The Ship Acquisition Process

Charles R. Cushing
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New York

2011
This book has been prepared as an outgrowth from a series of week-long lectures given at the United Nation’s World Maritime University (WMU) in Malmo, Sweden, over the past 26 years.

The book covers many aspects of project and program management as they apply to the ship acquisition process. By ship acquisition, I refer to acquiring tonnage from shipbuilding. Many aspects of the book derive from my doctoral dissertation at Cardiff University, and a chapter in the Society of Naval Architects and Marine Engineers’ (SNAME) book SHIP DESIGN, Volume I, Chapter 4, that I wrote in 2003.

The author deeply appreciates the assistance of Ms. Joanne McLeod for her tireless efforts in untangling a very messy manuscript; to Ms. Clair Lyons, editor extraordinaire, for translating the draft into English English, and to Mr. Brian Streb for his adept skills in print and graphics.

While imitation is regarded as the highest form of compliment, credit for the works of others throughout the text has been provided. Any uncited work is purely unintentional. Reasonable efforts have been made to correct efforts that may have crept into the book and any that have survived are solely the responsibility of the author. Mea Culpa.

Charles R. Cushing

March 2011
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. INTRODUCTION</td>
<td>2</td>
</tr>
<tr>
<td>2. PROJECT MANAGEMENT</td>
<td>6</td>
</tr>
<tr>
<td>3. STRATEGIC PLANNING</td>
<td>10</td>
</tr>
<tr>
<td>4. DESIGN</td>
<td>34</td>
</tr>
<tr>
<td>5. COMMERCIAL ACTIVITIES</td>
<td>60</td>
</tr>
<tr>
<td>6. FINANCING</td>
<td>76</td>
</tr>
<tr>
<td>7. CONTRACTING</td>
<td>106</td>
</tr>
<tr>
<td>8. PRODUCTION PRODUCT MANAGEMENT</td>
<td>120</td>
</tr>
</tbody>
</table>

**APPENDICES**

<table>
<thead>
<tr>
<th>APPENDICE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. MANAGEMENT SCIENCES</td>
<td>A-1</td>
</tr>
<tr>
<td>B. ECONOMIC ANALYSIS</td>
<td>A-7</td>
</tr>
<tr>
<td>C. GLOSSARY</td>
<td>A-29</td>
</tr>
</tbody>
</table>
INTRODUCTION

From man’s earliest days, water craft has provided him with an easy way to transport himself and goods. It has spurred trading, expanded exploration and provided society with protection from intruders. Vessels have been a vital factor in permitting society to extract resources from the sea. It has been a mode of relaxation and vacationing. Most recently it has been the important factor in globalization.

To accomplish this, man has had to engage in the very capital and labor intensive activity – shipbuilding. The building of ships involves the expenditures of enormous amounts of money. Ships are usually built in lot sizes of several or more.

The individual cost of ships drops dramatically with the first seven to ten identical ships. Ship owners often order ships 4, 8, 10, 12 or even 20 at a time. Hence if each ship costs tens or hundreds of millions of dollars, an order for a fleet of ships can be monumental. Vale’s order for 14 very large ore carriers (VLOC) at $140 million each amounts to an order for nearly $2 billion. A cruise vessel such as Royal Caribbean’s 6400 passenger project GENESIS can cost up to $1.25 billion, an aircraft carrier up to $6 billion.

It is therefore necessary that the acquisition be carried out in a very disciplined, businesslike and well planned manner, using all the best practices of project and program management. The processes to be followed apply equally well to any major capital project such as the building of a factory, refinery, port, railroad, hotel, etc.

This book recommends and outlines those basic steps as they would apply to a ship.

It is recognized, at the outset, that an entrepreneur or organization that wants to acquire additional tonnage has a number of alternatives available to him besides new construction. These include:

- Slot charter
- Voyage charter
- Time charter
- Bareboat charter
- Secondhand purchase
- New construction
Contract of affreightment
Vessel conversion
Merger
Vessel pooling

While this book focuses on new ship acquisition, the process can be readily applied to major ship conversions and other paths to new tonnage.

The examples in this book refer to commercial vessels engaged in the transportation of goods and people. Again, the principles can be applied to service vessels, offshore production and storage ships, naval and other government ships and the like.

Why do we need to define, identify and explain the process? Because:

a. It is not well documented in the literature.
b. Much is written on naval vessel acquisition, but not commercial vessels.
c. So much money is at stake.
d. A company’s very existence may be at stake.
e. It is common place for managers with little experience to place the orders.
f. It is a once in a lifetime experience for many – not the kind of activity for learning on the job.
g. Purchases may be infrequent (once every 5 or 10 years) and managers may lack the ongoing experience.
h. Managers are mobile, promoted, and may not be in the position 5 years.
i. Buyers may be banks or financial institutions without ship acquisition or vessel owning experience.
j. Buyers may be speculators, insurance companies, etc.
k. For many, unsuspecting building a ship is a heady, ego trip.
l. Buyers may be subjected to aggressive marketing efforts by “hungry” yards.
m. The commitment is not only large, but may also be long term, as much as 20 years.

Problems with the current methods

a. Current methods often skip or omit some or most steps.
b. Planning is the most ignored step.
c. Many buyers omit competitive bidding.
d. Concept formulation and mission statement is almost always omitted.
e. Economic analyses are abused.
   i. Buyer doesn’t realize that this is principally a capital activity.
   ii. Don’t focus on the objectives of the firm.
   iii. Omit or misapply
       • Depreciation
       • Tax
       • Life of asset
       • Effects of inflation
       • Financing alternatives
f. Risks are not identified.
g. Poor preliminary design efforts.
h. Poor project management.
i. Inadequate or understaffed team.
j. Non definitive contract plans and specs.
k. Wrong construction project managers.
   • Operating personnel without project management experience
   • Learners-on-the-job
   • Class surveyors
   • Leave it to the yard
l. Many other shortcomings.
2

PROJECT MANAGEMENT

2.1 History of Project Management

Project management has been used since the early days of civilization. Several examples of project management in early history include:

Pyramids of Egypt

These are among the oldest major projects. The pyramids at Saqqara, near Memphis, date back to 2630 B.C. Today, there are 138 pyramids in Egypt. The largest and most famous is the Pyramid of Khufu for Pyramid of Cheops, sometimes called the Great Pyramid. It was started around 2550 B.C. and took 23 years to construct. Records survive, which tells us that the architect was Imhtep. He assigned project managers and sub-project managers; one sub-PM for each face of the pyramids.

The purpose of the pyramids was for tombs for the Pharaohs. The entrance shafts for the burial chambers were aligned to the dark portion of the sky about which the stars revolve, i.e. Polaris, the North Star.

The shape of the pyramids was meant to represent how the earth was formed. The stones weighed about two and one-half tons each and were faced with reflective limestone. The Great Pyramid a Giza is one of the largest structures ever built.

The Great Wall of China

The Great Wall, called in Chinese “Wan li Chang Cheng” or the long wall of 10,000 Li. It was originally built along China’s northern border to keep invaders out. It actually is a series of several walls that have been built and rebuilt. When Qin Shi Huang unified China he started construction in the 8th Century B.C. and it continued through 231 B.C. More recently construction of the wall continued under the Ming Dynasty.

It is estimated that over one million people died building the wall. It is made of wood, rammed earth, stone and brick. It is 8800 km (5500 miles) long.

St. Petersburg

St. Petersburg was founded by Czar Peter the First (Peter the Great) on 27 May 1703. Peter went to Russia and wanted an outlet to the sea. During the Great Northern War with Sweden, he captured the Swedish Fortress Nyenskans (new camp) on the Neva River. He made this the Peter and Paul Fortress.
Peter selected Alexander Menshikov to manage the project and Jean Baptiste LeBlond was appointed Chief Architect. Their challenge was to build a western city on a “middle taiga lowland” (swamp). Countless serfs and Swedish prisoners-of-war built the city. Many died in the process.

St. Petersburg was Russia’s capital for over 200 years.

Other Major Projects

- The Roman aqueducts
- The Suez Canal
- The Trans-Siberian railroad
- Three Gorges Dam

Many of the great civil works were constructed by very creative and industrious engineers, such as Vitruvius (1st century B.C.), Christopher Wren (St. Paul’s Cathedral in London), I.K. Brunel (bridges and railroads).

It wasn’t until the 1950s that project management became systematic. Building on the work of Fredrick Winslow Taylor (scientific management theorist), Henry Gantt and Henri Fayol, U.S. government and industry developed PERT and CPM, followed in the 1960s by earned value, life cycle costing, PIMBOK and other developments.

2.2 What is Project Management

Project management is the process of planning, organizing and controlling project activities so as to meet the goals and objectives of the organization. It is a discipline that uses processes and techniques that monitor and control costs, budget, schedule, quality, risk, integration of the project within the organization and other distinct elements of the project.

Projects are a temporary, rather than continuous process that has a definite start and completion. They are usually constrained by objectives, a budget, schedule and scope of work.

Project Management is not the same as program management. Program management involves the senior level oversight and control of a number of related projects. Therefore, the entire ship acquisition process requires overall program management, whereas the design of the ship, the development of a strategic plan, owner’s representation during construction, are all project management tasks.

The life cycle of a project starts at the beginning of the project and carries on through a series of identifiable steps to the conclusion.

Projects are usually carried out by project teams and have a single point of responsibility in the project manager.

There are many techniques available to monitor and control projects. The traditional ones include:
- Gantt charts
- PERT
- Critical path method (CPM)
- Work breakdown structure (WBS)
- Earned value (EV)
- Value engineering and other techniques

Other methods include:
- Critical chain project management
- Extreme project management
- Event chain methodology
- PRINCE2

The Guide to the Project Management Body of Knowledge (PMBOK Guide) is a useful document that deals with the process groups: initiating, planning, executing, monitoring, controlling and closing of projects. The knowledge areas applying to each process group include: integration, scope, time, cost, quality, human resources, communications, risk and procurement.
STRATEGIC PLANNING

3.1 Introduction

1. The ship acquisition process consists of four distinct steps or phases, namely
   a. Planning
   b. Design
   c. Commercial
   d. Production (and post production)

2. Planning is the starting place.

3. We will assume that some paradigm exists – some agent of change – a company department – an individual – a speculator – some competitor – someone or some event suggests that a change must be made requiring:
   a. A new ship.
   b. A more competitive ship.
   c. Replacement of worn out or obsolete ships.
   d. A growing trade needing larger or more ships.
   e. A new service.
   g. Replacement of a wrecked vessel.
   h. A joint venture, i.e. some change.

This leads to strategic planning.

4. In fact, strategic planning is a continuous, ongoing form of management – and the need may have emerged from the strategic planning process.

5. Background on Strategic Planning
   a. The concept of planning goes way back.
   b. Planning is
      i. Future thinking, thinking about the future, action laid out in advance.
ii. Controlling the future – not just thinking about it but act on it. Planning is the design of a desired future and of effective ways of bringing it about.

c. 2400 years ago Sun Tzu makes reference in his The Art of War to a “director of strategic planning”, but this may be a loose definition of the text.

d. 200 years ago Napoleon and his contemporaries used early precepts of modern planning.

e. 120 years ago the French mining industry began a program of 10 year forecasts every 5 years.

f. The end of the 19th and beginning of the 20th century saw the formalization of business policies and procedures, work norms and standards capital budgeting, management by objectives and project planning.

g. Some of these procedures were formalized during World War II by the Office of Strategic Service (OSS), the forerunner of the C.I.A.

h. Popularity of planning had taken over Corporate America and Communist Eastern Europe.

i. By the 1960’s, such planning had evolved into a coherent discipline and adopted by most large corporations.

j. During the 1970’s and 80’s it spread to Europe and world-wide.

k. During the 1990’s it transmogrified into “Strategic Management.”

6. Reasons for Strategic Planning
   a. Increasing complexities
   b. Uncertainties
   c. Volatility
   d. Magnitude of changes
   e. Rate of change
   f. Changes caused by legislation, technology, industry, politics and society.

7. All lead to risks – especially in the long term.
8. **Strategic Management Definitions**

a. **Strategic Management** is a process for conducting the entrepreneurial activities of a firm for organizational renewal, growth and transformation. The major tasks are:
   - Set a mission and goals
   - Assess the environment
   - Appraise company capabilities
   - Craft the strategy
   - Implement the strategy
   - Evaluate and control the strategy.

b. **Business Policy** is a set of prescribed and discretionary statements, limiting actions of individuals in the firm, as set forth in directives and guides.

c. **Mission** is the reason for which the firm exists, and what it will do. Basically it describes the products/services to be supplied, the markets to be served, and the technology applied (if important).

d. **Vision Statement** answers the question, *What do we want to become?*

e. **Goals** express the aspirations of the firm, general ends that cannot be measured. Ex. “In unrelenting pursuit of perfection.”

f. **Objectives** are specific targets to be accomplished by a specified time. Ex. “Profits will grow at the rate of 5% annually for the next five years.” Long-term objectives (5 years or more) are strategic objectives and define the desired character of the company, at the specified time.

g. **Strategy** is simply the means or general actions to be taken to achieve long-term objectives. Strategic management is the work of the General Manager.

h. **General Manager** is person who is responsible for a profit center, as opposed to a functional manager who is responsible only for a cost or revenue center.

i. **Opportunity** is a set of circumstances that, if acted upon at the right moment, will produce a gain.

j. **Threat** is the probability of a future event and its potentially harmful impact on the firm.

*Source: Bar Charts, Inc. Quick Study – Business*
9. Strategic Planning is a defined process whereby management transforms a vision into reality (Hax & Magluf).
   a. “Strategy is a means of establishing the organizational purpose in terms of its long term objectives, action programs and resource allocation priorities.” (Hax & Magluf)
   b. Sometimes referred to as “Strategic Management.”
   c. Involves
      • Analysis of corporate objectives.
      • Analysis of corporate opportunities.
   d. Also is continuous process of
      • Making systematic decisions.
      • Organize method to carry out decisions.
      • Measuring results.
   e. Strategic Planning are plans formulated for
      • Specific periods
      • Future block of time, i.e. 5 year plan, 10 year plan, etc.
   f. Japanese tend to take long range view, stable, steady, slower, more conservative growth.
   g. U.S. companies tend to take shorter range view, shorter horizon, more immediate bottom line.
   h. Need for thorough documentation throughout plan.
   i. Strategic Planning is
      • Dynamic
      • Continuous
      • Flexible
      • Action-oriented
      • Requires review
      • Requires corrective action.
   j. Strategic Planning asks: What is our business? Where do we want to go?
   k. In Lewis Carroll’s book Alice in Wonderland, Alice asks the cat: “would you tell me please, which way I ought to go from here?” The cat responded: “That depends a good deal on where you want to get to.”
1. An important objective of strategy is to “achieve a long term, sustainable advantage over competitors.”

m. Strategy must deal with the business environment external opportunities and threats, and internal strengths and weaknesses.

10. Central to Strategic Planning is a willingness to change, for a company to adapt its organization and methods to improve its competitive position.

The strategic process should encourage full expression of different views and tolerate dissenting viewpoints. When consensus is achieved, differences must be put aside and managers must get behind a shared vision.

11. Strategic Planning asks four fundamental questions:
   a. How did organization get to its present position?
   b. Where does organization want to go?
   c. How will it get there?
   d. How will it function successfully when it gets there?

12. The permanent, long term objectives of the firm must be defined. These should not be constantly and erratically redirected without good reason, such as changes in external or internal conditions. A central concern of strategy development is in defining the competitive domain of the firm, i.e.
   a. What businesses are we in?
   b. What businesses do we want to be in?
   c. What businesses do we not want to be in?

13. In asking what businesses are we in involves analysis of company and environment, including
   a. The industry
   b. The company
   c. The market
   d. The competitors

14. We consider:
   a. Legal environments
   b. Regulatory environments
   c. Suppliers environments
   d. Service environments
   e. Technical environments

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1 (ibid)
15. We also consider the question of corporate objectives. These may seem like trivial questions, but they in fact can be very difficult. Senior managers may disagree and getting a consensus may be difficult. But they are at the very core of:
   a. Organizational structure
   b. Managerial responsibilities
   c. Customer selection
   d. Identification of competitors

16. Drucker tells us:
   “Objectives are the fundamental strategy of a business.”
   “Only a clear definition of the mission and purpose of the business.”

17. The MARAD – Guide to Strategic Planning asks:
   a. What markets will company serve?
   b. What customer needs will be met?
   c. How will company provide these services?

18. Strategic planning asks: “What business are we in?” It involves defining and developing corporate objectives. The third step involves analysis of the market, historical and current demand and forecast for transport services.

19. Strategic Planning is:
   Phase I - Analysis of Environment
   Phase II – Strategy Development
   Phase III - Implementation of Strategy

20. Internal Environment requires the analysis of:
   • Strengths
   • Competitive advantages
   • Weaknesses
   • Areas of vulnerability
   • Profitability
   • Market share
   • Load factors
   • Productivity
   • Customer satisfaction
   • Service levels, i.e. frequency of sailings, transit times, reliability, cargo damage, etc.
21. External Environment examines:

- Socio – Political
- Industry – other companies successes and failures
- Competitors – linkage between
  - market share
  - cost structure
  - leading to profitability
  - vessel size
  - vessel speed
  - pricing
  - replacement strategies
- Technology – new and emerging, such as:
  - ship design
  - cargo handling
  - automotive
  - manning
  - propulsion
  - size
  - speed
- Legal and Regulatory
  - identify barriers
  - other restraints to trade
  - favoritism
  - taxation
  - subsidies
  - emerging laws and trends
- Suppliers
  - fuels
  - materials
  - supplies
  - services
22. There is a rational procedure.
23. There is a natural flow of activities.

3.2 Phase One – Analysis of Environment

Internal Environment

Company – the strengths and competitive advantages; weaknesses and areas of vulnerability; profitability; market share; load factors; productivity; customer satisfaction; service levels, such as frequency sailings, transit times, reliability of schedules, cargo damage statistics, etc.

External Environment

Industry – an analysis of both foreign and domestic companies, particularly with regard to identification of key factors leading to success or failure of those companies.

Competitors – an analysis of the relative market share and cost structure of competitors and any linkage between the two leading to profitability, vessel size and speed, pricing policies, market role, and possible replacement strategies.

Technology – identification of the application of or potential for new technologies, especially in such areas as ship design, cargo handling, automation, manning propulsion, size and speed, manning, propulsion, etc.

Legal and regulatory – identification of legal barriers or other restraints to trade, favoritism, taxation, subsidies, etc.

Suppliers – identification and analysis of all support organizations which would have an impact on the cost and reliability of a service such as longshore and shipboard labor and their unions, terminal operator and port authorities, fuel suppliers, etc.

Market – a forecast of the volume of cargoes and demand for transport services, by commodity and shipping group; the identification of trends; the influence of inflation, exchange rates and trade finance on market shifts; and identification of any major government projects or industry programs. Principally, a projection of historic data, modified by factors such as above.
Strategic Planning Flow Chart

EXTERNAL ENVIRONMENT

- Industry Analysis
- Competitor Analysis
- Technology
- Legal & Regulatory
- Suppliers
- Market Analysis
- Historical Cargo Flow
- Pricing Analysis

- Forecast of Cargo Flow Demand

COMPETITOR ANALYSIS SUPPLY

INTERNAL ENVIRONMENT

- Strength
- Weaknesses
- Profitability
- Market Share
- Load Factor
- Productivity
- Reliability
- Customer Satisfaction
- Cargo Damage
- Etc.

- Strategic Issues

CORPORATE OBJECTIVES

EXIT/ENTRY PLANS

STRATEGIC OBJECTIVES

STRATEGIC SELECTION

RISK ANALYSIS

- Marketing Plan
- Competitor Plan
- Operations Plan
- Technology Plan
- Organization Plan
- Corporate Development Plan
- Financial Plan

MISSION STATEMENT

IMPLEMENT

MEASURE AGAINST OBJECTIVES
Market Analysis

A key element of strategic planning is the step involving the external environment and the question: “What business are we in?” It calls for an analysis and forecast of the market.

