possible when underway. Most tugs of the older design have a V-shaped, or "model" bow, and a may have push knee mounted on it to spread the load. The

push knee is the vertical black rectangle above the bow of the tug. There is a short length pilothouse with a lower cabin for rest aft of it on the upper deck. Inside the first level on the main deck are a crew mess and galley, a head (toilet) with sink and shower, and some berths for the rest of the crew. They are propelled by a single or double set of large diameter propellers, usually in nozzles, and have large rudders.

Tractor tugs are a newer type that have either rotatable propellers in nozzles, or vertical vanes that rotate and change their angle of attack as they rotate. The former is called an azimuthing thruster, and the latter is called a Voith-Schneider vane propeller. Both methods can move the tug in any direction, not just ahead and astern, so rudders are not required. And because tractor tugs can move in any direction, they have the more rounded hull shape you see, because they can push on the larger ship from any angle.

Figure 18: This is a typical “model bow” harbor tug of the older style propulsion.

Figure 19: This is a newer style tractor tug. Note the superior all-around visibility in the pilothouse and the red gun to the right of the pilothouse-this is a fire monitor for fighting fires and it can spray a stream hundreds of feet. (Courtesy of Eastern Shipbuilding Group)

Articulated Tug-Barges (ATBs)

Articulated tug-barges are the power end of a combined tug and seagoing barge. These were developed in the 1960's as a way to use fewer engine room sections on ships so that a company might own 5 or 10 seagoing barges, but only 2 to 4 tugs and therefore spend less on inactive crews waiting for cargo. The distinguishing feature of these is the extra tall pilothouse so that the person on the helm can see over the main deck of the barge no matter what the barge's loading and draft is. There are two main methods of connecting the tug to the barge, one that connects the bow into the barge, locking the pitch, but allowing the tug the roll independent of the barge, and a pair of pins in the side of the notch that lock the tug in roll but allows it to pitch independently.

Figure 20: Convertible ATB Tug, in this case towing a barge behind it (see cable over stern). The person on the helm can steer from above or below depending on how much view is needed.

Figure 21: ATB Tug. Note the gray box on the side under the pilothouse-this is the pin device that connects the tug to the barge, and it locks the tug into the rolling of the barge but allows the tug to trim separate from the barge.

Figure 22: ATB Combination on the Great Lakes. The barge is a bulk iron ore carrier, built with a notch for the tug at the stern, and no engine room section for propulsion. The tug locks into the notch and acts as the engine room for the barge.

Pushboats

Pushboats are used only for pushing strings of barges on the rivers, so they have a square bow rather than a round or pointed one. Like the model bow tug above, they also have a pair of push knees to spread the load. These are higher power boats because of the hull resistance of the barges, especially going up-river. These operate for perhaps week, or longer trips, and carry larger crews than river and harbor tugs.

Figure 23: Small pushboat. The shipyard that built this one has built over 50 of this same model for one operating company. (Courtesy of Eastern Shipbuilding Group)

Figure 24: Larger, higher horsepower pushboat. This is typical of what pushes large groups of bulk material barges on the main rivers. My first marine job was as a summer intern at a shipyard that built these. (Courtesy of Eastern Shipbuilding Group)

Figure 25: Pushboat pushing an unloaded deck barge. This is why the push knees are so high!

Figure 26: Pushboat and Hopper Barge with a load of gravel.

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Barges

Barges come in many varieties depending on their uses. The hopper barge above carries bulk cargos such as stone, coat, gravel, sand, wheat, corn, iron ore, and many of these types that are dumped into the barge by a conveyor belt or bucket crane, and they are unloaded the same way. Many of these have steel or fiberglass covers to keep the rain out. Figure 20 has a hopper barge with cover in the background.

Deck barges have a flat upper deck that loads are carried on, such as machinery, lumber, freight containers, railroad cars, concrete castings for bridges, steel beams, etc.

