THE LIFE OF A SHIP

Planning:

It starts with a business needing a tool to make money. It may be an entrepreneur seeing a niche market or wanting to break into new territory. Or, it may be an old line transportation company being approached by a customer that needs to move a product to market.

Feasibility studies are made, numbers are run, and if it appears that return on investment will justify the capital expenditures, a decision is made to build a vessel.

A business takes a business plan to a financial group, possibly backed by a charter for the new vessel that "guarantees" income for one year or more. Many charters will normally be for a one to five year period. When business is good, a vessel may be built out of a company's cash flow. When financing is assured, the life of a ship begins.

An intelligent vessel owner will assemble a team consisting of his marine operations personnel, possibly personnel from the charterer, and a naval architect. Input may also be received from the loading and discharge terminal(s) if the vessel will be in a dedicated service. And, of course, there will also be input from the chief financial officer.

At the beginning the basic decisions that have to be made will be how to set up the vessel's characteristics, starting with how much will it carry and at what speed. Most vessels are used for transporting a commodity (this includes passengers). For vessels such as tugboats it will be how much horsepower will it have. This can also be referred to as bollard pull, a measurement, in tons, of pulling or pushing power.

After determining the vessel's payload capacity, the following variables will have to be dealt with:

- What will be the vessel's length, breadth, and depth?

Because of harbor or terminal restrictions, one or more of the dimensions may be restricted. As per Archimedes, if you want to carry a certain weight, any change in one dimension will have to be compensated by a change in one or more of the others. Also, buoyancy will differ in waters of different density.

- What will be the vessel's propulsion?

It will probably be with one or more diesel engines. But options can be a fixed pitch propeller through a marine reverse gear, straight drive to a controllable pitch propeller, or a drive to a controllable pitch propeller but through a reduction or offset gear. Because of improvements in efficiency and weight, diesel electric propulsion is a growing option. For some vessels there is also the choice of azimuthing propellers as used in tractor or azimuthing stern drive (ASD) tugs. This is being seen on oilfield supply vessels, and some tugs and passenger vessels. [1]

[1] An Azimuthing Stern Drive (ASD) is a form of propulsion similar to an outboard motor. Instead of being "outboard" it is built into the vessel structure but can still turn 360°. Because it can provide thrust in any chosen direction, it removes the need for rudders, and, in some applications provides superior control. Because the power source, mechanical shaft, or electric motor comes in at the top and via gears is transmitted vertically down to turn a horizontal propeller shaft, the unit has been referred to as a Z-drive.

This decision will have to be balanced with the desired speed, fuel consumption, type of fuel to be used, use of high speed or low speed diesels, diesel engine weight and dimensions, engine availability and reliability, parts accessibility, original and maintenance costs, etc.

- What size crew will be needed?

This is a major operating cost. Some choices in crew size will be controlled by the vessel size and service, but it can also be based on the immediate and long term cost of automation, and the country in which the vessel will be registered, and/or the nationality of the crew. These latter two items will usually be changed over the life of a ship as economics change and/or the ship is sold. [2]

- Under what rules of construction will the vessel be built?

For the purpose of this article, it will be assumed that the vessel is built for international service, i.e., that it will at times leave its flag country to deliver cargo to or from another country or to work in another country. In such service, it will be an "inspected" vessel. It will have to be designed, built, and maintained under several sets of rules with the design, construction, and maintenance being overseen by a non-governmental type agency third party inspector(s). These groups are known as classification societies and flag state inspectors. The former were born out of the insurance industry and the best known in the United States is the American Bureau of Shipping (ABS). There are about a dozen primary class societies. [3] The latter, flag state inspectors, have developed over the last 25 years, and are each maritime country's attempt at forcing vessel's that enter their waters to be well maintained. This is mainly a preemptive battle against power failure and sinkings that can cause catastrophic pollution incidents and loss of life. The flag state group in the United States is the United States Coast Guard.

Although all of the groups' rules of construction are similar, the enforcement of these rules may vary. So like a marginal student might choose one college over another, and try to get "easy" courses and instructors, some ship owners or operators may try to pick an "easy" class society and try to have follow up inspections done in ports where there is an equally easy inspector. The classification societies have formed an umbrella group to try to maintain uniform rules and levels of oversight to discourage owners from "venue shopping" and to make vessels at sea safer.

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[2] Some countries compete for ship registry by enacting laws that attract a vessel operator. This can be thought of in the same way countries or states try to lure industry. While it does not provide a large amount of income, a country does not need a large bureaucracy to run a ship registry.