Market strategy development is likely the single most important phase of strategic planning. In transportation, it includes:

- Historical analysis of commodity flow
- Forecast of commodity flow
- Competitor analysis
- Pricing analysis
- Constraints or barriers

Commodity Flow Studies

These are often referred to as traffic flow, trade flow, transport studies, logistical analyses, etc. The purpose of these commodity flow studies is to establish the volume of cargo or other items to be transported. Such commodity or traffic flow studies can take a variety of forms, depending on the nature of the transportation problem. For example, in a captive trade where the vessel will be expected to serve a parent company’s transportation requirements, the traffic flow studies may just look at the expanding, or otherwise changing needs of that particular company. It probably would not look at too many external factors. On the other hand, if a vessel or vessels were to be acquired to trade in cargoes of opportunity, for example in a tramping operation, on a global basis, then the commodity flow or traffic studies would be more general and global in nature. In addition to looking at the historical flow of cargo in the various commodities of interest, and projecting these requirements, such a study would most certainly look at external factors and attempt to determine what impact those external factors would have on the volume of flow.

A careful analysis of the demand for and supply of capacity in a particular trade can suggest strategic alternative such as the number and size or speed of new vessels in that trade. It may also suggest new designs and innovative technology.

It is also important to establish the unit and lot sizes to be used in the study. These may be in volumetric units such as cubic meters, bushels, cubic feet, barrels, board-feet, etc.; weight units such as metric tons, long tons, short tons, etc.; shipping units such as pallets, cartons, billets, slabs, bales, containers (TEU’s, FEU’s), etc.

If the service is a ferry or passenger operation, the commodity may actually be people. In this case, one must collect the passenger statistics by classes. These classes could include such categories as:
• Quality – Luxury versus economy
• Age –Adults versus children
• Purpose – Commuters versus tourists
• Frequency – Daily, weekly, seasonally, etc.

Sources of Data

Historical cargo flow data is a fundamental part of marine market research. Such information may be found in government studies and reports such as custom review statistics, manifests, census data and governmental statistical abstracts. Industry commodity and trade associations also publish commodity flow reports. Vessel traffic is usually published in news and marine publications. Port authorities will often willingly supply such statistics to attract potentially new shipping services to their ports. Care must be exercised in using data provided by organizations whose basic concern is the marketing of their services.

In most countries the importation and exportation of cargo is recorded in manifests which are files with customs services. These manifests will show the type and quantity of cargo and the shipper and consignee. In some countries, notably the United States, this information is coded and stored on computer. It is readily made available to interested parties. This greatly simplifies data acquisition. In many countries, particularly developing countries, this information is somewhat more difficult to obtain and often requires working more closely with officials in government offices.

The current traffic flow of ships, containers, trailers, passengers, etc., can be determined in a survey. Often this can be done simply by positioning the surveyor at the port gate, an intersection, etc., and actually counting the units.

Forecast of Commodity Flow (Demand) – Historical and current data may be used to forecast flow by extrapolation. It goes without saying that many other factors should be taken into consideration in making the projections. Economic, political, social, industrial and technical trends amongst others will affect the forecasts. Some attempt should be made to establish a range of accuracy or confidence limits on the estimates.

In addition to extrapolation, an attempt should be made to locate forecasts made by others, such as government agencies or port authorities. In order to develop the transport infrastructure such as channels, ports, highways, etc., vast government investments must be made. These government projects are usually preceded by other strategic planning which may also include market research. That will be of interest to the shipowners.

Forecasts can also be made by the analysis of specific server or user industries. For example, in studies of a major bulk material terminal and alumina plan situated on the Mississippi River, C. R. Cushing & Co. analyzed the sources, pricing and demand for bauxite, as well as the economics and market for
alumina, in order to size the channel depth, yard storage and materials handling requirements.

A similar analysis was carried out for an agricultural bulk handling, storage and automatic bagging plant on the Galveston, Texas waterfront. In this case, the methods of inland transport (rail, truck and barge) to the site, the availability of government aid to stimulate exports, the likelihood of shortfall by overseas suppliers, the capability of ports in developing countries to receive bulk shipments or necessity to receive them in bags all are off assistance in making the forecasts, which permit the sizing of storage, bagging and handling equipment. They also permit estimations of ship loading time, some components of transport costs and berth availability.

Another useful tool in forecasting is through interviews with potential customers, experts, government officials, academician and others knowledgeable in a particular trade or service. This is an opportunity to use the Pareto Principle, named after Vilfredo Pareto, an Italian economist, who in 1897 observed that most of the wealth is controlled by a few people. R. K. Johns, former Vice President of Sales and later President of Sea-Land and others, including Mack Hannan and Mark McCormack also urge the use of the Pareto Principle in market research. Napuk redefines it in marketing terms, namely: “Your top 20 percent customers will account for 80 percent of your profits.”

Other sources of commodity flow data include the freight conferences. Conferences covering trade between the United States and other countries are required by various shipping acts to accept new conference members. Therefore, such conferences generally are cooperative and assist potentially new conference members by providing trade information. This is also generally true of other east/west conferences, such as the Europe and the Far East Conference. On the other hand the smaller, non-U.S. conferences, which are often dominated by only four of five carriers tend to be much more restrictive and uncooperative in making trade data available.

Eight Common Methods of Demand Forecasting

1. Constant growth rate forecasts: Sometimes referred to as “hockey stick” projections, these forecasts are driven by a posited growth rate that is expected to continue over the forecast horizon. Such unconstrained forecasts can lead to illogical projections over long periods of time (e.g., a projection based on a constant unconstrained reproduction rate could lead to a forecast of rabbits taking over the world)

2. Contained forecasts (based on the assumption of limited supply or demand): To overcome the limitations of constant growth rate forecasts, limits are imposed on growth rates to ensure reasonable results.
3. Industrial analysis forecasts: The forecast is based on manufacturing capabilities, with industrial development and investment as the primary predictors of growth.

4. Market research-based forecasts: Surveys of individual opinions, purchasing plans, and consumer expectations are used to develop growth rates and other information, on which the forecast is then based.

5. Time series forecasts: Historical data are analyzed, typically on the basis of regression analyses, to predict future demand or supply. Critics of projections based on historical data liken them to driving a car by looking in the rearview mirror.

6. Scenario forecasts: Scenario-based forecasts are based on a set of assumptions about future conditions. War gaming, such as that used by the Department of Defense, is an example of scenario-based forecasting.

7. Simulation-driven (Monte Carlo) forecasts: Ranges of expected outcomes, rather than single data points, are used for inputs and combined into an expected outcome distribution. Simulation-driven forecasts can provide insight into the range of potential outcomes and their likelihood.

8. Multivariate modeling forecasts: These forecasts develop an internally consistent model of future trade through the use of a large number of independent variables and multiple constraints. High-speed computers have facilitated the generation of these complex models, which are used for national and world trade models.
### Elements of Bulk Logistics Forecasting

<table>
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<th>Output</th>
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<td>Results of various alternative growth and decline of the system variables</td>
<td>Long</td>
<td>Water Resource Planning</td>
</tr>
<tr>
<td>Events and their effects</td>
<td>Table showing interaction among items</td>
<td>(No specific span)</td>
<td>Estimates of impacts on the project from occurrence of lower population rate</td>
</tr>
<tr>
<td>Variable and its value</td>
<td>Numerical forecasts</td>
<td>Long</td>
<td>Impacts on deep water ports from new policy</td>
</tr>
<tr>
<td>Sectors and amount of transaction</td>
<td>Input-output table showing interrelationship among sectors</td>
<td>Short medium</td>
<td>Estimates of output increase by additional demand</td>
</tr>
<tr>
<td>Preference of participants</td>
<td>Graphics illustrating weights and functions</td>
<td>(No specific span)</td>
<td>Measurement of the relative preference of individuals for competing issues</td>
</tr>
<tr>
<td>Data and Information Base</td>
<td>Formal documents (definition, assumption, data, findings, etc.)</td>
<td>Long</td>
<td>Scenarios for future growth pattern</td>
</tr>
<tr>
<td>Opinions of Experts</td>
<td>Varies</td>
<td>(No specific span)</td>
<td>Future of American water resource</td>
</tr>
<tr>
<td>Historical Data</td>
<td>Varies</td>
<td>Medium long</td>
<td>Alternative future of inland waterway traffic</td>
</tr>
<tr>
<td>Survey Data</td>
<td>Document (generalization and prediction about behavior)</td>
<td>(No Specific Span)</td>
<td>Forecasts of changes in peoples’ lifestyles</td>
</tr>
</tbody>
</table>

Source: Handbook of Forecasting, Stanford Research Institute, 1975.
Competitor Analysis (Supply) – Being aware of potential competition is important. The identification of existing competitors is usually not a difficult task and can be accomplished through readily available, public sources including and especially advertising. A profile of each direct-competitor fleet and the characteristics of the vessels in each fleet should be made. This should include vessel size, speed, capacity and deployment.

The analysis should include an investigation of new ships on order, especially those ordered by competitors.

Identifying other potentially new entrants into the market is much more difficult and subjective. Nevertheless such predictions should be made.

Another difficult task in the competitor analysis is identifying the market share by volume and percentage and the principal customers of each competitor. This again is an opportunity to use the Pareto Principle, by selecting a few competitors on which to focus.

The capacity share of each competitor should also be listed by ship and fleet owner.

Vessel and fleet data can be obtained from owner and maritime company directories. Marine periodicals frequently feature company profiles. Some classification societies provide computerized sorting and listing services. Conference statistics are available directly from the conferences themselves. Competitor vessel voyage data can be obtained from specialized periodicals. Data on quantity of cargoes carried by various carriers can be obtained through services such as The Journal of Commerce’s Tandem System. The financial conditions of competitors are available through annual reports and financial industry reports.

The marketing strategy analysis should also indicate a prospective or anticipated own market share. Associated with that market share are target transport rates and revenues. It should be recognized that whenever one tries to expand the market share the rates can be expected to decline.

Pricing Analysis – While the determination of historical and current pricing levels is a relatively straightforward task, the forecasting of transportation pricing even over a short period is much more difficult.

Current and past tariffs are available through conferences, brokers, agents, published rates, trade publications, and many other sources.

The practice of rebating, while very prevalent in the past, but now illegal in many places, is also difficult to quantify since both shippers and carriers are reluctant to discuss details.

The availability of bulk transport pricing data is even more readily available, especially when the trading is on a worldwide basis. Such pricing is reported in absolute terms, as charter fixtures, or keyed to indices such as Worldscale. When bulk transportation is carried out under contracts of affreightment, the
An important element in price forecasting is the cost analysis. The elements of the cost analysis, particularly the operating costs, are closely linked to national and international economic indices. Appropriate elements of these indices, such as labor and energy components can be applied to the cost patterns of own and competitor operations.

Forecasting of prices is carried out by chartists, fundamentalists, or as a mixture of both methods. The simplest form of charting is extrapolation of historical data. Difficulties arise, however, when rates fluctuate. Zeno Zenetos, the late Sloan School (M.I.T.) professor made a lifetime study of charting and predicting tanker rates, and attempting to determine the periodicity of such fluctuations, with limited success. On the other hand, the fundamentalists attempt to predict the future environment and the impact of events on the pricing of transportation.

Price forecasting is easier in stable trades. These are trades where there are high entry barriers, closed conferences, pooling agreements and consortia. Conversely, there is more volatility in trades with such characteristics as low barriers to entry, weak conferences, low levels of profitability and the presence of marginal operators and ships engage in other light back-haul or triangular trades looking for cargoes of opportunity.

Such factors as supply and particularly severe over-capacity or over-tonnage will have a dramatic impact on rates. Government aid to shipping and/or shipbuilding will also stimulate the supply-side and depress rates. Conversely, prosperity and, perversely, international conflicts and calamities will have the effect of raising rates. These events are very difficult to predict. New entrants, or the introduction of new technology or added capacity (larger or faster ships) usually will also depress rates. Cutthroat competition, predatory pricing practices and price wars will artificially or temporarily depress prices.

All of these factors make the work of the pricing forecaster extremely difficult. Nevertheless, such forecasts must be carried out since revenue represents one half of the equation which defines profitability.

Rate projections must be combined with a realistic assessment of capacity utilization in order to arrive at revenue levels.

It is important that the strategic planner understand the reliability of the assumptions which must be made, limitations in such forecasts and the confidence limits in the projections. It is therefore necessary that sensitivity studies and risk analysis be carried out.

Constraints and Barriers – Governments probably present the largest single constraint to free trade. While the world seems to be moving slowly in the direction of an easier and more natural flow of goods and services across national borders, there still exists an enormous number of places in the world where trade is restrained by government intervention. Protectionism and
nationalism result in cabotage laws, tariffs, shipping quotas, etc. The aborted UNCTAD 40-40-20 Liner Code of Conduct efforts of the 1980’s, the Jones Act, various operating and construction subsidies are all examples of constraints, at least to those to whom the benefits do not accrue. The constraints may be imposed by a group of trading nations, a national government, a state or a municipality. A port authority might grant preferential berthing rights to competitors. Government policies towards bilateral trade agreements and cargo sharing also can constitute a barrier to new entrants into a trade. Other governmental constraints could include taxes.

Unilateral trade and transport policies, restrictions on the flow of capital, barriers to investment, government control of rates, tight credit policies, state control of trade, political instability, government owned shipping companies and other nationalistic and protectionism policies. Governmental aid to competitors, favorable depreciation, other special tax treatment, anti-trust immunity and other incentives to domestic shipping companies present a barrier to entry into or expansion of services.

3.3 Phase Two – Strategy Development

Corporate Objectives

The foundation for strategies, plans, priorities and work assignments, must come from “a clear definition of the mission and purpose of the business.” In other words “What is our business and what should it be?” must be transformed into objectives.

While it is often assumed that profitability is the sole objective of a firm, in reality corporate objectives, in general, have to be set in a number of other areas. These can include:

- Market share
- Growth
- Stability
- Product or service quality
- Meeting the market needs
- Competition
- Profitability
- Return on investment

Drucker feels that objectives have to be set in eight key areas in a business:

- Marketing
- Innovation
- Physical resources
• Financial resources
• Productivity
• Human organization
• Social responsibility
• Profit requirements

These are the starting point for business planning in most Japanese corporations.

While it is often difficult to get management’s consensus within a large corporation on the objectives of the firm, it must be remembered at all times that “objectives are the fundamental strategy of a business.” Every effort must be made to get agreement on the objectives.

Strategic Objectives

A statement of the company’s mission concerning the markets to be served, the services to be provided, and how the company’s resources will be used to provide those services is required.

Strategic objectives should consider the future and how the company’s resources will permit it to succeed in that environment. The strategic objectives are measures of the success in meeting the mission of the company.

In addition to answering the four basic questions in the strategic plan, business policy must analyze both the fixed and controllable elements in its business environment.

The fixed elements may be regarded as:
• Competitive environment
• Company resources
• Management values
• Social expectations

The controllable elements can include:
• Corporate structure
• Marketing policies
• Finance policies
• Accounting policies
• Manufacturing or service policies
• Human resources policies
• Research and development policies
• Organizational behavior policies
Most of these controllable elements are imbedded in the corporation’s goals and objectives.

**Strategic Issues**

These are factors which will have an impact on the company’s ability to meet its projections. They are usually found in the external environment, and may include such factors as changes in the volume or types of cargoes, actions of competitors, technological developments, governmental restraints or aid, etc.

**Strategy Selection**

The strategy selection is the phase in which the course or courses of action are developed, which will meet the strategic issues previously identified. MARAS recommends developing a number of strategic options, which can be tested and compared. This usually requires the preparation of a series of pro forma financial projections for each alternative. Each alternative is then analyzed against the corporate objectives. The alternative then may be optimized to achieve the best possible value.

With regard to technology, it should be kept in mind that prior to this stage the decision has not yet been made as to whether the vessel to be acquired would be a new vessel, a second-hand vessel, a conversion of an existing vessel in the fleet, the chartering in of existing tonnage, or whether a vessel should even be acquired. The development of each option should be complete enough to include market share estimate, required corporate resources and financial pro forma. If computers are used, it is possible to carry out simulations and sensitivity analyses. In addition to testing the options against financial criteria, other criteria should be considered such as minimization of risk, optimal use of corporate resources, and the impact of unexpected changes in forecasts.

**Risk Analysis**

Drucker argues that risk taking is central to any economic activity and cites Boehm-Bawerk’s Law, namely “existing means of production will yield greater economic performance only through greater uncertainty, i.e. greater risk.” He concludes that the purpose of long range planning is to improve entrepreneurial performance by creating the capacity to take greater risks, the “right risks,” differentiating between such studied decisions and avoiding the uncertainty in “hunches, hearsay and experience,” even if meticulously quantified is the essence of long range planning.

The threats to any strategy that is developed should be identified. Napuk urges this step to be an integral part of the planning process for two reasons. First, if the risks are too great, the project can be aborted or modified to reduce the risk. Second, if the project doesn’t materialize according to plan, an alternative plan will be in place.

Bogue and Buffa advocate a technique called SCENSIM (SCENario SIMulation) whereby the various strategic alternatives, each with their own “uncertainty profiles,” have their key issues measured against the economic results. Some of the risks include competitor response, changes in the
competitive environment, forecasting errors, legal issues, etc. Other issues to be considered include government actions, technological risks, natural events, etc. Risks which are controllable should have corporate resources allocated to control the risks or results.

Risks can be reduced by intensive advance planning which should be performed before committing to action. The use of professional advisors and consultants to review the project may be worthwhile. Napuk suggests never exposing the entire company to failure if one project fails, “unless the company cannot survive without it.” Had U.S. Lines Co. followed this advice in 1987, they would have avoided their bankruptcy. Another approach to minimizing risk is to adjust the economic criterion (such as rate of return or payback period), which each project must meet, to the amount of risk inherent in that strategy. In other words riskier projects should provide higher returns.

Drucker feels that it is important for us to consider, not only the magnitude of the risks, but equally and maybe more important, the nature of the risk. By “nature of the risk” he categorizes them as:

- risks we can afford to take,
- risks we cannot afford to take,
- risks we cannot afford not to take.

One American shipping authority adds a vital, self imposed hurdle before implementing a new service. It is his view that if all of the other tests, including commodity analyses, marketing analyses, risk analyses, competitor analyses, etc. produce a positive result, he still asks the question: “What two additional factors does his company bring to this market?” It is his position that it is not just sufficient to identify the new market, to test it and to theoretically justify the anticipated market share, the new features that a new service would bring to the market might include a faster door-to-door service, more frequent sailing’s, faster port-to-port transit times, better equipment, improved cargo care, a greater shipping network, providing shipping services by an organization with more financial stability, better credit terms, etc.

**Entry and Exit Plans**

**Entry Plan**

A fundamental part of the implementation of the strategic plan is the development of a plan for its commencement. This entry plan addresses such issues as the timing and selection of a starting date. It calls for scheduling and a time table. Definitive coordination between all segments of the corporation and external organizations which are effected by the plan is essential. The marshaling of resources such as personnel, capital, equipment, etc., are part of the entry plan. Governmental actions, permits, licenses, etc. and political support, where necessary, must also be anticipated. Such an entry plan is useful in coordinating the various business plans discussed below.
Exit Plan
No less important are the development of “exit” plans. This should not be regarded as defeatism. Rather, it is prudent to consider as many options as possible in the event that the strategic plan does not develop as anticipated.

Alternatives to Exit Plan
A variety of alternatives is possible depending upon the nature of the unforeseen events. These could include committing additional resources, shifting priorities, even reducing effort or withdrawing completely. These exit options may consider totally scrapping the plan or selling, swapping, merging or otherwise gradually withdrawing. The benefits and drawbacks in these plans are available to be considered while the strategic plan is in force.