Figure 27: Deck Barge. The short wall on the deck is to keep the load in place and to fit a cover if needed.

Tank barges have tanks built into them to hold pressurized and/or liquified gasses and liquid chemicals like ammonia, methanol, diesel fuel, gasoline, etc. They can be distinguished by the tanks and piping on the deck.

Figure 28: Tank Barges

Specialty barges, such as the one in Figure 28, are built to carry unusual loads such NASA rocket stages. These often have a house on them that opens at one end for loading/unloading. This is how the rockets get to Cape Kennedy and how they go to the Mississippi Test Site for engine testing. This one is being pulled (towed) by a seagoing tug that has the necessary horsepower, and it is assisted in maneuvering by the small tug at the stern

Figure 29: NASA Rocket Delivery Specialty Barge

Dredges

Dredges are used to deepen and maintain harbors, rivers, lakes, and channels. They come in a few varieties, such as a hopper trailing suction dredge, and a dredge without a hopper but with floating pipes. Hopper dredges have a cutter head and pipe similar to that in Figure 31, but it trails the ship instead of being located in the front. The cutter head and pipe bring up the bottom dirt, shells, and stones, and load it all in a hopper forward of the deckhouse that can open underneath so the dredge can later deposit the tailings elsewhere. Conventional dredges bring up the bottom with the orange cutter head shown, and it sucks the tailings up the pipe to the pumps on board, then they pump the tailings into a long floating pipe that extends to the place where they dump the tailings.

Figure 30: Trailing Suction Hopper Dredge (Courtesy of Eastern Shipbuilding Group)

Figure 31: Forward Suction Conventional Dredge with cutter head up

Fireboats

Fireboats are specialized vessels used to fight fires on ships and in harbors. They are generally fast, have large capacity pumps, and many fire monitors as well as foam guns and hoses with nozzles. Most are smaller and have a few less features than the one shown. This one, which I worked on the construction engineering of, was built for the New York City Fire Department on a grant from Homeland Security. There are two of these, capable of pumping 20,000 gallons of water a minute as high as 250 feet up to a bridge deck through fire monitors, plus it has 2 manifolds with 8 hoses apiece for fighting fires under docks and on the water. They also have a Chemical, Biological, and Nuclear Ventilation air filtering system, a meeting room for the fire chiefs and politicians, accommodations and galley for the crew, a small boat that launches from the stern, a crane and a towing winch, and 4 engines and propellers that make 20 knots of speed. Fireboats are often painted red.

Figure 32: New York Fire Department Fireboat “343” (Courtesy of Eastern Shipbuilding Group)

Figure 33: Another Fireboat

Scientific Research Ships

Scientific research ships are used for oceanography, underwater geology, weather studies, hydrographic (mapping) of the ocean bottom, salvage, pollution studies, acoustic testing, fisheries regulation and population censuses, and many more. Unlike commercial vessels, they operate on grants from governments, universities, or institutions, and so are very cost-conscious in their operation, often doing projects that last only a short, fixed amount of time. They are slow speed vessels that rarely recover a cargo, but often deploy submarines, autonomous vehicles, tow instruments, stop and take water samples, etc. These ships are often painted white or red, although not always. They are somewhat distinctive in appearance because they tend to have high freeboard except the aft working area, there are many cranes and winch drums on the decks, and they have a large amount of enclosed interior space for the hull length. See picture below:

Figure 34: British Oceanographic Research Ship

Figure 35: U.S. National Oceanographic Atmospheric Administration (NOAA) research ship

Hovercraft

Hovercraft are specialized craft that are used to transport personnel and equipment to either difficult-to-reach areas like mud flats, ice fields, and swamps, or to environmentally wake-sensitive areas. They are not seen very often because they tend to only be used in these specific kinds of areas, and except for their operations bases, there are not many people around. I once designed a small 6-person hover crewboat for Shell Oil to use in Alaska where nothing but a helicopter could get anyone to or around on an exploratory drilling area. They are distinctive in that they have a rubber skirt under the bottom, they do not sit in the water like a ship when underway, and they are propelled by air propellers in nozzles rather than underwater.