[3] Classification societies are private groups that classify vessels by having then designed and/or built and/or maintained to certain proven engineering and performance levels. If they are built and maintained to the specifications, with the maintenance documented by periodic scheduled mandatory inspections, the vessels will maintain awarded compliance certificates. Having these certificates is a significant factor in reducing insurance premiums but also the vessel may not be allowed to sail or be accepted in world ports without the certification. Although the classification societies are headquartered in major maritime nations, the regulations may pertain to vessels of any flag that desire to be classed by that specific society.

After all of above planning is done, it is up to the naval architect to put together a vessel that does what it is supposed to do, is legal, is within budget, and floats right side up. A ship is the only plant that is made to operate on a foundation that can change by the hour, and can be in motion even when the vessel is idle. A ship's stability and sea keeping ability, if unfavorable, can have a negative effect on a vessel's value.

We finally get to the point where an idea can become an object. Specifications, construction drawings and a bidding package are prepared and sent out. A shipyard is chosen, a contract signed, and money changes hands.

In a few cases, a marine appraiser may have been contacted earlier on to perform a prospective appraisal for a lender to opine on what the vessel may be worth at the time it is completed and delivered to the owner. There are also times when the appraiser should have been involved in negotiating the milestone or progress payments contract during the construction phase which may be funded by a "bridge" loan. In some cases milestones are drawn so vaguely that they can bring about disputes on shipyard performance and justification of payments.

Once a contract is signed and things are turned over to the shipyard, work flow charts are developed for material purchases and for the various shipyard departments. The owner will have one or more representatives on site, part or full time, to interface with shipyard workers. This is necessary to answer the myriad questions that arise and to make hundreds of minor decisions that keep construction on time and on or under budget. It is also necessary to have owners' representation, along with class representation, to keep the shipyard from possibly "cutting corners" and on schedule.

Construction:

Basic ship construction has not changed in over 500 years. You first build a skeleton and then put skin over it.

A keel once was a large squared off tree trunk. Now, it can be a large steel flatbar, formed steel plate, or a fabricated box girder. Once wooden frames were bent and attached to the keel with planking secured over the spaced frames to make a skin. After the hull and deck were created, other craftsmen installed piping, electrical fittings, machinery, and the interior outfitting. The entire hull was constructed in an upright orientation on lauching ways adjacent to the water, or in a graving dock. [4] This is still true in some shipyards and for some types of smaller vessels.

Today's larger vessels are built in modules. The size of the modules is controlled by the efficiencies of personnel used in the yard and the transportation or lift capacities of the

[4] Graving docks are holes that are dug into a shoreline or riverbank with gates that keep water out. A ship is built in this dry hole. After the ship is built, valves are opened and the dock filled with water, gates removed, and the ship floated out. For repairs, a ship is brought into the graving dock, the gates closed, and the water pumped out. In early times, the tides were used when possible to flood and drain a graving dock.

shipyard or local contractors. Hull modules often start with the keel and skin sections that are assembled in what are known as panel lines.

Steel plate will come in various sizes such as 6, 8, 10, or 12' widths and 20' to 40' lengths. Steel thickness depends on the size of the vessel, but normally range from 5/16" to 3/4" steel plate. Thicker plate is used in high stress or impact areas or on large ships. Framing can be angle iron or bulb angles with occasional use of channels, flange plate, or I-beams. Precut for length, frames are positioned on the plate and gang welded by track welding machines in modern shipyards, or by hand in small yards.

In modern yards steel plate is cut to size, or cut for flange plates, brackets, gussets, etc, by CNC plasma cutters. However, even with computer aided design and lofting, it is often necessary for a human being to do some fine adjustments for fit. In more modern yards, panels are also pre fitted with pipe penetrations, piping, and cable trays at this stage. Panels are also taken to a shot blasting chamber where they are blasted to remove millscale slag, and primed. Doing as much as possible with flat panels increases efficiency, reduces man hours, and therefore cost. As shipyards often build on a fixed price basis, any reduction in cost or manhours can increase profit.

Bulkheads, deck, bottom, and hull side panels are then assembled into modules. Some modules may be assembled upside down to increase the percentage of down welding, and then rolled upright for completion. Some main and auxiliary machinery may be placed inside a module, crate and all, before a module is completed and closed up.

Modules are then moved to an assembly site where the vessel can be launched. Finally, modules are united to form a complete hull and complete deckhouse.

During all this time, Class surveyors and owners' representatives have been inspecting and testing all major components and signing off on or rejecting welding, piping, electrical systems, etc. Class oversight goes all the way back to the manufacturing and testing of the steel, casting of the anchor and anchor chain links, the manufacturing of shafts and propellers, and the manufacturing and assembly of main engines and gears.