American shipping managers are becoming somewhat more conservative. With regard to new services there is a growing trend to look not only at the entry strategies, but to also consider the “exit” strategies. Often, the exit plan should be executed swiftly to minimize losses.

3.4 Phase Three – Strategy Implementation

The first two phases are transformed into practical and concrete business plans capable of being executed. Strategic planning should not be mistaken for business planning. Strategic planning involves the entire organization whereas business planning may only involve one specific aspect of the strategic plan. A business plan usually involves a program for the implementation of one of the objectives resulting from the strategic plan.

The Harvard Business School refers to this process as “business policy” involving corporate structure, manufacturing, finance, accounting and human relations. In strategic planning for the marine industry, transportation services may be treated in the same manner as manufacturing in more traditional strategic plans.

These include:

Business Plan – The business plan should consist of a history of the company, a description of the company, its marketing strategy, management team organization and personnel, operations, funds required and their use, financial data, risks, R&D, legal issues, insurance considerations and schedule.

Marketing Plan – the identification of specific market segments, customers, their needs and sales methods to be used.

Competitor Plan – the actions to be taken to overtake, by-pass, forestall, overwhelm, join or otherwise counter the position of competitors.

Operations Plan – the detailed operational plan for carrying out the strategy, including the sequence and phasing of such actions.
**Financial Plan** – the budget and controls to be used for the business plan, including cash flow projections and capital requirements.

**Technology Plan** – the plan for the development or acquisition of new and competitive techniques and equipment, i.e., ships, handling systems, etc. The technology plan identifies the methods and hardware which will be used to carry out the strategic plan. This technology may relate to computer software, communication systems, scientific and mathematical processes and the like. In the case of vessel acquisition, the technology candidates may include the use of traditional, proven risk free techniques. There is not necessarily a mandate to use “advanced” technology. Indeed, the project may favor “low tech” methods. Alternatively, the planner may opt for a more aggressive approach, namely more technically advanced features that, for example, may relate to hull materials (high strength steel, plastics or aluminum vs. mild steel), propulsion systems (self-unloading conveyors, slurry systems, FLO/FLO, etc. vs. conventional cargo transfer methods). The ship acquisition technology plan may also identify special vessel construction or conversion methods.

The technology plan should identify, and quantify, if possible, both the benefits and drawbacks for each technological alternative. The benefits, for example, may improve cargo capacity through hull weight reduction; reduce operating cost through lower fuel or lube oil consumption; minimize maintenance costs or reduce manning costs; extend vessel life such as through corrosion resistance or reduce construction costs. The negative aspects of new technology must also be identified. These can include technical risks, high acquisition costs and environmental issues.

**Organization Plan** – the plan for the organization’s structure and the use of the company’s human resources to carry out the strategic plan.

**Corporate Development Plan** – the plan for integrating and coordinating the strategic plan into other plans within a large organization’s other plans and which will meet the corporation’s overall goals.

The final step in strategic planning is the implementation of the plan. The effective communication of the details of the plan to all participants is an essential step. The progress of each of the business plans in meeting goals and criteria must be monitored and corrective action applied, not only to plans which are failing to meet goals, but also adjustments to meet differences from forecasts.

### 3.5 Mission Statement

The complexity of researching, designing and building a vessel is apparent. The criteria to be used for the design and acquisition may involve hundreds of factors. For the sake of good order, and in order to communicate a common standard to the entire team, it is essential that these criteria be set down in a mission statement.
The principal results of the Technology Plan should form a part of the mission statement. The objectives of the firm or owner and key elements of the company’s strategic plan should also be embodied in the mission statement.

A second purpose of the mission statement is to prevent the unintentional or accidental deviation from the original objectives. When and if these early objectives to change, the mission statement records these modifications. The mission statement becomes a control document that aids management and the vessel acquisition team.

C. R. Cushing & Co., Inc. has used the mission statement approach in a large number of projects. In the development of the contract design of a 28,000 DWT molten sulphur tanker, it was especially useful because of the complex vessel routing or itinerary.

In the case of the design of a fleet of Jumbo Econships for U. S. Lines, the mission statement was helpful in documenting decisions on the grading of differing weights of containers in layers on the ships.

Another example of the usefulness of the mission statement occurred during the design of a pair of Panamax self-unloading bulk carriers. The multiple port itinerary required the assembling of large amounts of data relating to the many ports that the vessels were to serve. These included port costs, handling rates, storage capacities, channel depths, bridge clearances, etc.

Therefore, the mission statement becomes a centralized compendium of information necessary to design the vessel and criteria to test its economic feasibility.
DESIGN

4.1 The Design Process

The second major phase in a ship acquisition program relates to DESIGN. Design, while having many meanings, in this context means to prepare engineering drawings, specifications and to support these with calculations and experimental testing as required. The design phase forms a transition from the requirements of the planning phase. It lends form and substance to the mission statement by establishing a configuration, form, dimensions, layout and other characteristics, which can be represented visually. It is the point at which the center of effort shifts from management science to engineering, particularly, naval architecture and marine engineering.

Engineering is the art of applying –
• Knowledge
• Scientific principles

DESIGN is the essence of ENGINEERING

- Buxton

The engineering phase of the ship acquisition process progresses through distinct and increasingly more definitive stages.

The CPCD Design Sequence
• Concept
• Preliminary
• Contract
• Detailed

It should be noted that the fourth design stage that of the Detailed Design, wherein the working drawings are prepared, is usually executed after the shipbuilding contract is signed. There are rare occasions when an owner may cause the detailed design to be carried out prior to contracting with a shipyard. This is more likely to be done for smaller vessels such as tugs, service draft or specialized vessels or where the owner may purchase a set of working drawings from a designer or from a shipyard. The owner may buy
the working drawings for an existing ship. He may do this because the shipyard he is contracting with may lack the necessary skills, it may shorten delivery time or he may want to duplicate ships already in his fleet.

However, the more customary procedure is for the shipyard to prepare the detailed plans during the production phase, and hence we will deal with this fourth engineering stage as part of PRODUCTION.

**Design**

- Drawings
- Sketches
- Artist renderings
- Diagrams/Schematics
- Computer imaging
- Calculations
- Models
- Model testing
- Research/Development
- Experimentation

There is no question that ship design is engineering work and as such should be carried out by professionals trained in naval architecture and marine engineering. Engineering may be defined as the application of science and mathematics by which the properties of materials and energy are made useful to people through the creation of structures, machines and systems.

The process of designing involves conceiving, planning, and devising, and then sketching, drawing and/or modeling the concepts to give them graphic form. Yoshikawa explains design in another way, as a mapping from a “function or specification space” to an “attribute space.” The design effort is supported by carrying out whatever calculations, model testing, research, development and experimentation are necessary to assure that the engineering effort is sound.

The design effort may also include the preparation of written materials, which aid in conveying the ideas of the designer and in explaining the working of the device or system. These written explanations may take the form of simple or extensive notes on the drawing, or in the form of written specifications in booklet or book form.

There is a popular misconception in the marine field that specification preparations is an independent, non-engineering activity and can be prepared by semi-technical, or non-technical personnel. Often, technical writers, with little marine experience, or no formal engineering education will undertake the preparation of a shipbuilding specification. The use of specifications...
prepared for other designs lend encouragement for this bold and imprudent approach, sometimes with disastrous and/or fatal results. This sometimes also occurs when managers will attempt to save legal fees and avoid consultation with lawyers by using previous contracts as a model and write their own contracts.

**DESIGN INCLUDES**

- Industry standards
- Classification society rules
- Governmental regulations
- Manufacturers’ specifications
- Shipbuilder’s design detail standards

The written portion of a design may also take the form of reference to industry standards, classification rules, governmental regulations, manufacturers’ specifications, or shipbuilders’ detailed standards. These then also become an integral part of the design. It is very important that the designer incorporating these materials be thoroughly familiar with such documents in order to avoid ambiguities arising from the existence of alternative approaches of features which may appear in those documents, but may not be intended by the designer. It is also essential that reference be made to the intended or most current issue of those documents as they are usually under constant review and revision.

It must be borne in mind that drawings and written specifications are both integral and intertwined parts of the design. They are meant to explain each other. They both represent engineering effort and as such need to be prepared by and thoroughly checked by engineers.

The design effort might also involve modifying, extending, or otherwise building on previous designs, or synthesizing other designs. Hence, another necessary design activity involves research into both previous specialized work in the field, and current or state-of-the-art developments in the field. While it is reasonable to assume that the designer is well informed in these matters, it must be recognized that the accelerating pace of technology, worldwide, and the proliferation of research and technical information makes it essential that the designer be current and up-to-date. The prudent designer will also be aware of the requirement that the design-build-implementation process is a lengthy process, and the ship he is designing is expected to operate and compete effectively for as many as 20 to 30 years after deliver. Hence, just being up-to-date is not sufficient. The designer should also be aware of the status of research and development, worldwide, and be alert to potential breakthroughs in the many disciplines in the marine field.

The designer must also factor into the design the manufacturing or shipbuilding processes and procedures so as to create “shipbuilding-friendly”
features in order to assure that the vessel construction costs will be minimized. This requires a strong appreciation, by the designer, of the most current and advanced procedures used by shipyards. The same applies to machinery and material selection.

Research and development are also part of the ship design process. Pugh tells us that “research and development are mutually exclusive, but interactive activities...each having completely different characteristics” and that “research is a necessary and vital part of ship design, so is development.” In the research phase, engineers seek new principles and processes using scientific concepts, experimental methods and inductive reasoning. In the development phases, the results of research are applied to useful purposes. For example, the application of finite element analysis (FEA) concepts to working programs to solve complex ship design structural, vibration, fluid flow and other problems is an example of development.

The art of applying knowledge and scientific principles to useful purposes is called engineering. Engineering requires “the imagination to conceive original solutions to problems, and the ability to predict performance and costs...” The fundamental task of engineering is problem solving, a process which involves analysis of the stated problem, establishment of methods of solution, restatement of the problem in elemental questions or terms, and answering these questions or solving these problems by deductive reasoning from existing systematized information, knowledge or principles, or in the case of original or new systems, by creative synthesis. Synthesis prevails at the conceptual design state whereas analysis is more prevalent in the detailed design stages. Buxton tells us that “design is the essence of engineering.”

The Engineer Is Faced With Conflicting Requirements

Example

- Physical – minimum weight
- Economic – minimum cost
- Social – maximum safety
- Environmental – minimum impact
- Commercial – maximum efficiency
- Esthetic – maximum stylishness
- Etc.

The engineer is usually faced with solving problems with conflicting requirements. These may be physical (minimum weight), economic (minimum cost), social (maximum safety) environmental (minimum impact), etc.

The engineer must resolve these conflicts and search for “optimum” solutions.
Design is solving a problem with many VARIABLES.

Engineering requires “the imagination to conceive original solutions …” It is the step in engineering where shape and form evolve, where structure is defined, where materials are selected and components to be assembled are identified. MacCallum says that “design should be thought of as a process of modeling.”

Rawson and Tupper in their book, Basic Ship Theory, begin with the question: “Naval Architecture – art or science? They acknowledge that ship design draws on a vast number of sciences, but feel that it is the “blending” of these, together with the complex compromises that makes ship design an art. Munroe-Smith feels that the intimate relationship between science and technology required by naval architecture makes it both an art and science.

On the other hand, Keane, Price and Schachter feel that the pressure to measure the quality of, i.e. analyze, ship design moves naval architecture from the realms of art-form to science.

Recognizing that the design effort can involve vast amounts of labor (400,000 man-days for some naval vessels) and other resources, design must be planned and carried out in a systematic way. Erichsen says that “ship design should follow a task-oriented strategy and sequence.”

Engineers, in general and ship designers in particular (Mandell, Chryssostomidis, Eames, Drummond, Gallin, MacCallum, et al) agree that ship design should be thought of as a process of modeling the systematic procedures and their efficiency directly impact the efficiency of the model. Pugh points out that not only does one have to “model” or design the ship, but equally important, the design activity has to be modeled.

Design is an ITERATIVE process.

Prior to 1970, designers used the design spiral. Since 1957, it has been customary to describe the ship design process as a design spiral J. Harvey Evans, a professor at MIT, used the spiral to explain the design process as an iterative or repetitive step-wise method moving from a general set of requirements to converge on a detailed and definitive final design. Numerous other authors, (Buxton, Rawson, Atkinson, Eames, and Drummond, Gilmer, D’Archangelo) have also used the design spiral to illustrate the process, arranged in what the designer considers a logical sequence. The design proceeds by progressively improving each parameter, while holding all other constant.
The Design Spiral.

Propulsion machinery preliminary design spiral

Source: Ship Design and Construction
U.S. Naval designers depict the same design activity model in a graphical sequence of block diagrams which they call “Current Design Sequence.” These stages, briefly, include:

1. Definition of Requirements
2. Mission Analysis
3. Concept Formulation
4. Preliminary Design
5. Contract Design
6. Detail Design
7. Design Spiral
8. Design Bounding - (A range of ships with various dimensions and coefficients which bracket or bound the domain space that contain all solutions.)
9. Design Option Space
10. Set Based Design

Gilmer also defines the design activity within each design step as an iterative process.

Prior to 1970, an immense amount of labor was required in order to achieve even one circuit of the design spiral. Work done at the conceptual stage was often crude. It was based on common relationships and ratios, and was only a first approximation. The search methods or number of circuits of the spiral at the latter stages were also constrained by available resources.

Computers permit multiple criteria –

multi variate search patterns.

The availability of high speed computers and design software “packages” or modules (such as for structural design, seakeeps, speed and power prediction, HVAC, pipe flow, heat balances, etc.) have raised the possibility that more efficient optimization methods may be applicable. However, the availability of such computers and software has not precluded the necessity of following the fundamental CPCD ship design sequence.

**COMPUTERS IN SHIP DESIGN**

1. CAD – Computer aided design, a system which simplifies and to some extent automates the preparation of graphical representations of the design, i.e. drawings.

2. CAE – Computer aided engineering, a system which simplifies and automates the engineering calculation processes, all at higher speed and with greater accuracy.
3. CASM – Computer aided synthesis modeling – uses trends from existing design data to approximate of a new vessel or modification to an existing vessel.\(^2\)

4. CAM – Computer aided manufacturing – Programs which bridge the gap between design and construction. Applications include welding, cutting, nesting, robotics, pipe bending, etc.

5. CIM – Computer Integrated Manufacturing.

6. CSII – Computer system Integrated Initiatives.

7. CI – Computer Integration.

Sen argues that the usual approach to ship design, namely, the iterative approach may not be effective because of the complexity of resolving multi-faceted conflicts. He points out that in the usual iterative method, each requirement, in turn, is dealt with, but requires a re-formulation of the problem at each step to assure that the requirements remain mutually consistent. He and colleagues at the University of Newcastle-Upon-Tyne have been developing a Multiple Criteria Decision Making (MCDM), sometimes called Multi-Attribute Decision Making (MADM) methods or models which are applicable to ship design. The success of these methods greatly facilitates the use of more modern optimization techniques. Nevertheless, it does not eliminate the required conceptual-preliminary-contract-detail (CPCD) design sequence.

Other techniques besides the design spiral can be used, especially because of the availability of high speed computers. These include:

1. Design Bounding – A range of ships with various dimensions and coefficients which bracket or bound the “domain space” that contain all solutions.

2. Design Option Space

3. Set Based Design

These can be evaluated using:

1. Weighted sum methods.

2. Hierarchical weighted sum.


4. MAU – Multi-Attribute Utility Analysis.

\(^2\) Source – SNAME Ship Design – Vol. 1, Chapter 13
4.2 Concept Design

“New ships should be
25% novelty
75% well proven practice.”
- Baker

Conservative pressures increase as
The design progresses.

Hence the early stages should be
Biased towards the novel.”
- Brown

Concept Design
The step in the design process that follows data gathering and development of the mission statement is the CONCEPT DESIGN phase. It is the point where the project starts to develop form and dimension. The Concept Design phase involves the transformation of a qualitative set of requirements into an early design configuration, with some of the principal characteristics defined. The Concept Design effort usually results in a sketch or drawing, partially or fully dimensioned, and may also include a written description of the concept. It may also include one or more design alternatives.

While it is possible that in the planning stage that the ship acquisition strategy will call for the purchase of a second-hand vessel, or possibly an identical or sister vessel to one already in the owner’s fleet; or where the owner decides to purchase a stock or standard design from a shipyard, the necessity for carrying out conceptual and preliminary designs is obviously precluded. It is with entirely new ships and major conversions, where the overwhelming benefits from conceptual design occur.

Kiss defines the Concept Design phase as one which “essentially involves the translation of the owner’s requirements or mission requirements into a broad definition of an item of hardware that can be produced and operated in a manner that will satisfy the stated mission.”

Concept Design Requires
- Innovation
Miller also places the Concept Design phase, which he and other U.S. Navy designers call “ship design feasibility,” as the necessary first step following the mission statement. Gillmer, in describing the U.S. Navy design process also places Concept Design phase, which he calls “concept formulation,” in the same position and importance. They define phase as one where potential ship “vehicles” that will meet the requirements and criteria of the user are determined, through a review of alternatives.

Pugh feels that the subject of conceptual design “incites more emotion, at least in engineering circles, than any other phrase in the English language.” There is concern that systematic concept generation in many industries has stagnated, and this may also apply to ship design. Pugh identifies ships as being “conceptually dynamic” and that many conceptually differing designs are yet to emerge. However, he also cautions that such new concepts can be suppressed by the establishment of fixed and static mission requirements and through the excessive use of mechanical design techniques, i.e. computers, at the conceptual stage. Kreitner concurs.

The Concept Design phase has unique and distinctive characteristics which differentiate it from other phases of ship design. Assuming that new ships are being considered, the concept phase is one where synthesis, the combining of conceptions into a coherent whole, takes place. Before analysis and optimization can take place, it is necessary to have models to analyze.

- Synthesis takes place.
- Requirements evolve into form and configuration.
- Some dimensions and principal characteristics may evolve.
- Results in sketch or drawing.
- May include a written description.
- May include more than one alternative.
- 10 to 80 man – days.
The Concept Design phase requires a small number of engineers, but these people should be highly creative and innovative. Gillmer estimates that the Concept Design phase often takes between 10 and 80 man days. While it is very difficult to put such bounds on the amount of time required for conceptual design, it is agreed that conceptual design requires one to several orders of magnitude less effort than preliminary or contract design.

Erichsen recommends beginning the design process by developing a prototype solution for the purposes of testing the underlying conditions and assumptions; as a test as to whether to proceed or discontinue work; and to highlight or help focus on important issues in the design. Miller suggests starting with general arrangement sketches and developing estimates of volumetric requirement.

Virtually all of the “design spiralists” (Miller, Kiss, Rawson, Buxton) begin the iterative process, even at the concept design phase, by establishing the hull form and approximate dimensions, namely length, beam, depth and draft. The use of standard ratio lead to fineness of hull (block and prismatic coefficients) and to the powering estimates. Hull machinery and outfitting weights, stability and cost are also quickly established through the use of readily available, standard relationships and coefficients.

It is because of the relative ease with which these coefficients can be determined and that initial trips around the design spiral made, that many (Sen, Miller, Buxton, Enchsing, etc.) urge the use of the computer approach and even the development of and use of “expert” systems (MacCallum, Kristiansen).

Andres is of the opinion that while the design spiral conveys the concept that the design process “homes in” on a specific solution, it does not convey the “openness” of the process. Instead, he proposes that the spiral be replaced by a converging conical solid, which permits the many dialogues and constraints to be represented.

Therefore, Andrews suggests that “concept design is not characterized by being highly structured, nor should it be.” It is essential that the designer in this embryonic stage should have “hands on” control of the synthesis process, and not rely on computers or expert systems to do creative work. While the computer may be programmed to generate and evaluate alternatives in this early stage it is the innovation, creativity, judgment, technical perception, economic awareness and analytic log of the engineer that be expected to synthesize the more qualitative prototype design.