Figure 36: Commercial Hovercraft Workboat

Submarines

Submarines are a special type of submersible ship that is primarily used for warfare, but also for undersea inspection and construction work, pipelaying, ocean exploration, and salvage work. Many famous shipwrecks are now being found by research submarines. According to Dr. Robert Ballard, the finder of the "Titanic", German battleship "Bismark", and the U.S. Navy submarine "Scorpion", the days of deep-water manned submarines are coming to a close, as they are being replaced by remotely-operated submersibles and underwater autonomous vehicles (UAV's), which takes the risk of human life out of the job and allows the operator to sit in comfort on the ship while they watch through the cameras and operate the arms and propulsors from above.

The "Alvin" has a maximum dive depth of 21,300 feet, and it was used to recover a lost hydrogen bomb in the Mediterranean in the late 1960s. It also discovered the "hot smoker" vents on the Mid Atlantic Ridge, which opened up a new field of research in anaerobic life forms. The Alvin was built in 1964, has been rebuilt and enlarged several times, and is still operating. There

is a long, interesting history of this submarine on the Woods Hole Oceanographic Institution's website.

The Anorep was used by famous oceanographer Jacques Cousteau for underwater exploration, and now is displayed in Monaco outside their Oceanographic Museum.

Remote operated vehicles (RAVs) and underwater autonomous vehicles (UAVs) are rapidly replacing the need for manned deep submergence submarines.

Figure 37: Manned Research Submarine Alvin (1980's period configuration when it found the Titanic)

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Figure 38: Manned Research Submarine Anorep I

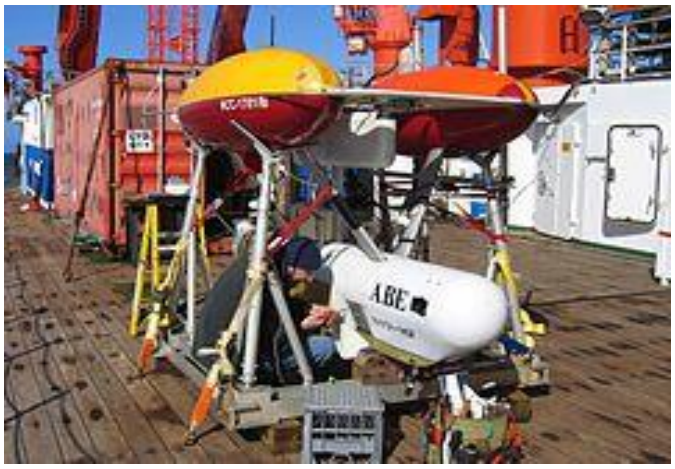

Figure 39: Remote-Operated Research Vehicle

Figure 40: Torpedo-Like UAV

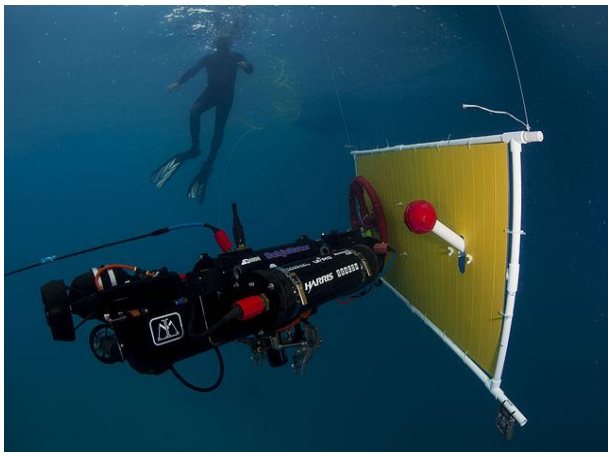

Figure 41: Another UAV