The ship will be launched when the external hull is complete with all underwater equipment installed. The vessel will then be completed while afloat. Putting a ship in the water allows a shipyard room to start construction on a subsequent hull. Also, machinery and shaft alignment often cannot be done until the vessel is afloat and has settled out in its natural surroundings.

Part way through construction, the ship's captain, chief engineer and possibly some other crew members may join the vessel to learn the vessel as it comes together. Some other crew may join closer to the end to perform some cleaning, painting, and stocking of the vessel that may not be part of the shipyard contract. Stocking the vessel is a big job because of the large number of spare parts, food, and thousands of other necessary items that need to be onboard for self sufficiency at sea.

One of the final steps will be when a mix of shipyard crew and owner's crew take the vessel out for one or more sea trials which may last about 12 – 36 hours. But the vessel will not be complete and acceptable until the class surveyor, and in some cases, the flag state authority, issues certificates stating that the vessel has been properly built to the correct specifications and is in compliance with the appropriate national and/or international safety and manning regulations.

Life:

Most ships that are in international commerce will receive special recognition on their maiden voyage. There may be designation at both the first load port and first discharge port. Many years later, you may still see a plaque or framed photo in the captain's cabin or ship lounge. After this brief moment of fame, the ship becomes just one of thousands in international sea trade.

In its first half decade, it will pretty well be free of oversight. There may be inspections on board for classification or cargo interest. There may be an occasion flag state boarding, which may have more to do with the vessel's flag or crew nationality than the vessel's condition. The class surveyor will do an annual inspection and the vessel must go into drydock twice in a five year period.

Large ships will rarely see an appraiser during their usual 25 year lifetime. With sales and purchase it is not unusual to have a value agreed upon by buyer, seller, and a one page "letter of value" provided by a ship broker based on comparable sales. It is rare that a broker will sight a ship that is valued. The banks may be more interested in the solvency of the company than a few of its assets.

There are two times where any vessel may be subject to an appraisal. One is when a vessel comes off lease and the second is in the event of a marine casualty or a death on board or involving the vessel.

When a vessel comes off lease, the lease term may state that the vessel's value is a big factor for a new lease or for a buy back. If there is a disagreement on value an appraiser is hired. Often the lease agreement will stipulate that one appraiser will be hired by the lessor, one by the lessee and one by mutual agreement. How the results of these three appraisals are used varies by lease agreement.

In the case of an accident the vessel's value is important. Under Admiralty law, in the absence of negligence or intent, recovery for an accident or death may be capped at the value of the vessel causing the accident. This is known as Limitation of Liability. It is a retrospective appraisal, valuing the vessel and its cargo immediately prior to the incident.

Smaller vessels or vessels owned or operated by small companies are much more likely to be financed on their asset value. Such appraisals involve the usual three forms of valuation, cost, comparable sales, and income.

For the more common types of marine equipment, replacement cost may be found in published sources. Other vessel types, and reproduction cost, might have to be gotten from privately cultivated sources. If one type vessel has not been built in many years, it may be necessary to index its historic cost.

Because marine sales do not have to be registered, some sales of some type vessels may only be obtained through subscription sources. Other sales may have to be developed through private sources. However, there is much information on many brokerage sites of vessels being offered for sale. On most sites only bare bones information is provided. A few sites may give more detail. The appraiser, through experience, should "learn" the sites and what their information and prices mean. Finding the same vessel with multiple listings helps this understanding. The appraiser will also have to make suitable adjustments of asking prices to better approximate sales price. As always, assumptions made should be explained in the report narrative and limiting conditions.

For vessels in a set service, particularly U. S. flag Jones Act vessels, the income approach can be readily done if the proper historic and future budgeting expense/income information is provided. For some foreign flag vessels, the income approach can be treacherous and the assumptions many. Income can be very cyclical, which is true of many industries. But costs also vary widely. There can, of course, be frugal owners and open pursed owners. But vessels can also be moved into trades where insurance premiums may vary, where fuel costs are higher or lower, or where repairs are cheaper. Owners may also change the ship nationality or crew makeup which may alter costs. The appraisers must be aware of the possibility that an owner, by reducing maintenance and using flags and crews "of convenience" [5] while incurring greater income may be doing it on the back of asset value. That is why the marine appraisal motto is "Condition, Condition, Condition". A great benefit of an "inspected" vessel is that the outside inspections noted above, by class and flag state, have leverage in forcing a basic level of maintenance. But as noted above, the appraiser must also know which class societies may generally maintain a higher standard. As mentioned, there is a move by the major class societies to "standardize" levels of inspection so that as much subjectivity as possible is removed.