Baker suggests that new ships should be 25 percent novelty and 75 percent well proven practice.

A ship is a multifunctional object operating in a multidimensional environment. As such, its design is subject to many constraints, a large number of which conflict with one another. Andrews identifies three types of such constraints.
a. Design Constraints – such as the requirements for minimum manning, or simplification in production.

b. Design Process Constraints – such as the structure of the design organization or the availability of computer software.

c. Design Environment – such as funding available, or the enactment of new laws affecting the design or construction.

In the concept and preliminary design stages, naval architects usually start the design process by establishing the size of the vessel (length, beam, depth and draft) so as to satisfy either the volumetric or deadweight requirements for the vessel. Sizing the ship also requires defining the hull form, primarily block and prismatic coefficients. These are selected with speed and powering requirements in mind. What follows includes what Leopold calls “S,” namely speed, stability, seakeeping, strength and style.

Concurrently, arrangements and layout of the spaces, and configuration of the above deck areas is developed, to assure feasibility and satisfaction of requirements and constraints. Arrangements tend to be more important and challenging with volume and deck area restricted ships, i.e. passenger, ro/ro, etc., than with deadweight ships.

The positional relationships of spaces are important in balancing the requirements of security, trim, operating procedures, etc.

Andrews feels that this process is sufficiently complex, in the early synthesizing stages, that it cannot be handled creatively by computers, CAD (Computer Aided Design), CAAD (Computer Aided Architectural Design) and “expert” systems.

In optimizing the design features of a ship, optimizing arrangements and layout are the least amenable to computerized methods, because of the subjective nature of many of the constraints on arrangements. Whereas such design areas as powering or damage stability lend themselves to mathematical treatment, layout does not.

The use of CAD and CAAD are extremely useful when the designer can interact with them and they are used to generate a wider range of design alternatives.

### 4.3 Preliminary Design

- The second iteration in the design process.
- Provides more detail.
- Provides more accurate dimensions.
- Focuses on essential features.
- Provides enough detail to verify.
- technical feasibility
- economic feasibility

- Provides outline specification.
- Provides enough information for
  - Construction cost estimate
  - Operating cost estimate
  - Revenue generating estimate

Preliminary Design

The second design stage in the evolution of a ship is the PRELIMINARY DESIGN. The preliminary design is an engineering effort which builds on, and provides much greater detail than does the concept design. It is a second iteration in the design process. For those who think of ship design in terms of the design spiral, it is the second circuit (or more) of the spiral which is meant to converge on a more accurate and improved set of vessel characteristics.

The preliminary design is also meant to provide a greater level of detail, especially identifying and defining those features which have a significant effect on other characteristics of the ship. For example, a calculation of the longitudinal strength of the hull and the development of the midship section permit a more accurate calculation of the weight and center of gravity of the vessel. This, in turn, permits a more accurate calculation of draft, deadweight capability and stability, etc.

The preliminary design should provide sufficient detail to permit the verification of both the technical and economic feasibility of the ship. While there is no clear definition as to how detailed or exactly what constitutes a preliminary design package, most writers on the subject agree that the preliminary design should include:

1. Principal Dimensions
   a. Length overall
   b. Length between perpendiculars
   c. Beam
   d. Depth
   e. Draft
      i. Scantling
      ii. Design or operating
   f. Air draft
2. Displacement
3. Weight estimate
a. Structural
b. Machinery
c. Outfitting

4. Carrying capacity of the vessel, as appropriate:
   a. Deadweight
   b. Volume of cargo spaces
   c. Deck area
   d. Passenger capacity
e. Etc.

5. Power calculations

6. Power requirements
   a. Propulsion
      i. Maximum installed
      ii. Design or operating
   b. Electrical
   c. Cargo related, as appropriate:
      i. Pumping
      ii. Refrigeration
      iii. Heating
      iv. Etc.

7. Type and arrangement of main engines

8. Propellers and shafting
   a. Type
   b. Arrangement
   c. Principal dimensions
      i. Diameter
      ii. Pitch

9. Rudder
   a. Type
   b. Arrangement
   c. Area

10. Weight and center of gravity estimate

11. Stability and trim calculation
a. Intact
   i. Arrival
   ii. Departure
b. Damaged

12. Fuel
   a. Specific fuel consumption
   b. Fuel capacity
   c. Endurance

13. Longitudinal strength
   a. Still water
   b. Wave

14. Structural drawings
   a. Midship section
   b. Outline scantling drawing
   c. Typical bulkhead

15. Electrical
   a. Number
   b. Capacity
   c. Prime movers
   d. Arrangement

16. General arrangement drawings
   a. Outboard profile
   b. Inboard profile
   c. Decks
   d. Tanks
   e. Engine room (preliminary)
   f. Quarters (preliminary)

17. Outline specification (between 1 and 50 pages)

This level of detail is sufficient to permit a new building or construction cost estimate to be made. This usually requires just the principal dimensions, weight estimate and type of main engines. Any special features of the vessel which significantly affect the construction also need to be identified. These could include such features as cargo handling equipment, tank cladding, thrusters, stabilization systems, etc.
Preliminary design should also establish:

- Ability of vessel to meet mission statement.
- Regulatory feasibility.
- Patent infringements (if any).
- Need for new technology.
- Model testing requirements.

The preliminary design also provides sufficient details to permit a reasonably accurate operating cost estimate to be made. The operating cost estimate relies on such information as number of crew, fuel and lubricating oil consumption and an estimate of maintenance costs based on the outfitting and coating systems used.

The preliminary design also provides sufficient information to permit estimates of the revenue generating capability of the vessel to be made. These calculations rely on deadweight or other cargo capacity estimates and trim and stability calculations.

Typical voyage calculations can be carried out using the foregoing capital and operating cost estimates. The voyage calculations will assume various trade route scenarios but will rely on such preliminary design details as speed and hull form (to assess voyage times based on expected sea conditions), cargo gear (to permit estimates of both loading and discharge times and costs) and gross and net tonnage estimates (to permit estimates of canal and harbor fees, dry-docking costs, etc.)

The preliminary design also permits an assessment of the technical feasibility of the ship. The compatibility and stowage of cargoes can be verified. The ability of the vessel to operate at various conditions of loading, including the ballast condition, can also be reviewed. The defined level of automation can be correlated with the assumed or planned crew size and designations.

The preliminary design stage obviously should be carried out in compliance with the regulations of the intended country of registration and the rules of the intended classification society. However, ambiguities and subjectivity often arise in the application of these rules. The preliminary design affords an opportunity for the designer to discuss with, clarify, resolve and/or appeal the decisions of these regulatory bodies. If necessary, adjustments to the design can be made at this time.

The preliminary design will also permit the identification of the need for any new or special technology. It may be presumed that experimental ship model tests will be run, in conjunction with or just after the contract design stage. However, some designers carry out preliminary model tests when the design departs significantly from usual practice.

The preliminary design stage, if not at the concept design stage, will permit a check on whether any unusual features of the vessel infringe on existing
patents. Alternatively, such a patent search may reveal new patent opportunities which arise from original features arising from the design. The rights to these potential patents, together with the cost and effort to pursue them are often the subject of a special clause in the consulting agreement between the designer and the owner. In the absence of such an agreement, they, together with the design itself, are the intellectual property of the designer.

Prior to the advent and widespread use of computer in preliminary ship design, each iteration or circuit around the design spiral was costly and time consuming. Design short cuts, approximations and rules-of-thumb were standard practice. While the accuracy improved with successive iterations, there was less likelihood of achieving precisely optimum designs. Also, the limitations in scheduling, manpower and financial resources for design often truncated optimizing efforts or restricted the exploration of design alternatives. The extensive use of computers now permits greater accuracy and more alternatives to be examined, all with less effort and in a dramatically shorter time. For this reason the traditional design spiral approach as a search technique for converging on a feasible and optimal design may be replaced by other optimizing techniques. For example, a matrix or grid approach is possible, wherein a large array of design alternatives can be quickly explored.

4.4 Contract Design

The third design phase is called CONTRACT DESIGN. It involves the preparation of both plans and contract specification. The primary purpose for preparing contract plans and specifications is to create a set of documents which accurately describe the vessel to be built, and can be used as a basis for agreement between the buyer (or owner) and builder (shipyard). The level of specificity at this stage is not fixed by industry practice. Rather, it depends on a number of factors, including the size and complexity of the vessel, the presence of novel features, the contractual risks in dealing with certain shipyards, etc.

- The third iteration in the design process.
- Creates definitive description of the vessel.
- Can be used as contract documents.
- Permits total meeting of the minds between designer and builder.
- Increase details and accuracy of the design.
- Increase accuracy of feasibility checks.
- Decreases risks.
The level of detail in the plans and specifications should be just sufficient for both parties to fully understand the requirements of the other, i.e. a meeting of the minds. The specifications are meant to be a companion document to the contract plans and the contract itself. In the event that there are contradictions between the contract, specifications and drawings, the generally accepted hierarchy, is that the contract terms prevail, followed by the specifications and lastly the drawings. This is usually explicitly stated in the contract and specification.

There is no generally agreed upon format for specifications. The U.S. Maritime Administration’s standard specification has been found to be thorough and logically arranged. When given the opportunity, Japanese and Koreans shipyards prepare their specifications, divided into three volumes, namely hull, machinery and electrical.

The Norwegian Ship Research Institute (Norges Skipsforskningsinstitutt) has organized their standard specification so as to simplify design, purchasing and manufacturing. Each section of the specification is coded to a standard.

The U.S. Navy breaks down the components in their vessels into their SWBS System (Ship Work Breakdown Structure). This classification system, a military standard, MIL-STD-881A, is used to integrate design, engineering and logistics in the shipyards. This is a three digit preliminary and detail design system. An expanded five-digit SWBS system enhances the purchasing, maintenance, cost accounting, storing and overhaul procedures.

The acceptance of specifications is usually the subject of long and tedious negotiations between the buyer and seller. Compromises are usually necessary to achieve agreement.

The plans and specifications should be prepared to thoroughly describe the vessel and those features which the owner truly needs or desires. However, the owner should realize that excessive specificity can inhibit the ingenuity of a builder, and in the end, produce a more costly vessel, for which the owner will pay extra. At times it is desirable for the owner to specify machinery or equipment by brand name. This is a normal and sometimes necessary practice. However, when it is not necessary, it should not be done because it constrains the shipyard in his price negotiations with suppliers. If the suppliers know that they are written into the specifications, they will be reluctant to lower their prices to the shipyard.

The specifications should be prepared by engineers, since many of the features described in the specifications involve or impact upon engineering decisions. There is a prevalence on the part of many owners to have non-technical operating staff prepare the specifications. This is to be deplored as it can lead to serious mistakes or weaknesses in the design.

“There have been recent horror stories arising from flawed statements of requirements and specification documents, drawn up on the cheap resulting in the inability to compare shipyard tenders on a like for like basis, old
fashioned or even bad practice, and almost always a contract opening a door of opportunity for the builder or repairer to claim substantial extras.

A second reason for carrying out the contract design is to increase the amount of detail and improve the accuracy of the design. This, in turn, permits the designer to continue assessing the economic and technical feasibility of the design, but with increasing accuracy, greater reliability and less risk.

During both the preliminary and contract design efforts, a great many calculations are performed. These do not usually form a part of the contract package. However, they should be treated formally, carefully checked and documented and kept with the design package. While many shipyards or preparers of the working design drawings prefer to re-do these calculations, many do not, and the calculations are useful in simplifying or verifying ongoing design work.

Contract Design should

- Avoid ambiguity
- Avoid excessive specifics.
- Be precise.
- Use legal terminology.
- Avoid use of guidance drawings.

The use of guidance drawings is a practice often encountered. The purpose is to convey to the shipyard some of the engineering effort that has been carried out, leading to the contract design. However, since the guidance drawings do not carry contractual obligations, they often lead to misunderstandings between the buyer and the shipyard. Both parties need to be very clear regarding what their obligations are with respect to guidance drawings. The use of guidance drawings should be avoided, wherever possible.

4.5 Classification Societies

The origins of ship classification societies go back one and one-half to two centuries. Their original purpose was to act as independent verification agencies to permit marine insurers to be more confident in the risks they were undertaking. First Lloyd’s Register of Shipping (circa 1760) and later American Bureau of Shipping, Bureau Veritas and others offered the same services.

More from experience than first principles, they established standards for the construction and maintenance of ships. The class societies did and do survey the materials, such as steel, that used in the construction of ships. They have surveyors who attend the building of ships to assure that they are constructed to a standard set of published rules. After delivery, they periodically (annual,
intermediate and special) survey the vessels to assure that they are being maintained to their published standards. Not only do insurance underwriters rely on these certifications, but flag state and port state authorities, safety organizations, investors, lenders, shippers and even crew members have come to depend on class certification that vessels meet minimum standards.

Class societies have expanded their roles to provide inspection and certification to flag states. International registries (flag states) are not equipped technically to provide the certification that vessels meet international safety convention standards such as load line, stability, life saving, structural fire protection and many other requirements. Consequently, those countries contract with class societies to act on their behalf to assure that the vessels are properly constructed and maintained.

In 1968, the leading classification societies formed the International Association of Classification Societies (IACS) to promote improvement of standards and to consult and cooperate with the world maritime industry and organizations. Currently, there are ten members of IACS. These are:

- American Bureau of Shipping - ABS
- Burea Veritas - BV
- China Classification Society - CCS
- Det Norske Veritas - DNV
- Germanischer Lloyd - GL
- Korean Register of Shipping - KR
- Lloyd’s Register of Shipping - LR
- Maritime Registry of Shipping - MR
- Nippon Kaiji Kyokai - NK
- Registro Italiano Navale - RINA

There are several associate members of IACS, and many class societies that are not members.

Since class societies are in competition with one another, to prevent such competition to erode their technical standards, IACS members confer on enveloping unified requirements and unified interpretations of international conventions and codes. Common structural standards is an important area where such work is being done.

A shipowner-buyer will designate which class society’s rules are to be followed during construction. Paradoxically, the classification society is hired and paid by a shipbuilder to assure that it is constructed in accord with its published rules.

After delivery, the class society then works for the owner for ongoing surveys and certification. In the event that the vessel is not maintained in accord with
published standards, the class society may establish a “condition of class” (a warning), suspend or even cancel certification.

Class societies are generally, non-governmental, non-profit organizations run on a committee basis. In recent years, however, class societies have developed adjunct, profit-making organizations to offer other technical services and profits. From time-to-time these create conflict of interest situations. All participants must use every effort to make sure that class society roles as underwriter standards monitor actions on behalf of governmental bodies and profit-making consultants do not become blurred.

4.6 Model Basins

One of the very important steps in ship design is the test of ship’s hulls and propellers in experimental model basin. In spite of increasing sophistication in hydrodynamic calculations through the use of computer driven computational flow dynamics (CFD), there are no better ways to calculate and observe resistance, propulsion, maneuverability, sea-keeping, flow separation, cavitations and other hydrodynamic phenomena than with model tests.

There are numerous such model basins throughout the world. Some offer commercial services and others are attached to universities and used for research and educational purposes.

Either shipowners, in the early design stages or shipbuilders, during construction may engage model basins to carry out tests on vessels or some of their specific features such as bulbous bows, bilge keels, anti-rolling tank, breakwaters, rudders, propellers, etc.

Often, the guaranteed speed of a ship is established between the shipowner and the builder, on the basis of a very carefully conducted set of model basin resistance and propulsion tests, which are verified during sea trials.

In addition to model basin tests, ships are sometimes tested in wind tunnels. The wind resistance of a ship can be accurately determined by such tests. More importantly, and especially on passenger vessels and cruise ships, wind tunnel tests will identify the effectiveness of exhaust stack and superstructure shape to carry engine and other exhausts clear of the vessel.
4.7 **Vendors**

<table>
<thead>
<tr>
<th>The Role of the Manufacturer in High Tech Equipment</th>
</tr>
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<tbody>
<tr>
<td>• Technical Information</td>
</tr>
<tr>
<td>• Quality Control During Manufacture</td>
</tr>
<tr>
<td>• Installation &amp; Start-Up-Support</td>
</tr>
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<td>• Guarantees</td>
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<tr>
<td>• Service</td>
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<tr>
<td>• Stock of Spares</td>
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<td>• Crew Training</td>
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<td>• Documentation</td>
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Vendors are important participants in the ship acquisition process. Manufacturers and their sales representatives are in the best position to supply technical and economic data on their products. Design engineers need information of their products. Design engineers need information on:

- Output, capacity, capability
- Cost and deliver lead time
- Weight and center of activity
- Dimensions
- Clearances required for maintenance
- Spare parts requirements
- Required maintenance
- Required services such as compressed air, cooling water, ventilation, electrical power, etc.

Where there are no products on the market or special features are required to meet the needs of designers, the designers need to consult with manufacturers to determine if such special needs can be met.

In former years, management kept economic information confidential and the price of products was kept secret between purchasing agents and vendors. Engineers were not supposed to trouble themselves with such matters. Of course, this was nonsense, and the situation has changed. It is not possible to make proper design decisions or optimize designs without knowing the first cost (purchase price), energy requirements, maintenance costs, product life salvage value and other life-cycle costs.

Vendors provide, when requested, installation engineers to assure that their products are being correctly installed and commissioned.
Vendors often provide training programs for owner’s seagoing and port engineering staff.

Vendors can provide full service maintenance programs, and can stock important spare parts in convenient locations at no cost to the owner. The vendors, such as paint suppliers, may provide the owner with exceptionally long guarantee periods.

Therefore it is important for the owner to work together with various vendor, pre-contract as well as during construction and after delivery. It is possible to specify components by name and manufacturer in the contract specifications, providing it is not a public contract. However, it is important to agree with the vendor on the price beforehand. The more usual procedure in shipbuilding programs is to provide and agree on a makers list at the outset, or to provide the owner with a choice between three vendors for each component.

4.8 Consulting Naval Architects

Consulting naval architectural firms provide many varying services. One important role is to assist shipowners during the ship acquisition process. They may participate in all phases or in only selected tasks, depending on the capabilities and needs of the owner. Some large shipping companies, such as tanker companies, have their own technical department and only need occasional or specific assistance. Smaller owners may need assistance in many or all phases of the ship acquisition process. In some cases, consulting naval architects may be called upon to assist shipbuilders with design services or specific technical help.

Consulting naval architects are also graduate marine engineers since the machinery, piping and electrical systems are inherent parts of the ship. Consequently, consulting naval architects and marine engineering firms have capabilities in most or all of the following disciplines:

- Hydrostatics and hydrodynamics
- Structural design
- Marine propulsion
- Power plant design
- Electrical generation and distribution
- Pumps and piping
- Heating, ventilation, refrigeration and air conditioning
- Electronics and control systems
- Fire safety
- Welding
Corrosion control and coating system
Shipbuilding processes
Marine transport planning and economic analyses
Contract management project management
Cargo and materials handling
…and many other fields
5

COMMERCIAL ACTIVITIES

5.1 Introduction

The third phrase in the ship acquisition process mainly involves commercial activity. It includes bidding, negotiating, contracting and financing. This third phase requires the expertise of professionals in these areas. The extent to which the shipowner may need to reach outside for assistance depends on the skill levels and experience within the owner’s organization. It is likely that, on a very large program, the owner would need, or at least benefit from, the talents of experts in these different disciplines. It is not usual for an owner or his staff to acquire a few vessels over a short span of years. However, an admiralty attorney, naval architect, or a purchase and sale broker probably will be involved in a great number of newbuilding transactions for many clients in the same period. Hence their spread and depth of experience will greatly exceed those of a typical owner’s staff. On the other hand, the owner’s staff will be much more familiar with the owner’s needs and methods. Hence, a team approach, using the talents of both insiders and outsiders, tends to be a more effective overall solution.

The commercial phase essentially consists of the following steps:

COMMERCIAL

• Selection of yards for invitation
• Request for expression of interest
• Invitation to bid
• Bid analysis invitation to bid
• Pro-forma contact invitation to bid
• Negotiations
• Financing
• Contracting

Factors in Selecting Yards for Invitation

• Physical characteristics
• Technical capabilities
• Experience
• Order book

60
5.2 Selection of Yards For Invitation

There are over one thousand shipyards in the world capable of building ships of at least 5,000 DWT in size. Obviously, it is impractical to invite every one of these to participate in a shipbuilding bidding program. It is therefore necessary to limit the number to be invited. The reasoning used in making such a selection may be based on a number of factors. These include:

1. The yard’s capability\(^3\) in terms of size of ship which can be accommodated (these would include such factors as size of drydocks, graving docks, depth, width and air draft of waterways leading to the yard, etc.). Shipyard directories provide this information. However, they should be cross or double checked, as this information is often dated or inaccurate. Waterway access to the shipyard can be determined by reference to publications providing channel depths and widths, etc. These data can be verified by reference to nautical charts and sailing directions.\(^4\)

2. The yard’s technical capability compared to the sophistication required by the type of vessel sought.

3. The yard’s experience in building similar ships. Reference to trade journals listing ships built will provide the requisite information. Also the classification societies indices will indicate types and characteristics of ships and their shipbuilders.

4. The yard’s order book position or the number of vessels on order. An excess of work might indicate that the owner’s order may not receive sufficient attention or that production delays might occur. Insufficient work at the yard may indicate that the yard has lost key manpower and skills or that the yard is entering a period of financial difficulty.

5. The yard’s geographical location. Often, especially with smaller vessels, the initial positioning costs of the completed vessel represent a significant portion of the final cost of acquiring a new vessel.

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\(^3\) The importance of physical constraints of shipyards is highlighted in a paper Marketing Strategy for Merchant Shipbuilders, Journal of Ship Production, SNAME, August 1995.

\(^4\) Such as Guide to Port Entry, Shipping Guides, Ltd., Surrey, UK, Fairplay World Ports Directory, Fairplay Information Systems, Surrey, UK, etc.
6. The yard’s ability to assist in financing. This may involve using the yard’s banking connections and/or using the yard’s credit.

7. The yard’s reputation with regard to customer satisfaction. A check of directories such as, in the United States, The Federal Legal Practice (West Publishing Company) or electronic databases such as LEXUS/NEXUS or the legal database Westlaw would indicate any history of disputes such as lawsuits or arbitration hearings. It should be kept in mind that these will list cases which result in awards, whereas many cases are settled before conclusion. L. Sheinbaum, Esq. estimates that 75 percent of all disputes get settled before trial. Inquiries to previous customers concerning their experience in dealing with the yard are also useful.

The number of yards to be invited will be reflected by the size and importance of the order, with a larger program requiring a broader, more extensive list of invited shipyards. For example, in the Del Monte Fresh Fruit Company’s shipbuilding program involving six (later expanded to nine) refrigerated cargo ships, a total of 50 shipyards were asked if they were interested in bidding. Thirty-two responded positively and 18 declined.

On the other hand, Italian and German Owners, for one and two-ship order of Econfeeder Class vessels, have limited their initial solicitations to three or four shipyards.

8. Political unrest, a history of strikes, the expiration of labor contracts, and other similar factors may also enter into the yard selection process.

5.3 Request for Expression of Interest

- Simple and brief inquiry.
- Sent by e-mail or fax.
- Saves time and effort.
- Permits assessment of number of yards participating.

Request for Expression of Interest

This step calls for making a simple, brief inquiry from each of the selected shipyards. The inquiries, which have been sent by fax, but more recently by e-mail, outline the owner’s intended order (number, type and size of vessels). It asks for the responding shipyards to state whether they are interested in bidding on the project.

There are several important reasons for carrying out this step. First there is a considerable cost involved in preparing each bid package which usually involves voluminous specifications, an extensive number of drawings, a pro forma contract (or heads of agreement), bid forms and other documents.
The second reason involves the predictability of responses. It is important to know whether each yard is actively working on a response to the requests for proposals. If a large number of yards decline to bid, the owner may want to add additional yards to his invitation list. He may also want to investigate why the large number have declined, so that he may make appropriate adjustments, if necessary.

5.4 Invitation to Bid

The next step in the commercial process is to formally request proposals from eligible shipbuilders. The invitation to bid is sometimes called a “request for proposals” (RFP). The necessity for carrying out this step formally includes a consideration of the fact that the relationship between requester and bidder has legal liability implications. Also, unless the responders submit proposals in a consistent manner, such as on a standard form, the following step, analysis of bids, becomes extremely complex. The formal request for proposals also helps the project managers to maintain a consistent and reliable schedule for the commercial phase of the acquisition process.

<table>
<thead>
<tr>
<th>Invitation to Bid (RFP)</th>
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<tr>
<td>• Best process.</td>
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<td>• Make create legal obligations.</td>
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<td>• Not to be used to develop price estimates.</td>
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<td>• Use standard formats.</td>
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<tr>
<td>• Formality is required.</td>
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<tr>
<td>• Use bid form.</td>
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Information to Be Sent in Invitation to Bid

- Brief description of vessel.
- Name and address of person requesting proposal.
- Number of vessels and options (if any).
- Documents
  - Plans
  - Specifications
  - Pro-forma contract or Heads of Agreement
- Required delivery.
The request for proposal usually contains the following elements:

1. A brief statement of the nature of the vessel on which bids are requested.
2. The name, address and name of the project manager requesting the proposal.
3. The number of vessels involved in the project, together with possible optional vessels.
4. Reference documents upon which the proposal is to be based, including such items as:
   a. Specifications
   b. Proposed contract drawings
   c. Guidance drawings
   d. Pro-forma contract or “Heads of Agreement”
5. Requested delivery schedule, if any, including
   a. Required dates
   b. Intervals between vessels deliveries.
      • Requirement for cash price
      • Currency
      • Financing terms
      • Confidentiality of owner’s documents
      • Performance bond (if any)
      • Period of validity of bid
      • Obligations on owner concerning bids
      • Signature by authorized representative
7. Acceptable currency or currencies.
8. Financing terms, if any.
10. Statement concerning confidentiality of owner’s RFP documents.
11. Performance bond requirements, if any.
12. Period for which proposals shall remain valid.
13. Basis on which bidding is carried out, bids are opened, successful bidders selected, right (if any) to accept or reject bids.
14. Requirements for bids to be signed by an authorized representative of the shipyard.

15. Requirements (if any) for additional information such as:
   - Additional yard information
     - Quality information
     - Yard standard details
     - Current order book
     - Financial statement
     - Bank reference
     - Management plan
     - Technical plan
     - Major event schedule
   - Complete bid form


17. Bid form.

It is customary and prudent to give the bidders sufficient time to prepare a well thought out and studied proposal. Too short a bidding period will cause the bidders to have to estimate, rather than calculate their costs with the requirement that some margins will be included, resulting in higher bids.

In preparing the bids, bidders need basic design data such as weight breakdowns, lineal estimates of pipe, wire, ducting, etc. Where the owner is able to supply this information in the design package, it simplifies the bidders work and shortens the bidding period. It also provides a more consistent basis for all bidders prices. However, it also exposes the owner to liability for any errors or ‘growth” in these values between contract design and working drawings. Therefore, the owner should, in this case, require that the bidder, before final contract, confirm those design values given and accept responsibility for their correctness.

On complex projects, it is possible and even likely, that bidders will have questions or will require explanations, clarifications or more technical information. In such cases, it has been found useful to hold a bidders conference at some intermediate point in the bidding period. It is unfair, in the extreme, for the owner to communicate individually with one bidder, without sharing this information with the others. Therefore, on smaller projects, all bidders should submit their questions in writing. All questions, together with answers should be sent to all bidders. The bidder’s conference should be sponsored by the owner, usually at a location convenient to most bidders. All questions and oral answers given at the conference should be confirmed in writing, all to form a part of each proposer’s bid.
On occasion errors in the design or specifications are found during the bidding period. The owner’s requirements may change during the bidding period. This may require sending out an addendum or addenda to the specifications and/or revisions to the drawings. An extension in bid due date may be appropriate.

The owner may want to encourage bidders to use their ingenuity to propose alternative design features or other ways to enhance their proposals. However, for purposes of consistency and to simplify analyses, each bidder should be required to include, with such innovations, a proposal strictly in accordance with the request for proposal.

Bidding on Government Projects

Bidding procedures followed in most governmental shipbuilding projects are essentially the same as those in commercial projects, except that they usually are governed by laws and hence tend to be more formal. For example, in the United States, government ship acquisition is carried out under the Federal Acquisition Regulations (FAR) and have the full effect of law. Similar regulations in the U.K., Germany, France, and elsewhere. Under government procedures, contracts are executed or terminated for the government by a contracting officer. The contracting officers have the authority to bind the government; are responsible to see that all laws, executive orders, regulations and appropriate procedures are followed; may exercise business judgment and must see that the contracts “receive impartial, fair and equitable treatment.” Many of these explicit regulations are either implied in ethical commercial transactions or should be imposed on the parties by the buyer. For example:

a. No employee should solicit or accept, directly or indirectly, any gratuity, gift, favor, entertainment, loan or anything of monetary value from anyone who has or is seeking to obtain business with their employer. (see FAR 3.101-2)

b. Employees should not have financial interests that conflict substantially with their duties as employees.

c. Employees should not engage in financial transactions as a result of or relying on information obtained as a result of their employment.

d. Bidders prices should be arrived at, independently (FAR 3.103-1 and 13.000).

e. Offers shall not be knowingly disclosed to any competitor before bid opening or award, in the case of negotiated procurement (FAR 52-203.2).

f. Neither party should discuss post-contract personal employment.

g. Neither party should solicit or disclose proprietary or source selection information.
Bidders should not be allowed to eliminate competition, or restrain trade through “follow-the-leader” pricing wherein bidders take turns at being the low bidder. (This process is customary in Japan where Sea-Land’s D-9 program and U.S. Lines’ Jumbo Econship programs were bid on by the major Japanese yards, who coordinated their bids and decided before submission which yards would get orders, and how many ship orders each would get.) This procedure leads to higher prices for the owner.

The owner should be alert to “buying – in” practices, where bidders submit offers below anticipated costs, with the expectation and intention of increasing the contract amount through excessively priced change orders or receiving follow-on contracts or change orders on the original contract at high prices.

In the U.S., the Anti-Kickback Act, prohibit subcontractors from making payments to influence the award of subcontracts.

Federal regulations require that opportunities to contract be publicly advertised. A synopsis of the project should be submitted for publication or other method of dissemination.

Federal procedures allow both sealed bidding and competitive proposals. Sealed bidding involves:

- a. Preparation of invitations for bids (IFB).
- b. Publicizing the invitation for bids.
- c. Submission of bids by prospective contractors.
- d. Public opening and evaluation of bids without discussions by bidders.
- e. Awarding the contract to that responsive bidder, whose bid conforms to the invitation, (FAR 14.101).

Sealed bids must be used if sufficient time permits. The award is made on the basis of price and there is an expectation of receiving more than one bid. Otherwise competitive proposals may be used.

Non-financial selection criteria include:

- a. Ability to comply with proposed schedule.
- b. Satisfactory record of performance, integrity and business ethics.
- c. Possess necessary organization experience, accounting, operational controls and technical skills.
- d. Production control procedures, property control systems, quality assurance measures.
- e. Possess the necessary production, construction, technical equipment and facilities.
TIPS IN BIDDING

- Hold bidders’ conference.
- Use addenda, if necessary.
- Be firm on submittal date.
- Create short list.
- Be courteous and fair.
- Ensure ethical practices.

BID ANALYSIS

- Price for one vessel
- Price for a multiple vessel order
- Currency of payment
- Additional cost for financing
- Location of yard (and distance to where vessel or vessels will be deployed)
- Cost of positioning vessel
- Reputation, experience and quality of yard
- Financial health of yard
- Proposed building schedule
- Owner’s costs as they relate to yard location (i.e. inspectors’ housing, travel, taxes, etc.).
5.5 **Bid Analysis**

The primary considerations in a bid analysis center around:

a. Price and currency  
b. Financing terms  
c. Responsiveness to the RFP  
d. Delivery schedule  

Other factors which are important include:

e. Yard reputation  
f. Yard experience  
g. Labor stability/union contract dates  
h. Weather and possible delays  
i. Degree of subcontracting  
j. Work load in yard  
k. Number of employees, manning  
l. Yard facilities  
m. Quality of workmanship  
n. Yard location, positioning costs  

A visit to one or more yards that are being seriously considered is a way of verifying many of the important factors affecting the yard selection. After a “short list” is developed, the owner should have a meeting to discuss the bid, clarify any points not understood. The initial meeting and negotiations should be attended by both legal and technical personnel. Go through all plans and every page of specs together and sign. The yard must accept the design – (take enough time to do this) and the yard becomes solely responsible.

Model tests to be jointly witnessed.
5.6 **Negotiations**

- Have primary bidder and two back-up bidders.
- Beware of driving bidder below level of profitability.
- Be well informed and prepared.
- Be aware of legal obligations in negotiating stage.
- Have a total and complete meeting of the minds.
- Yard to take total responsibility for design.
- Avoid split responsibilities.
- Review, in detail, all documents and initial *every* page and drawing.
  - Contract
  - Specifications
  - Drawings

The next step in the process involves negotiations. Unless the bidding process calls for a public opening and award based on low price, which would be more usually found in government bidding, commercial bidding more typically results in the selection of a short list of bidders for further negotiations. This short list can be as few as one, and is typically two or three, namely a primary candidate, with one or two back-up bidders. There are several reasons for having more than one bidder involved during the negotiation stage. The first is to provide a back-up in the event that the negotiations with the primary candidate reach an impasse on some issues, or in the course of the negotiations, hidden issues cause the real price to rise or the bid to become less desirable than originally presented.

It is also possible that because of other business opportunities (they may be bidding on several other projects, which materialize), the primary bidder may withdraw its bid.

A second reason for having back-up bidders is that it is important from a psychological point of view. If the negotiating efforts are to further reduce price or improve terms, it is helpful to the buyer for the primary bidder to know that his competitors are “waiting in the wings.”

In a buyer’s market, the buyer must use his advantages judiciously, and not push the bidders below a level of fairness or reasonable profitability. Of course, it is difficult for the buyer to know at what point in the negotiations the bidder reaches a non-compensatory price. Therefore, it is in the buyer’s own interest to enter into the negotiations carefully prepared with as much knowledge of not only what he can afford to pay, but also with a knowledge of, or best estimate of the bidder’s cost factors, including worker wage rates,
projected inflation allowances, worker productivity (such as man-hours required per ton of steel produced or per compensated gross ton), the steel weight of ship (both plate and shape; both mill and special steels), steel and main engine prices, etc.

The pitfalls in pushing the bidder below a point of reasonable profitability and more importantly into a loss-making contract include the possibility that the bidder will bankrupt itself during the project, or that the candidate may attempt to find ways, during the construction, to reduce the quality or performance of the ship or otherwise avoid its contractual obligations. The probability of dissatisfaction and litigation during or at the end of the project increases dramatically as the losses of the builder increase. The buyer is certainly not responsible for errors which occur during the project. However, he does play an important role in assuring that all participants in the project emerge with commercially satisfying results at the end of the project.

1. A negotiation is a transaction between parties to reach a mutually acceptable agreement on objectives, where both parties have a veto.
2. A common misconception is that a negotiation is merely an attempt to reduce a price.
3. In addition to price, every transaction is selling. This is incorrect. Negotiations take place after the selling phase.
4. Another misconception is that a negotiation is selling. This is incorrect. Negotiations take place after the selling price.
5. There are two approaches to a negotiation. One is where we look for a gain for ourselves. A better approach is to try to achieve a solution where both parties gain, i.e. a win-win situation.
6. A good negotiator will consider the aspirations of both parties, and balance and trade, so that both parties are satisfied and acceptable objectives are achieved.
7. A negotiation must be planned.
8. You must have a clear understanding of your company’s goals and objectives.
9. There must be a strategy for a negotiation, namely:
   a. Decide who will conduct the negotiation.
   b. Research the other party’s objectives.
   c. Decide what experts you will have with you.
   d. Decide where best to conduct the negotiation.
   e. Plan to control the process.
   f. Prepare documentation in advance.
   g. Understand your bottom line.
h. Decide what your bottom line is.

10. Tactics
   a. Prepare
   b. Decide what factors are important
      i. Cost
      ii. Price
      iii. Payment terms
      iv. Financing
      v. Delivery
      vi. Penalties
      vii. Guarantees
      viii. Exclusively
      ix. Patents, rights to design
      x. Contract terms
      xi. Technical terms
      xii. Post delivery service
      xiii. Additional concessions
     xiv. Options
   c. Stay in control
      i. Prepare an agenda
      ii. Let the other party talk
      iii. Ask questions
      iv. Don’t respond too quickly
      v. Use positive language
   d. Let the other party propose
      i. If you accept the proposal immediately it means that you probably could have done better.
         ii. You can counter-propose.
  e. Bargain
     i. Trade
     ii. Don’t just concede.
f. Agree
   i. Write down each point.
   ii. Summarize what has been agreed to.
   iii. Initial by both parties while being formalized.

11. Avoid intransigence.
12. Never say “yes” the first time.
13. Be informed.
15. Trade in small steps.
16. Trade one concession at a time.
17. Aim higher than you think.
18. Don’t “split the differences.”
19. Use “if” when making proposals.
20. Use silence.
21. Don’t be frustrated by deadlocks.
22. Avoid unmovable positions.
23. Ensure your counterpart has the authority to negotiate.
25. Conceal emotions and body language.
26. Use experts.
27. Attack the problem, not your counterpart.
   a. Listen
   b. Sympathize/empathize
   c. Formulate, propose solution
   d. Action
   e. Confirm
28. Don’t deal in round numbers.
29. Don’t concede before necessary.
30. Be patient.

The negotiations usually dwell on the contract terms (price, deliver and guarantees) and on the specifications.

It is customary to have lawyers present during the negotiations involving the contract. In fact, it is customary that a lawyer take the lead in this segment of
the discussions, whereas during the review of the specifications and drawings a naval architect or marine engineer is most suitable as the buyer’s negotiations leader.

If the design is conventional, the specifications clearly written and the drawings complete, then the technical phase of the negotiations are a simple procedure. However, where a shipyard is being asked to accept full and sole responsibility for a novel design or one supplied by the owner, the yard tends to be much more cautious, careful and reluctant to accept anything more than it has to.

Far Eastern yards, principally those in Japan, Korea and China, tend to treat the negotiation and joint review of plans and specifications much more carefully than do Western European or American yards. Such technical negotiations may last two or three weeks, with each page of the specifications and each drawing initialed by all parties.

TIPS IN NEGOTIATING

- Be fair.
- Be patient.
- Be firm, until it is absolutely necessary to be flexible.

Take enough time for the process.

There are many books on negotiating techniques. Obviously, patience is a key element, especially in dealing with Far Eastern shipyards there must be a complete understanding by both parties. McCormack gives a short list of other elements which he feels are important in a negotiation. These include:

- Do not get stranded by “how much”. Money issues are only one part of the transaction.
- Let the other party go first (with terms and numbers).
- Play in majors.
- Do not deal in round numbers.
- Avoid showdowns.
- Negotiate backwards.
- Trade places.
- Mollify then modify.
- Deflect with a question.
- Question positions but do not ignore them.
- Improve the offer with other parties’ self interest.
- Consider barter.
• Keep your time frame quiet.
• Step back and relax.
• See emotional outbursts as opportunities.
• Act in anger – never react in anger.
• Give the other parties side victories.
• Use candor.