The vessel, as was noted above, may have been purpose built and chartered for a contractual period. When the charter ends, or is prematurely ended, the vessel owner must look for other usage for the vessel. The new job may not be a 100% perfect fit. Here we frequently have both the business and appraisal use of the principle of substitution. From the business side, the owner will try to find suitable cargo or a suitable day rate or tonnage rate. A shipper will try to find a ship that can carry his type and amount of cargo at an affordable rate. For the appraisers, the value of the vessel, from a comparable sales point, can be determined by looking at sales or offerings of all vessels that the shipper might choose from.

[5] Flag of "convenience" is a term used to describe those countries which have ship registry laws that may be considered to be lax when compared to the ship registry laws of countries such as the United States and North Europe. Among other things, these flags of convenience may allow certain tax breaks and crew size and benefit regulations that allow operators a greater return on investment.

An uncomplicated example is that the shipper is looking for a Handy Size [6] bulk carrier of about 30,000 DWT to go from port A to port B (and maybe other ports). The shipper may also be interested in the age of the vessel (insurance reasons), flag and/or crew nationality (cost and political reasons) and engines and speed (cost in both fuel and voyage length).

The appraiser when doing the comparable sales approach on the subject Handy Size bulk carrier will be looking in the market for similar size and similar age vessels. Since size in this case is directly related to value, adjustments will be made. As one rarely, if ever, knows the condition of the vessels on the market, or their class and drydocking status, a difference of a few years either side of the subject, in practical terms, will probably make no difference in value. It gets to be very difficult to name any more details for adjustment as there are rarely details available to work from. In rare cases a vessel's "birth place" or current flag may suggest that an adjustment up or down may be prudent. So we have the appraiser trying to think in terms of the end user. Is there similar utility in the comparables chosen?

So a vessel moves on through its life and it ages, sometimes not too gracefully. The three forms of depreciation affect it as it ages. Physical depreciation is an obvious factor. For many years the marine industry was so conservative that, other than containerization, there was no real technical obsolescence. But economic obsolescence such as OPA 90, fuel costs, crewing costs, shipyard maintenance costs, engine emission regulations, etc., forced technical changes within the industry.

One common type of technical obsolescence was size. Older vessels could not compete in economies of scale and fuel consumption so they may have been pushed aside to shorter runs, in smaller markets, and earning smaller rates.

As a vessel's value dropped, it could become a candidate for a different service. If a low purchase price combined with reasonable conversion costs were lower than the cost of a purpose built vessel, the principal of substitution would come into play. One example is that over the past thirty years, unwanted Jones Act supply vessels were converted to Alaskan fishing vessels. Then recently, when the fishing market was soft and the supply vessel market very strong, a number of those boats were reconverted back to supply vessels.

Statistically the life of a foreign flag ocean service freight vessel is about twenty-five years. Jones Act economics make the life of a U. S. flag vessel more in the thirty-five to forty-five year range, depending on the vessel's service. With the strong world market in the period 2005 to 2008, many ships that would normally have been scrapped were kept in service because of the very high day rates that were in effect. But the high day rates also brought on a massive amount of new construction which is producing a saturated market in many world markets and services.

[6] Handy Size is a small ship in the 10,000-30,000 DWT range. The industry has reference terms generally used in chartering and sales and purchase (S & P) for different size groupings. Examples are Very Large Crude Carrier (VLCC) a crude oil tanker of 200,000 to 299,990 DWT and Panamax, a bulk carrier of 50,001-80,000 DWT that is narrow enough to fit through the Panama Canal.

So, eventually an owner must make a decision about the fate of an aging vessel. Frequently, this decision is made in the year leading up to a Class society, Special Survey and drydocking. Does one go through the downtime and expense? Should we extend the life of the vessel enough into a reasonably strong market that will pay for the shipyard period plus a decent return on investment? Or will the future market not be there to justify our expenditures.

A decision is finally made to scrap the vessel. The vessel is put up for sale in the local or worldwide scrap market. The bids received may decide how the last voyage is handled. If the vessel has mechanical problems or the trip is short, the shutdown ship may be towed to the scrap yard with or without a small riding crew. If operable, a delivery crew might sign on for this one way trip. The owners' preferred path is for the ship to book a cargo at transportation costs, or at a slight profit, to take the cargo for discharge at a port near or a few steaming days from the scrapping port. Typically, at an Indian subcontinent port (Pakistan, Bangladesh, India) or in China, where most of the world's ship scrapping take place, the ship is physically run up on the beach. It is intentionally run aground. Then the vessel is systemically cut up into scrap. Some machinery may be saved, but in general all is scrap for re-smelting and the rest burned.

The interesting end to this story is that in China, the world's second largest ship breaking nation and the largest ship building nation, the steel from the scrap ship can very well end up in another, new vessel, and start the ship's life cycle all over again.

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