Silbiger provides us with his rules for negotiations:
• Know your opponent.
• Know yourself.
• Do your homework.
• Understand your strategy.
• Understand your limits.
• Review your negotiations, afterwards.
6

FINANCING

6.1 General

There are three principal sources of funds for commercial shipbuilding, namely:

   a. Equity
   b. Debt
   c. Government grants

Within these three categories, there exist a great number of variations and combinations. While the commercial bank loan (debt instrument) remains the classical method for financing ships, there have been major changes over the last two decades in this traditional method. First, the availability of government grants through direct and indirect subsidies, guarantees, etc. has declined. Second, the use of equity markets has grown steadily.

Players in the Ship Finance Equation
Source: B.I.S. Solvency Ratios and Cost of Capital
International Ship Finance 6, Lloyd’s of London Press, 1994

World wide need for
Ship Financing
$250,000,000,000 per year
Kippenger stated that Worldwide shipbuilding would require approximately $20 to 25 billion annually in the years up to 1996 or 1997 and rising to 50 billion, annually in the years 1998 to 2002. He bases these assumptions on Drewry’s estimates of new building demand for the decade 1992 to 2002. By 2007 this figure had risen to $100 billion.

In deciding which form of financing is best for the shipowner Kelly states that the Harvard Business School recommends the FRICT approach, namely, each financing should be analyzed against:

<table>
<thead>
<tr>
<th>WHAT FORM OF FINANCING TO USE?</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRICT approach:</td>
</tr>
<tr>
<td>• Flexibility</td>
</tr>
<tr>
<td>• Risk</td>
</tr>
<tr>
<td>• Income</td>
</tr>
<tr>
<td>• Control</td>
</tr>
<tr>
<td>• Timing</td>
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</tbody>
</table>

**TYPES OF FINANCE**

<table>
<thead>
<tr>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Equity – Owner Equity</td>
</tr>
<tr>
<td>Funds from owner</td>
</tr>
<tr>
<td>2. Equity – Limited Partnership</td>
</tr>
<tr>
<td>Partners (K/S and K/G)</td>
</tr>
<tr>
<td>3. Equity – Ship Fund</td>
</tr>
<tr>
<td>Stock exchange, shares bought</td>
</tr>
<tr>
<td>4. Equity – Public Offering</td>
</tr>
<tr>
<td>Subscription on stock exchange</td>
</tr>
<tr>
<td>5. Mezzanine Financing – Private Placement</td>
</tr>
<tr>
<td>Debt with high interest</td>
</tr>
<tr>
<td>6. Debt – Bond Issue</td>
</tr>
<tr>
<td>Security issued in capital market</td>
</tr>
<tr>
<td>7. Debt – Commercial Bank Loan</td>
</tr>
<tr>
<td>Bank or syndicate of banks</td>
</tr>
<tr>
<td>8. Debt – Yard Credit</td>
</tr>
<tr>
<td>Loan provided by Government to assist yards</td>
</tr>
<tr>
<td>9. Debt – Private Placement</td>
</tr>
<tr>
<td>Debt with pension funds, insurance cos., etc.</td>
</tr>
<tr>
<td>10. Lease – Finance Lease</td>
</tr>
<tr>
<td>Long term, tax effective based on sale of ship after depreciation</td>
</tr>
<tr>
<td>12. Grants and Subsidies</td>
</tr>
<tr>
<td>13. Islamic Financing</td>
</tr>
</tbody>
</table>
FACTORS TO CONSIDER IN FINANCING

<table>
<thead>
<tr>
<th>If You Have</th>
<th>Consider</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unused tax depreciation</td>
<td>- Leasing</td>
</tr>
<tr>
<td>Excess debt</td>
<td>- Equity</td>
</tr>
<tr>
<td>Potential business risk</td>
<td>- Equity</td>
</tr>
<tr>
<td>Buyer’s market</td>
<td>- Shipyard Credit</td>
</tr>
<tr>
<td>Large earning power</td>
<td>- Debt</td>
</tr>
<tr>
<td>Strong, predictable cash flow</td>
<td>- Debt</td>
</tr>
<tr>
<td>Low stock price low expectation</td>
<td>- Hybrid</td>
</tr>
<tr>
<td>Long term, fixed rate</td>
<td>- Bonds</td>
</tr>
</tbody>
</table>

Factors which affect which type of financing to seek include:

a. Availability of funds in each sector, which can vary cyclically.
b. Availability of unused tax depreciation (leasing).
c. Companies with excess debt (i.e. “all borrowed up”) or which are potential business risks (equity).
d. Buyer’s market (shipyard or export credit).
e. Companies with large earning power, strong predictable cash flows, and asset quality and financial leverage below optimal capital structure (debt).
f. Companies whose stock price is extremely low, given future expectations (hybrid).

INSTITUTIONS PROVIDING OR ARRANGING SHP FINANCE

1. **Commercial Banks** – Debt (loans)
2. **Ship Mortgage Banks** – Specialists, K/S, K/G, tax concessions, bonds, etc.
3. **Investment and Merchant Banks** – Arrange and underwrite loans (but do not make loans) – arrange loan syndications, public offerings, bond issues, public and private placement.
4. **Finance Houses and Brokers** – Financial Institutions – as GE Capital, Fidelity Capital, lend and put together finance packages.
5. **Leasing Cos.** – Lease of assets – can offer long term leases that banks cannot.
6. **Shipbuilding Credit Schemes** – Government guarantees, credit through central or commercial bank, OECD controlled 80% at 8.5 year at 8%/year.
6.2 Debt Financing

- Least expensive
- Most restrictive
- Commercial or government loans
- Loans secured or collateralized
- Mortgages
- Possible pledge of:
  - earnings
  - insurance
  - corporate guarantees
  - pledge of shares
  - personal guarantees
- Seldom 100%

Debt Financing

Debt financing is the least expensive, but most restrictive form of ship finance. The more usual way to finance ships is through commercial or government loans. These traditional loans are almost always secured or collateralized. The ship owner, in addition to granting a mortgage to the bank on the vessel, will also pledge one or more of the following as collateral:

- Assignment of earnings
- Insurance
- Corporate guarantees
- Pledge of shares
- Personal guarantees

Lending institutions seldom lend 100 percent of the vessel acquisition or building cost. They prefer to have a portion of the cost provided by the owner. There are two reasons for this. First, it ensures a more serious involvement by the owner when he has his funds invested. Second, the lender is more likely to recover his full investment in the event of a liquidation of the assets. In the event that the primary lender does not make available sufficient funds, the owner may find a second lender who will accept a second mortgage (one that is inferior in rank, i.e. which is paid out only after the first mortgage, in the even of liquidation).
Debt financing source include:

1. Commercial Banks – Senior Debt
2. Mortgage Banks – Senior Debt
3. High Yield Corporate Debt – closes the gap between what the owner and bank can provide and what is needed – a high yielding corporate debt, i.e. “Junk Bonds” – high return (well over bond rates) to compensate for risk. Arranged by investment banks for small shipping companies. This is “MEZZANINE FINANCING”.

SOURCES OF DEBT FINANCING

- Commercial banks
- Ship finance banks
- Investment banks
- Government banks
- Commercial finance companies
- Saving and loan associations
- Pension funds
- Insurance companies
- Commercial credit companies
- Account receivable factors
- Manufacturers and vendors

DEBT — COMMERCIAL FINANCE COS.

- GE Capital
- Greyhound
- CIT
- Kleinwort Benson
- Henry Ansbacher
- Samuel Montague
- Others

Ship loans are also provided by commercial finance companies. In the United States typical commercial finance companies include, GE Capital, the CIT Group and Greyhound Leasing. In Europe, and principally in the United Kingdom, investment bankers such as Kleinwort Benson, Henry Ansbacher and Samuel Montague provide these loans.
DEBT – COMMERCIAL BANKS

- Norwegian owners - Norwegian banks
- Chinese owners - Hong Kong banks
- Japanese owners - Japanese banks
- Greek owners - Non-Greek banks

Commercial banks, principally in the U.S. and UK provide shipping loans. Norwegian, Hong Kong and Japanese banks lend principally to Norwegian, Chinese and Japanese shipowners, respectively. The Greek shipping community usually borrows from the non-Greek banks. Within Europe, a number of specialist ship finance banks service the higher risk portion of the market using funds derived from commercial paper, floating rate notes and bank borrowings.

DEBT – MEZZANINE FINANCING

- Used when bank unwilling to loan owner sufficient money.
- High yield corporate debt, i.e. Junk Bonds.
- Closes gap.
- Provides high return.
- Compensates for high risk.
- Usually arranged by investment banks.

When the bank is unwilling to loan the owner a sufficient amount to close the shipbuilding transaction, the owner may resort to mezzanine financing. Mezzanine financing refers to high yield corporate debt, which closes the gap between the owner and the bank and can provide what is needed. Such high yielding corporate debt, for example “junk bonds,” provides a high return, well over bond rates, to compensate for the risk. It is financing, usually arranged by investment banks, for small shipping companies.

DEBT – BONDS

- Issued by shipowner
- Certificates of indebtedness
- Specific purposes
- Specific rates and period

Another form of debt financing is the issuance of bonds by the shipowner. Such shipbuilding bonds are certificates of indebtedness for long term loans for a specific purpose, with specified interest rate and payback terms.
DEBT - SHIP MORTGAGES

Purposes:

- Public record of lien
- Priority of the lien
- Sequence of prior liens
- Agreement between lender and owner:
  - Operation
  - Insurance
  - Maintenance
  - Trading areas

The ship mortgage serves several purposes, namely it provides a public record of the lien on the vessel, the degree to which the vessel is subject to prior liens and the priority of the lien. It also is the basis for an agreement between the lender and the owner concerning operation, maintenance, insurance, trading areas, etc. The mortgage should be developed with the assistance of an experienced lawyer. The mortgage will usually include such information as:

a. Flag state endorsement of record
b. Date and time of recording
c. Applicable law
d. Enforceability of lien
e. Covenants, such as:
   1. Definitions
   2. Description of ship
   3. Insurance type and amount
   4. Trading restrictions, if any
   5. Maintenance and repair standards
   6. Compliance with regulations
   7. Payment of expenses
   8. Payment of future liens
   9. Posting of mortgage in the vessel
   10. Payments in event of default
   11. Other lender remedies in even of default, including taking possession of vessel, owner’s power of attorney
   12. Application of insurance proceeds
   13. Application of liquidation proceeds
Liquidation proceeds are usually applied in the following sequence:
   a. Expense advanced on behalf of owner
   b. Lender’s interest
   c. Lender’s principal
   d. Residual to owner

DEBT – FACTORS CONSIDERED IN GRANTING LOANS
   • Age of business
   • Type of operation
   • Method of payment
   • Currency of loan and repayment
   • Collateral
   • Character of management
   • Credit history
   • National economic factors
   • Industry
   • Mortgage and loan terms

Paine points out the difference to the lender in importance of the balance sheet between a liner shipping owner and a bulk carrier or tanker owner. The liner company’s performance is often reflected in “its success in marketing a transportation service involving multiple vessels or a period of time.”

QUALITY OF BORROWER
Liner Co.
   • Ability to market its service

Tanker or Bulk Carrier Co.
   • Ability to service debt
   • Cash flow
   • Quality of charters

Bulk shipping operators generally link the financing of a tanker or bulk carrier to its ability to service its debt, what Paine calls “quail-project” financing. Hence, the cash flow forecast is crucial. The quality of charters and predictability of costs become the focus of the lender.
DEBT – RATES

• Floating (variable)
  - usually tied to LIBOR

• Fixed
  - Rare from commercial banks.

• “Swap”
  - Swaps are more costly
  - Lender and third party who have excess variable and fixed rate
    funds arrange swap.

• “Cap”
  - Protects against rising rates.
  - Lender pays interest over an agreed level.

• “Collar”
  - Reduces extra costs for a cap.
  - A combination of a cap and “floor”.

Loans can be made on a fixed interest rate basis or a floating or variable rate. Fixed rates from commercial banks are rare since they depend on sources of funds that are themselves subject to variable interest rates. One method of arranging for a fixed rate is to have the lender arrange a “swap,” which is an agreement with a third party to exchange streams of interest payments. The two parties, which respectively have excess funds at variable and fixed rates, are able to achieve a balance. Such swaps will cost the borrower a higher rate than he would pay for a variable rate.

Another way for a borrower to protect himself against rising interest rates is to pay the bank an extra cost to provide a “cap.” A cap is an agreement by the lender to pay all interest exceeding a certain specified level.

Interest Definitions

Cap  An interest rate cap allows shipowners to protect themselves against increasing debt funding costs as a result of rising interest rates, whilst also allowing them to retain the benefit of lower rates. The buyer of an interest rate cap is required to pay an up-front premium to the cap seller.

Floor An interest rate floor is in effect a mirror image of a cap – it provides a buyer with protection against downward movements in interest rates.
Collar

An interest rate collar is a combination of a cap and a floor. It enables the buyer of the collar to fix a maximum and minimum rate payable on their liabilities. For example a borrower would buy a cap at one level (say 9%) and sell a floor at another level (say 6%). By buying the cap they will be protected against rates exceeding 9%, but by selling the floor they are committed to paying a minimum of 6% and will not benefit should rates fall below this level. Often the collar is constructed on a “zero cost” basis with the premium payable on the cap being offset by the premium receivable on the floor.

A method for reducing the extra cost for a cap is to arrange a “collar.” A collar is an agreement by the borrower to pay the difference between the actual interest and an agreed floor level, when the floor level is above the actual level. In other words, a collar is a combination of a “cap” and a “floor.”

Interest Rate Swap

An interest rate swap, in its simplest form, involves an exchange of fixed interest payments for floating rate payments (usually LIBOR linked). For shipowners with LIBOR linked borrowings, a swap can be used to transform the floating rate facility into a fixed rate loan. The shipowner will receive a floating rate payment on the swap which offsets the floating rate interest cost on the borrowings. The fixed rate paid by the shipowner on the swap becomes the effective cost of borrowing and provides protection against rising interest rates.

Floating rates are tied to an index which is usually the London Interbank Offered Rate (LIBOR).[^5] LIBOR is the rate at which the bank is willing to place deposits, which are usually set daily by a bank’s London branch.

The spread in interest rates is the difference between the cost of money to the lender from other sources and the payment by the owner.

Interest Rate Swap

A deal between banks and companies where borrowers switch floating-rate loans for fixed rate loans. The advantage to this is that one company may have access to lower fixed rates and the other company may have access to lower floating rates – so they trade.

---

[^5]: London Interbank Offered Rate. LIBOR interest rate fixings for a variety of currencies are determined each business day at around 11:00 AM London time. These rates are used to determine the floating rate payments on a wide variety of derivative instruments.
Swap
Interest rate swap – most common type swap called “plain vanilla” swap. They typically exchange fixed rate payments against floating rate payments. The principals are not exchanged, and are known as the notational principal.

A derivative where two counter-parties exchange a stream of interest payments (at a fixed rate) for (a floating rate). The two streams of payments are called “legs”.

Party A agrees to pay Party B periodic interest rate payments of LIBOR + 50 bPS (bPS = basis points = 0.05%) in exchange for periodic interest rate payments of 3%. There is no exchange of principal amounts and interest rates are on a “notional” (i.e. imaginary) amount. Interest rates are settled in NET (e.g. if LIBOR + 50 bPS is 1.2%, then Party A receives 1.80% and pays B nothing).

SPREAD
• Difference between cost of funds to the lender and the borrower.
• Based on:
  - Credit worthiness of owner
  - Risk in shipping operation
  - Size of loan
  - Period of loan
  - Type and amount of security
  - General supply and demand for loans

Ship financing is usually carried out in U.S. or Euros, the currency of most charters or freight earnings. However, when income is in another currency, the owner should be aware of the risk, should structure the loan in that currency, buy that currency ahead in the futures market (although this is an expensive alternative, if at all available in a long term loan) or otherwise provide for multi-currency risks.

Interest
1. Maybe fixed or fluctuating with market interest rates.
2. Spread is different between cost of money to lender from other sources and revenues from borrower.
3. Spread determined by:
   a. Financial standing of borrower
   b. Risk of Venture
   c. Amount and type of security
   d. Amount of loan
e. Period of loan
f. Supply and demand for loans

4. Spread is typically 1½ to 2½% (but could be lower).
5. “Standard Interest Cap” can be provided by a bank to protect owner from rising interest rates (obviously for a cost).
6. “Participating Interest Cap” – paid over life of loan, but rate is based on the downside benefit borrower receives from low rates.
7. Bank may sell a “floor” to the borrower.
8. The combination of the cap and floor is a “collar.”
9. Banks tend to deal in floating rates.
10. Pension funds and insurance companies in fixed rates.
11. “Interest Rate Swap” – institutions trade float and fixed rates to balance funds.

Currency
1. Single Currency Borrowing
2. Multi-Currency Borrowing
4. Most conservatives are revenues and interest and principal payments in same currency.

Security
1. “First” or “Preferred” Mortgage
   – Filed with authorities in homeport.
   – Noticed on ships registry papers.
   – Notice to interest parties of this “mantime lien.”
   – Asset can be easily repossessed.
2. Second Mortgage
   – Additional mortgage taken on another ship in fleet, or
   – subordinated mortgage on the vessel lent against.
3. Assignment of Income
4. Assignment of Insurance
   – (hull, machinery, P&I, War Risk, loss of earnings and increase in value policies assigned to lender).
5. Corporate Guarantee
6. Personal Guarantee

7. Security Maintenance Clause (or “Asset Protection Clause”) kicks in if the second value of the asset falls too low – owner then must come up with additional security.

**Derivatives**

A derivative instrument is a financial product whose value changes with a variation in one or more underlying market variables, such as foreign exchange or interest rates. For example, the value of a currency option changes with movements in the exchange rate.

**Why Derivatives?**

They allow shipowners to minimize the negative impact of changes in interest or exchange rates. For instance, floating rate loans or deposits can be fixed and the value of receivables or payables in foreign currencies can be guaranteed in advance. Derivatives are also used to precisely tailor investment products for owners.

**What are the key derivative products?**

Interest rate swaps and options and foreign exchange options. These basic building blocks underpin the majority of the derivative instruments.

**6.3 Leasing**

Leasing is a method for increasing assets without equity input from shareholders. It is also a method for an owner to trade away tax advantages (such as depreciation) which he is unable to use.

**LEASING**

- Operating or Service Lease
- Finance Lease

There are two types of leases, “operating” and “finance” leases. The ship operating lease is a time or voyage charter whereas with a finance lease, the lessor is only responsible for finance; the lessee is responsible for insurance and all operating costs.

**LEVERAGED LEASES**

Most ship leases are leveraged leases.

<table>
<thead>
<tr>
<th>Owner</th>
<th>Lessor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides equity portion of funding</td>
<td>Provides debt portion</td>
</tr>
<tr>
<td>Retains ownership</td>
<td>Holds mortgage</td>
</tr>
<tr>
<td>Make lease payments</td>
<td>Receives assignment of lease payments</td>
</tr>
<tr>
<td></td>
<td>Tax benefits</td>
</tr>
<tr>
<td></td>
<td>Residual at end of lease (sometimes)</td>
</tr>
</tbody>
</table>
There are two types of leases, “operating” and “finance” leases. The ship operating lease is a time or voyage charter whereas with a finance lease, the lessor is only responsible for finance; the lessee is responsible for insurance and all operating costs.

Most ship leases are leveraged leases where investors provide funds (equity portion) for a portion of the ship’s cost and the debt portion is secured by a mortgage and assignment of lease payments. Lease payments cover the debt service and a return to the investors, who also may receive tax benefits and a residual portion of the vessel at the end of the lease.

### OFF-BALANCE SHEET FINANCING
- Indebtedness does not show on balance sheet.
- Usually done through chartering
Not legal in U.S. nor GAAP.

Off balance sheet financing is a method in which neither the asset nor the indebtedness appears on the books of the lessee. Hence, the lessee is able to incur an increased amount of debt. For many years, in the U.S., the major tanker fleets and the major oil companies engaged in chartering, particularly with the view that the charters would not appear on their balance sheet and encumber further borrowing. U.S. laws and GAAP now prohibit this practice, although it is to be found in many parts of the world. Nevertheless, sophisticated lenders, in doing their due diligence searches, always ask for details of any existing charter obligations.

**Leasing General**
1. A way of increasing assets without equity input from shareholders.
2. Commitment often does not appear on balance sheet.
3. Doesn’t have long term commitment (sometimes) hence company can increase debt.
4. Owner cannot take advantage of shifting asset values (i.e. buying and selling).
5. Tax benefits.
6. Often trading houses buy the vessel and offer them out on charter.

**Leasing**
1. Finance Lease
2. Service Lease (or Operating Lease)
3. Off Balance Sheet Financing
   Asset does not appear on balance sheet of lessee nor long term liability.
   (Hence lessee can increase debt.)

4. Trans-national leasing arrangement

6.4 Equity Financing

Another source of financing funds is from equity; equity in the sense of ownership in or shares in the profits or future value of a business.

EQUITY – GENERAL

1. Sale of assets.
2. Issuance of stocks and shares.
3. Investment banks and stock brokerage (security) houses most active.
4. Difficulty in raising equity funds due to shipping being so risky.
5. Suitable for companies “all borrowed up” or with risky ventures.

<table>
<thead>
<tr>
<th>SOURCES OF EQUITY FUNDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Retained earnings</td>
</tr>
<tr>
<td>• Cash Flow</td>
</tr>
<tr>
<td>• Sale of Assets</td>
</tr>
<tr>
<td>• Sale of stock</td>
</tr>
<tr>
<td>- common</td>
</tr>
<tr>
<td>- preferred</td>
</tr>
<tr>
<td>• Limited partnerships</td>
</tr>
</tbody>
</table>

The cruise ship industry has expanded rapidly during the 1980’s and 1990’s, with a concurrent demand for capital that traditional bank credit sources have been unable or reluctant to supply. Consequently, the cruise industry turned to the equity markets, with Carnival “going public” in 1987, and RCCL and Kloster raising significant quantities of money through securities.
Funds for ship acquisition might come from:

a. Retained earnings
b. Cash flow
c. Sale of assets
d. Sale of stock
   - Preferred
   - Common
e. Limited partnerships

SALE OF STOCK

- Public Offering
  - Strict government controls
  - Rigorous accounting
  - Expensive
  - Time consuming

- Private Placement
  - Insurance Cos. (casualty and property)
  - Mutual funds
  - Finance cos.

IPO’S – INITIAL PUBLIC OFFERINGS

1. The surge in IPO’s matched the expansion in trade with China.
2. 2001 - $393 million – 4 deals
   2005 – 6.07 billion – 27 deals
   2006 – 2.28 billion – 14 deals

The sale of stock to the public is a difficult and complex undertaking and becomes realistic only with larger ship owning companies or in large ship acquisition transactions. In most countries, the sale of securities is controlled by strict laws, for example, in the U.S. the Securities and Exchange Commission (SEC) requires rigorous accounting methods (GAAP – generally accepted accounting procedures), disclosure requirements, etc. The floating of stock issue is expensive, time consuming and requires government review and approval. Nevertheless, many owners, particularly tanker and cruise line owners are resorting to this opportunity.
Many companies enter IPO (initial public offering) market for Ship Acquisitions.

New issuers use IPO funds to:

a. Reduce debt from fleet expansion.
b. To “cash out” original investment
c. Acquire additional ships.
d. Reduce debt from initial start up costs.
e. Build cash reserves.
f. Increase company’s value.
g. Make easier to expand through mergers and acquisitions.

NY Stock Exchange (NYSE) and NASDAQ are the chosen exchanges.

Stock exchanges:

<table>
<thead>
<tr>
<th>Exchange</th>
<th>Cos.</th>
<th>Capitalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>NYSE</td>
<td>(1)</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1) $60.5 B</td>
</tr>
<tr>
<td>NASDAQ</td>
<td>(2)</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(7) 7.0</td>
</tr>
<tr>
<td>Oslo</td>
<td>(3)</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4) 12.5</td>
</tr>
<tr>
<td>Tokyo</td>
<td>(4)</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3) 22.5</td>
</tr>
<tr>
<td>Singapore</td>
<td>(5)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(9) 6.5</td>
</tr>
<tr>
<td>Copenhagen</td>
<td>(2)</td>
<td>41.7</td>
</tr>
<tr>
<td>Malaysia</td>
<td>(5)</td>
<td>92</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>(6)</td>
<td>7.6</td>
</tr>
<tr>
<td>Taiwan</td>
<td>(8)</td>
<td>6.6</td>
</tr>
<tr>
<td>S. Korea</td>
<td>(10)</td>
<td>4.9</td>
</tr>
</tbody>
</table>

IPOs offer investors an opportunity to invest in companies with high growth potential and significant returns.

PRIVATE EQUITY

Private equity is a form of specialty finance usually provided: to take firms off a stock market; to allow management to buy out a firm from its founders; to hive off a corporate division from its parent company; or to help large unquoted companies grow.
The managers of big buyout funds tend to invest in companies that have good growth prospects and the ability to pay large amounts of bank debt (‘gearing’).

Capital is pumped into the company alongside the equity finance provided by the fund.

Really big fund managing groups, such as Carlyle, resemble conglomerates, with interests in diverse sectors such as transport, aero-space, healthcare, travel, property and telecommunications.

At the opposite end of the scale is venture capital, which usually refers to cash ranging from a few hundred thousand to several million dollars being channeled into small, growing technology firms, in return for an equity stake.

Debt is rarely used by venture capitalists, who in the distant past helped back start-ups such as Federal Express, Compaq and Microsoft.

A second method of selling shares for shipbuilding finance is through the private placement market, i.e. to such institutions as property and casualty insurance companies, private and public sector pension funds, mutual funds, and finance companies. Smith states that the funds available in the private placement market are enormous ($100 billion in 1991). They to access to this market is for an owner to find an agent or advisor with a strong record of success in this field, and to gain acceptable credit ratings for the shipping transactions being put forward. Overseas Shipholding Group and Stoldt Tankers are two shipowners who in 1992 raised substantial financing in the private placement market ($200 million in the case of OSG).

**GOING PUBLIC (Equity Financing)**

1. First public listing - Dutch East India Co. – 1606
2. During 1990s, shipping companies entered capital markets in a big way.
3. By November 2006:
   a. 180 shipping companies listed.
   b. On 37 stock exchanges.
   c. Operating a fleet of 8,645 ships.
   d. Representing 35% of global fleet.
   e. Combined market capitalization of $209 billion.
EQUITY SOURCES

To summarize

1. Common Stock
2. Preferred Stock
3. Limited partnerships between shipping companies and banks forming “limited partnership companies” to raise money on stock market.

6.5 Hybrid Financing Schemes

- Convertible debt
- Debt with warrants
- DIFKO (Danish)
- KG System (German)
- Blocked currency schemes
- Barter deals

There are a number of hybrid ship finance schemes which do not fit under the simple debt or equity categories. These methods work for companies whose stock prices are extremely low, given future expectations. They include:

a. **Convertible debt** – where the holder has the right to convert to common stock at a particular price in the future.

b. **Debt with warrants** – where the holder has the right to buy common stock at a particular price in the future.

A unique, government sponsored hybrid scheme is:

c. **DIFKO** – This is a limited partnership with tax benefits sometimes called the Danish “Money Machine” A Danish tax investment company which finances ships built in Denmark using a three-tiered arrangement, namely:

   - A K/S partnership (K/S stands for Kommanditt selskap, a limited liability partnership with tax benefits).
   - Ship finance credit.
   - Danish Bond Scheme (where the owner places his capital on deposit and takes out a loan at a lower rate – the difference between the ship interest credit rate and the long term bond rate). Owner places his capital on deposit and takes out a loan at a lower rate.

d. **THE KG SYSTEM** – the KG System is a German limited partnership system available to German tax payers for German flag vessels, which holds individuals liable only for the amount of their investment. The benefit to German taxpayers, especially those in the higher tax
brackets is that they can take tax deductions accruing from investment losses (mainly depreciation). This accelerated depreciation, Sonderabs Schreibung, permits an additional 40% on top of the 8.33% in the first year and 82% in the first five years.

**KG Financing**

1. “Kommand It Gesselschaft” is a limited partnership.
2. Equity financing from “retail” high-net worth individuals (i.e. doctors and dentists).
3. 60-70% from bank sources.
4. 30-40% from equity retail investors.
5. 12-25 year investment periods.
7. Mostly smaller vessels.

**AG** is an incorporated company.

A KG alternative – same as KG, but the equity investors are institutional investors such as insurance companies.

**German KGFund Structure**

(“Kommandit Gesellschaft”)

- **Investors**
- **Shipping Trust**
- **Commercial Manager**
- **Technical Manager**

Shareholders:

- General Partner – “KOMPLEMENTAR” bears unlimited liability.
- “KOMMANDITST” – Limited partner liable only to extent of his investment.

Vessel purchased by 35% equity from investors.

German tax law - deductible changing
e. K/S (Kommandit Selskab) and K/G (Kommaudit Gesellschaft) Schemes limited partnerships for high income investors (partners) who enjoy the benefits of tax loss of gains.

f. Blocked Currency Schemes – where multinational companies find themselves with profits in countries that prohibit the export of their currencies. In such cases, where the countries have shipbuilding industries, these companies are able to provide local funds to finance the building of ships for export (such as in the Polish-PepsiCo International construction of bulk carriers, and McDonnell-Douglas’ financing assistance to Del Monte on their Spanish-built refrigerated cargo ships during the 1980’s.

g. Barter Trade Deals – usually done on a government-to-government basis where basic commodities such as grain, oil, natural gas, etc. are bartered for manufactured goods such as ships.

6.6 Ship Finance Intermediaries

Because of the changing nature of the financial markets, the availability of a great variety of alternative methods to financing a ship, the large number of risks to the lender, the international nature of the work, etc., it is clear that ship finance can be a complex undertaking.

Large shipping companies with well established banking relations are usually experienced in ship finance, and are able to use their banking connections effectively. However, smaller ship owners, first-time buyers or large companies with limited financial capabilities find it convenient to use ship finance intermediaries. These professionals search out financing sources, make introductions, assist in the preparation and the presentation of finance documents. They are primarily based in the large commercial banking centers, London and New York.

6.7 Government Grants

- Loans
- Loan guarantees
- Subsidized interest rates
- Cash grants (owner or builder)
- Cash or credit to allied industries
- Operating subsidies
- Favorable tax treatment
- Moratoria on debt repayment
- Training funds
Government Grants

Financing assistance from government sources is done to aid and stimulate domestic shipbuilding or domestic shipping. Such assistance takes many forms and these include but are not limited to:

a. Government loans
b. Subsidizing interest rate
c. Cash grant to owner
d. Cash grant to shipbuilder
e. Cash or credit to allied industries
f. Operating subsidies tied to shipbuilding agreement
g. Favorable taxation incentives
   1. Lower or no taxes
   2. Deferrals
   3. Write-off of previous loans
   4. Accelerated depreciation
   5. Tax-free reserves
h. Guarantee of private loans, i.e. risk transfer
i. Favorable loan terms
   1. Low interest rate
   2. Long grace period
   3. Little or no down payment
   4. More than 100 percent financing
   5. Repayment out of profits only
   6. Long loan term
   7. Balloon payment at end of loan
   8. Little or no security or collateral required
j. Write-off of previous losses
k. Moratoria on debt repayment
l. Training funds
m. Custom duties waived on imported materials
n. Shipbuilding research and development funds
o. Vessel scrapping subsidies

p. Grace period before repayment

Many of these methods, such as cash grants and loans, directly affect ship financing. The financial viability of the remainder indirectly affects the ship acquisition program.

With the excess of shipbuilding capacity, worldwide, governments have created and participated in these many subsidy schemes to assist their domestic shipbuilding industries. They also institute these programs to aid their merchant shipping industries. Many countries with liberal social philosophies (i.e. Norway) see this as a method for both stimulating and aiding developing countries.

In an effort to control what had become shipbuilding “cutthroat competition” or “runaway” government export subsidy programs, about 30 years (1968) OECD formed the first treaty to limit the loan percentages, terms and interest rates on shipbuilding loans. The European Union has instituted similar limitations, particularly in government grants to shipyards, in recent years. Both are working to eliminate government shipbuilding subsidies altogether.

At this time, domestic shipping subsidies and aid to developing countries is not the target of these efforts.

Subsidy Issues

2004 (Feb. 12, 2004 Lloyd’s List)

1. In 2004 there was a subsidy war, principally between


3. The arena is WTO – The World Trade Organization.

4. European governments have been paying a 6% subsidy to their Shipbuilding Industries – and extending this “Trade Defense Measure” one more year.

5. S. Korea is also targeting export credits.

6. Examples of such subsidies include:
   - Operating aid
   - Restructuring aid
   - Insolvency and closure aid
   - Aid for regional or other investment
   - R&D aid
   - Aid for environmental protection
6.8 Ship Finance Documents

Paine provides a catalog of the documents that the prospective shipowner should present to the potential lender. These include:

1. Background memorandum
   a. Company ownership
   b. Corporate structure
   c. Company history
   d. Current and future strategy
   e. Management team
   f. Business or operating philosophy

2. Transaction details

3. Vessel details

4. Shipbroker valuations (if any)

5. Borrowers financial statements

6. Corporate guarantor’s financial statements

7. Personal guarantor’s financial statements

8. Fleet list and employment details

9. Cash flow forecast

10. Proposed time charters (if any)

11. Proposed ship construction contract

12. References from bankers, brokers, charterers, suppliers, agents, etc.

6.9 Basel Accords


1988 - International banks were required to maintain adequate capital to cover credit risks.

- Take a more cautious approach by penalizing risky lending.

- An 8% capital allocation must be set aside by every bank for every transaction.
2. Basel II “2004 Capital Accord II”

2006 - Best quality deals (i.e. double or triple A ratings, long term deals for oil company majors) only a fraction of the Basel I 8% need be set aside, for example only 1.6%.

- Shipping deals are not regarded as so credit worthy – i.e. rated B+ to B- will require banks to set aside say 12%.

- Loans to ship owners who are speculating on employing new ships in the spot market will require banks to set aside even more capital.

3. The effects, especially on second-tier (more risky or smaller owners) will be to

Increase the cost of loans.

Reduce the number of banks willing to lend.

A reduction in lending capacity.

6.10 Hedge Funds

Hedge funds are legal structures that enable their managers to pursue an almost limitless range of investment strategies toward the objective of achieving an absolute return objective. This is one of several important differences between hedge funds and mutual funds, where managers’ performance is measured against one or more indexes. Definitionally, the term hedge fund refers to funds that use one or more alternative investment strategies, including hedging against market downturns, investing in asset classes such as currencies or distressed securities, and utilizing return-enhancing tools such as leverage, derivatives, and arbitrage, among others. Extending their reach far beyond traditional asset classes by employing the entire spectrum of investment techniques with no holds bared is another differentiator of hedge funds from traditional mutual funds. Some hedge funds apply none of the more esoteric strategies while others will use many of them.

Alternative investment is private investment partnerships that loosely comprise private equity, venture capital, leveraged buyouts, distressed securities and other illiquid assets. In addition to partnerships, LLC structures are also used in the U.S., and some new hedge funds are now being organized as bona fide mutual funds to broaden the market base. Offshore hedge funds
may assume corporate or other investment company forms, always organized in a tax haven and sometimes traded on a foreign stock exchange.

Today, the thousands of hedge funds employ dozens of strategies. Lack of regulatory oversight makes it difficult to count or categorize them all, but the Internet is making it easier to find the funds that want to be found. Many don’t since their investment strategy, indeed their very existence, is rooted in secrecy.

A more complete categorization of strategies, though by the hedge fund definition of ever moving and often secretive, never complete, appears in the glossary to this article:

- arbitrage
- emerging markets
- market-neutral
- opportunistic
- short-selling
- small-cap
- special situations
- value

The Sharpe Ratio

The Sharpe Ratio is a measure of the risk-adjusted return of an investment. It was derived by Professor William Sharpe, now at Stanford University who was one of three economists who received the Nobel Prize in Economics in 1990 for their contributions to what is now called “Modern Portfolio Theory.” It is a non-dimensional figure computed by dividing an investment’s “excess” return (ROI – risk-free borrowing rate) by the volatility of the return in terms of its standard deviation:

$$SR = \frac{ROI - RFR}{STD OR ROI}$$

Sharpe Ratios are included for the hedge fund strategies presented in Figure 3.

Higher SR is superior and is achieved by

1. A high success ratio
2. A positive and wide spread between largest gain and loss, and
3. A positive and wide spread between average gain and average loss.

Hence, an investment strategy that has a good success ratio, but its losses tend to be disproportionate with its gains, will not have a high Sharpe Ratio over long periods of time. But simply achieving just a positive spread between gains and losses is not enough either, nor is staying on the sidelines, which earns no more than the risk free rate on capital. Simply stated, to achieve a
high Sharpe Ratio, a money fund manager has to win more often than lose, the winners have to be proportionately larger than the losers, and the spread has to be achieved consistently.

The end game is the same for shipping, or for any other business enterprise, for that matter. What is interesting about the Sharpe Ratio is that in a single figure or score it provides a measure of financial return against the risk incurred to attain it. Shipping would benefit immensely from adoption of the Sharpe Ratio since, return on an asset being indifferent to how it is financed; the only way to increase the Sharpe Ratio is for the incremental cost of debt to be lower than the incremental increase in volatility of return produced by taking on debt. In other words, the money managers and their score keepers long ago learned that quality of earnings is as important as ROE itself, when consistency of returns is valued. Without measuring, and hence managing the risk, it’s just gambling. The Sharpe Ratio helps identify under-performing risk managers of hedge funds, and it could do the same for shipping.

Shipping at its very highest levels is really a finance game. Let the clarion call to devise a ranking system for shipping comparable to the Sharpe Ratio be received eagerly in London, Oslo, Piraeus, Hong Kong, New York and other centers of maritime learning.

Source: Marine Money, Geoff Uttmark

6.11 Islamic Bank Finance

1. Based on traditional Islamic principles.

2. Desire on part of Muslim governments and businesses to use funds and revenues, particularly from petro-chemicals, i.e. petro dollars, to assist in
   a. Development of infrastructure in Muslim countries and
   b. aid Muslim owned businesses
      in a manner consistent with Islamic values.

3. Islamic banks have a large, stable customer base in most Muslim countries, but particularly
   - Bahrain
   - Kuwait
   - Oman
   - Qatar
   - Saudi Arabia
   - UAE
   - Iran
   - Pakistan
   - Malaysia
   - Nigeria

4. …Who do not expect nor desire an interest-based rate of return on deposits.
5. Islamic Banking – a general term for the investment of money according to Islamic Law (“SHARIA”).

6. A basic feature is that
   a. Receipt and payment of interest (“RIBA”) is prohibited.
   b. Any return on funds employed by the Islamic bank be earned by way of profit derived from a commercial risk taken by the Islamic Bank.

7. i.e., the bank shares in the risks and rewards of the venture undertaken by the customer.

8. Therefore, the bank’s return is based on the customer’s success rather than an income stream based on financial market interest rates.

9. Financing can be made available to projects that do not contradict Islamic principles – i.e. alcohol, gambling related activities.

10. Some western banking practices are prohibited under Islamic banking principles, i.e.
    a. currency futures
    b. forward trading

    because they are considered speculative, i.e. gambling and also because they treat currency (trading) as a commodity. Under Islamic banking money is not regarded as a commodity such as wheat or oil. It must be put to use for productivity.

11. Currency swaps are acceptable providing there is no interest-rate swap.

12. Islamic banking market in the Gulf is currently $200 billion and increases 30% annually.

13. Depositors place their funds on deposit interest-free, and receive a share of the bank’s profits.

14. Islamic banks benefit greatly from the inherently low cost of funds available to them from depositors.

15. Banks have boards of Islamic scholars to review methods and operations.

16. Islamic banks have difficulty managing liquidity positions (especially short term).

MURABAHA  Cost-plus method for project financings.

MUDARABA  Fund where customers subscribe to fund – where bank manages investment. Percentage of profits go to investor-customers. Bank charges fees. Shares in funds can be bought and sold.
<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IJARA</td>
<td>Equivalent to leasing. Bank purchases asset and rents to 3rd party.</td>
</tr>
<tr>
<td>ISTISNA</td>
<td>Islamic institution places order to build project and sells on agreed terms.</td>
</tr>
<tr>
<td>MUSHARAKA</td>
<td>Provides venture capital by establishing a special purpose company. (Bank and customer are shareholders and share profits and losses.)</td>
</tr>
<tr>
<td>MUQARADA</td>
<td>Bank issues bonds to finance projects.</td>
</tr>
<tr>
<td>BEIBI</td>
<td>Forward financing transactions to provide working capital to buy raw materials. SALAM identifies the goods.</td>
</tr>
<tr>
<td>SALAM/BEI</td>
<td>BISALAF</td>
</tr>
<tr>
<td>BISALAF</td>
<td>SALIF refers to goods in general generic terms. (The goods must exist at time of sale.)</td>
</tr>
<tr>
<td>BEIAL</td>
<td>Acceptable only to Hanbali school of Islamic jurisprudence, an Islamic option. Islamic investor purchases goods on behalf of real purchaser and keeps 10% of real purchaser’s deposit.</td>
</tr>
<tr>
<td>URBUN</td>
<td></td>
</tr>
<tr>
<td>MUSQOT</td>
<td>Irrigation financing.</td>
</tr>
<tr>
<td>MUZARA’A</td>
<td>Farming equipment financing, where farmer supplies the farm land, labor, management and shares in profits with bank.</td>
</tr>
<tr>
<td>JOALAH</td>
<td>Simply a fee for rendering a service.</td>
</tr>
<tr>
<td>GCHARAR</td>
<td>Uncertainty – excessive uncertainty, risk or ambiguous outcome.</td>
</tr>
<tr>
<td>MAYSIR</td>
<td>Gambling is used to criticize insurance or derivatives.</td>
</tr>
<tr>
<td>RIBA</td>
<td>“Increase, growth,” usuary, interest.</td>
</tr>
</tbody>
</table>
6.12 International Finance

Definitions

• Exchange Rate: Price of one currency in units of another currency.
• Bid Rate: Price at which a dealer is willing to buy a given currency.
• Ask Rate: Price at which a dealer is willing to sell a currency.
• % Bid/Ask Spread = \( \frac{\text{Ask rate} - \text{Bid rate}}{\text{Ask rate}} \times 100 \).
• Direct Quote: U.S. dollar price of 1 unit of foreign currency.
• Indirect Quote: Foreign price of one U.S. dollar.
• Spot Rate: Exchange rate of a currency for immediate delivery. Settlement within one to two business days.
• Forward Rate: Exchange rate of a currency with delivery at some point in the future.
• Cross Rate: An exchange rate between two currencies other than the U.S. dollar.

Foreign Currency Financing

The effective financing rate of using a foreign currency over a single period is given by:

\[ r_f = (1 + i_f) (1 + e_f) - 1 \]

where \( i_f \) is the foreign currency interest rate per period, and \( e_f \) is the expected percentage change in the spot rate (dollar price of 1 unit of the foreign currency) over the period.
7

CONTRACTING

7.1 General

The next step in the ship acquisition process involves the establishment of a legal relationship between the buyer (owner) and seller (shipyard). This relationship is the shipbuilding contract.

The contract to build one or more vessels is a very complex undertaking, and as such should be approached with great care. It is complex because:

1. It is usually an international transaction, which may involve the laws and regulations of one or more countries or jurisdictions.

2. It involves an agreement to construct (and hence embodies some features of construction or building contracts), and the provision of services and the sale of goods, all with different implications under the law. In the UK and the U.S., a shipbuilding contract is regarded as a contract for the sale of goods. The goods are viewed as future goods (as they are yet to be manufactured).

3. The transaction may involve more than two parties, especially depending upon the complexities of the vessel financing.

4. The contract involves a considerable amount of money.

CONTRACTING

- Written (usually)
- Involves legal advice and assistance
- Often starts with “Heads of Agreement” and a “pro forma” contract
- Sometimes letter of understanding

Shipbuilding contracts are usually in written form, and in fact, some jurisdictions require them to be in writing. However, some contracts are oral. Some are even formed by merely the actions of the parties. Therefore, even during the bidding and negotiating phases of the ship acquisition process, actions may be taken that will be considered legally binding.

It is for these and other reasons that the prudent ship owner and shipyard will avail themselves of the services of attorneys skilled and experienced in shipbuilding contracts. This advice and assistance should be sought (and heeded) early in the program, when the commercial phase begins. The lawyer is usually a useful participant during the commercial negotiations, and is
essential if a pro-forma contract, heads-of-agreement and/or letter of intent is used.

There is often the temptation by an owner’s technical staff to use one of the deceptively simple standard form contracts by merely filling in the blanks. Even worse is the re-use of earlier contracts, without consulting attorneys. Changes in law, tax regulations, differences in jurisdictional interpretations, etc. can lead to serious errors.

Fisher claims that over the last 20 years, they have seen a surprisingly large number of contracts which could at best be termed amateur. “Ship construction…contracts developed by amateurs are the ones most likely to result in contractual disasters” and exhibit the result of poorly prepared contracts, namely delays, cost overruns and litigation.

**DELIVERY AND ACCEPTANCE**

The concept and execution may vary in different jurisdictions and under different contracts. Title could pass either when:

- physically delivered
- at another time, if both parties contractually agree
- vessel registered
- execution of bill of sale
- when both parties so declare
- when ship is in a “deliverable” state
- bill is paid
- Progressively as the builder completes his performance.

**SHIPBUILDING IS GOVERNED BY MANY LAWS**

- Contract law
- Other laws:
  - tort
  - fraud
  - negligence
  - environmental
  - etc.
7.2 The Law

The making of a contract is a legal act, and as such, is governed by law. Not only is the contract governed by law, but the actions of both parties during the negotiations, contracting and construction are also subject to laws other than contract law, such as tort, fraud, negligence, etc.

Society has created a system of rules to regulate and control such transactions called “law”. The concept has evolved over thousands of years and the term “law” has many meanings. It varies from culture to culture, society to society. However, what it has in common is that it is “the philosophy of what society feels is the right and proper way to behave.” It is also a formalized code of conduct.

The Winston Dictionary defines law as “a binding rule of action established by authority with the intent of enforcing justice.” Other authorities, similarly define law as rules of civil conduct that which commands what is right and prohibits what is wrong, that which must be obeyed, subject to sanctions or legal consequences.

The first known laws date back to the tablets of Eshnuma (3800 BC) and the Babylonian laws of Hammurabi (1800 BC). These were spread throughout the Mediterranean by Babylonian traders. They greatly influenced Roman law – the Twelve Tables (450 BC) and the emergence of civil law, when Emperor Justinian codified Roman law (approximately 534 A.D.).

After the Dark Ages, two major systems of law developed, common law, with its origins dating back to the centralized administration of William the Conqueror (1066), and the more codified civil law of Romano-Germanic traditions. The principal system of law to be found in England and the United States is common law, a system which has evolved from the Middle Ages and which is a “body of early customary law, based on judicial decisions and embodied in reports of decided cases.” The French, German laws and those of many other European countries are modeled after the Justinian system which is codified Roman Law. The Russian Code is in turn based on these codes.

Contract law had its origins in sixth century AD Justinian codes. It re-emerged in Western Europe from the thirteenth century AD out of necessity with the development of commercial trading and industry. However, contract law, like many other branches of law, began to diverge between England and the continent. Contract law in England followed common law whereas, on the continent it was built around a more formal civil law, the idea that something more than “an informal expression of agreement was required if a contract was to be upheld in court.”

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6 “The customs of Southern France were codified in 1453, and modified Roman law became the main source of Imperial German law in 1495.” Encyclopedia Britannica – Micropaedia, Vol. 4, Page 1000.
Business or commercial law is not a precise legal term, in the Anglo-American system. Pearson regards it as a generic term applying to transactions in the commercial world and includes many divisions of law such as contract, agency, sale of goods, competition, torts (such as unfair trading or product liability), etc. On the continent of Europe, commercial law is distinctively superimposed on the civil law applying to all persons. In the case of the German Commercial Code (which also influenced those of Austria, Bulgaria and Hungary) it is subjectively applied to defined merchants; whereas under the French code, (including Belgium, Greece, Luxembourg, Portugal and Spain) it is applied objectively, i.e. to the commercial transactions. Many civil law countries, such as Italy, Netherlands, the Scandinavian countries and Switzerland do not have separate commercial codes.

“Continental mercantile law, which contains Roman law elements, was absorbed into English law.” “Continental law has also contributed to some of the (English) rules of contract, such as the effect of mistake.” “Commercial law (in England), with its Sale of Goods Act (1893), has become the domain of legislation.” In England, the mass of case law was codified into the Bill of Exchange Act in 1832 and the Sale of Goods Act 1893, and in the United States commercial law is tied to the Uniform Commercial Code and replaced a patchwork of trading laws in every U.S. state except Louisiana.

In addition to the two broad categories of law, common law and civil (statutory) law, there are specific branches of law such as international law, constitutional law, municipal law, administrative law, criminal law, tort law, etc. Only some apply specifically to shipbuilding, such as commercial and contract law.

The field of Admiralty law which draws heavily on Greek, Roman and Italian law, normally deals with maritime matters occurring after the construction of a vessel, such as charter parties, errors in navigation, injury to seamen, etc. Shipbuilding is not the subject of Admiralty law.

While shipbuilding is often a transnational commercial activity, it is not the subject of international law which usually deals with matters involving the relations of nations.

Similarly, criminal and tort law are not normally matters relating to shipbuilding, unless the actions of one of the parties violates such criminal statutes that would result in fraud or criminal negligence in the design or construction of the ship. Labor laws (in the employment of workers), environment law (during construction), municipal law or other local ordinances (in the operation of the shipyard), etc. are all matters of direct concern to the builder, but not to the buyer, unless they effect the timely construction and delivery of the ship.

Of greatest importance in the shipbuilding acquisition process is contract law.
7.3 **Contracts**

**CONTRACT**

- A promise enforceable by law.
- “A contract is a promise or set of promises for the breach of which the law gives a remedy, or the performance of which the law in some way recognizes as a duty.”
- *Pact Sund Serventa* (Promises made must be kept)

The word “contract” has been defined by authorities in many ways. Simply, it is a promise enforceable by law. *Pact Sund Serventa* (a promise should be binding) was an ancient and is a modern rule that agreements are to be observed.” “The concept of promise has been the greatest tool ever invented by the human race.” Keyes says a slightly more expanded definition of a contract is:

“A contract is a promise or set of promises for the breach of which the law gives a remedy, or the performance of which the law in some way recognizes as a duty.”

Some jurisdictions (English law, for example) require that contracts for the sale of goods (ships for example) must be in writing, when the value of the goods is above a stated amount.

The subject of contract law is regarded as one of the more difficult. Stone points out that fundamental areas such as “consideration” and “priority,” can in fact be complex; where case law can be inconsistent, (such as in “mistake”), where common law and equity can be inconsistent (for example in “estoppel”) and where inconsistencies occur between common law and statute (as in “exclusion clauses”).

Regardless of under which jurisdiction the contract is made, there are several fundamental requirements for a contract to be valid.

**CONDITIONS FOR A CONTRACT**

- An offer
- An acceptance
- Consideration
- Intent to create a legal relationship
- In writing (sometimes oral)
- Parties are competent
- Form required by law
• Not impossible of performance
• Not contravene law or public policy

AN OFFER
• Complete
• Free of ambiguities
• Properly communicated
• Fixed time of acceptance (or kept open for a reasonable time)
• May be revoked
  – before acceptance
  – providing offer provides for notice of revocation.

There must be an offer by one party and an acceptance by the other. The offer and acceptance, which are promises, form the basis of the agreement. Depending upon jurisdiction, for example in the U.S. and UK, the agreement need not be in writing (although it almost always is) to be a valid contract. It may be oral or it may result from the actions and intentions of the parties. Therefore, it is of vital importance that all action taken by the parties during and after the tendering process by treated with utmost care and with expert legal advice.

AN ACCEPTANCE
• Creates the binding contract
• Must be absolute and complete
• Qualified or conditional is NOT an acceptance (it is a counter offer).
• Silence is NOT an acceptance.

CONSIDERATION
There must be some consideration. On one hand, the builder (seller) commits himself to build and deliver the vessel. The owner (buyer) makes a financial commitment and usually makes a down payment upon signing of the contract.

The fourth requirement is that the parties must intend to create a legal relationship. In some non-shipbuilding activities this is an important distinction. However, because of the many steps taken, previously described, and which occur during tendering and negotiations, the intent of the parties in a shipbuilding project are usually quite clear.

Shipbuilding contracts are usually “express contracts” (stated in writing or orally) rather than “implied contracts.” They are “bilateral contracts,” where both parties mutually promise, one to build and deliver a vessel and the other to pay.
In order to form a valid contract, several elements are necessary. They include:

1. The parties must be competent.
2. The parties must express definite assent in the form required by law.
3. There must be an offer.
4. There must be an acceptance.
5. The agreement must be supported by consideration.
6. At the time of contract, it must not be impossible of performance.
7. It must not contravene law or public policy.

The offer must be complete and free of ambiguities. It must be properly communicated to the offeree (buyer). The offer should provide for a fixed time of acceptance. In the absence of this, some jurisdictions require that it be kept open for a “reasonable” period of time. Most jurisdictions permit the offeror (seller) to revoke his offer provided that he expressly provides notice of revocation, and that occurs before an unqualified acceptance.

An acceptance creates a binding contract providing that the acceptance is absolute and complete. A qualified or conditional acceptance is not really an acceptance, but rather a counter effort. Silence, in the absence of other actions is not considered an acceptance.

A CONTRACT MAY BE VOIDED

- Material misrepresentations
- Fraud
- Duress
- Improper conduct

There must be reality of consent between the parties, with both parties genuinely intending to enter into the contract. Where there are material misrepresentations, fraud, duress or improper conduct by one party, most jurisdictions permit the other party to void the agreement.

In the rare instances where mutual mistakes are made, i.e. both parties making a mistake, the courts have held that no contract existed. However, in the case of unilateral mistakes, the general doctrine of “caveat emptor” prevails and does not usually void an agreement. Clerical errors contrary to the agreement between the parties do not void the contract. The agreement must be accompanied by consideration which is deemed to be something of value. This may also include another promise, such as to pay a stipulated amount. The law does not judge the adequacy of the amount of the consideration that is between the parties. The adage, “A cent or a peppercorn, in legal estimation, would constitute a valuable consideration,” sums up the courts’
position on whether the bargain or agreement is a good or poor one from an economic standpoint.

SHIPBUILDING CONTRACTS

- UNCITRAL
- UNIDROIT
- Specially drafted
- Owner or builder’s standard form
- Industry standard
  - SAJ form
  - AWES form
  - MARAD form
  - Norwegian form
- BIMCO’s NEWBUILDCON

The Shipbuilding Contract

As international trade grows, efforts to standardize, unify and harmonize commercial law is being carried out by the United Nations Commission Uniform Trade Law (UNCITRAL), the International Institute for the Unification of Private Law (Unidroit), the European Union, and others. However, in the absence of such an internationally consistent set of commercial laws, the laws that will apply shipbuilding contracts will vary depending upon jurisdiction. That jurisdiction, in the absence of a declaration in the contract may apply to where the ship is built, or where the contract was made, or the domicile of one of the parties. Jurisdictional disputes are among the more frequent issues to be resolved. Hence, a very important part of any shipbuilding contract is the declaration of what law is to be applied to the contract.

In the following countries, the shipbuilding contract is regarded as a sale of goods of a finished product, with all the implication of warranties of fitness:

- Denmark
- Norway
- Sweden
- France
- United Kingdom
- United States (except Louisiana)
In the following countries, a shipbuilding contract is regarded as a contract for work and materials:

- Germany
- Italy
- Japan
- Korea
- Yugoslavia (formerly)

Depending upon whether the contract is signed before construction commences, at some intermediate point or at the time of launching, the following countries will regard the contract as a contract for work and materials or a sale of goods:

- Greece
- Portugal
- Argentina

The written contract may take one of several forms, namely:

1. A specifically drafted contract for the transaction by the owner’s or builder’s attorneys. Such contracts usually are biased in the direction of the party preparing the first draft. The party preparing the first draft, of course bears the legal expense of such an effort. Also, in some jurisdictions the courts place a burden on the party preparing the first draft.

2. The owners’ or builders’ usual form of contract. Where either party frequently enters into shipbuilding contracts, they may have a form of contract which they customarily use, but which should be carefully reviewed by that party’s attorneys for applicability to the current types of ships, locale of yard and/or recent regulations or legal rulings.

3. A shipbuilding contract form. There are several in common use, namely:


   b. AWES Form – The Association of West European Shipbuilders Form of July 1972.


   Regardless of which form is used, any shipbuilding contract should contain a number of basic elements.
7.5 Basic Elements of a Shipbuilding Contract

- The parties
- What is to be done
- Price
- Delivery
- Guarantees
- Tests
- Change procedures
- Right to reject
- Default
- Title
- Jurisdiction

A shipbuilding contract should identify the yard in which the ship will be built. Most contracts do, but the SAJ is silent on this point. The owner wants to be assured that the ship will be built in the yard he reviewed and selected.

The contract should state the builder’s hull number, and most do, because the owner wants assurance that the builder will not substitute a later order ahead of his.

The contract should describe the vessel, even if briefly, including the type, the principal dimensions, registry and classification. A more detailed description is included in the specifications and contract drawings, which should be made a part of the contract.

An important part of the contract should deal with the owner’s right to inspect and approve drawings, appointment and rights of owner’s representative and facilities for them to be provided by the shipyard.

Every contract provides for guaranteed speed, fuel consumption and deadweight tonnage. Some contracts also include a guaranteed cubic capacity (AWES and Norwegian Form). It is not out of order to require the builder to guarantee other features of the ship such as cargo deck area (Del Monte refrigerated cargo ships), vertical center of gravity (for stability reasons on Sea-Land ships), LNG boil off rate (El Paso), pallet capacity (Reefer Express Lines), lane-meter of vehicle space (Trailerbridge), number of passenger berths (RRCL), etc.

The guarantee section ascribes penalties for shortfall, and the right to cancel the contract if the deficiency exceeds a given amount.

The contract will provide a delivery date, an effective starting date and penalties for late delivery. AWES provides for premiums for early delivery, although most owners elect not to include such a clause.
The contract will state the contract price, currency in which payment is made, payment methods, installment payments and procedures for extra costs. Provisions may also be made for escalations in the contract price based on wage and/or material cost increases. Generally such escalation clauses, where they do occur, are tied to industrial or governmental indices.

*Force majeure* terms are usually the subject of much discussion. Some *force majeure* clauses remain amongst the most arcane to be found in law, e.g. “restraint of princes,” “letters of marque,” etc. Nevertheless, other terms are very important and have a reasonable likelihood of occurrence, e.g. “strikes,” “riots,” “civil commotion,” “earthquakes,” “hurricanes,” “floods,” etc. It is reasonable to include events which are totally out of the control of the shipbuilder. However, shipyards will often ask that clauses referring to “failure of suppliers to deliver materials on time,” be included. It is not in the owners’ interest to include such a clause, since it relieves the yard from penalty for planning, i.e. lateness in ordering material, or failure to press the suppliers for timely deliveries.

Similarly, “work stoppages” may be partly subject to the control of yard management and should be omitted from this clause.

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7 A works strike in 1984 during the construction of U.S. Lines Jumbo Econship at the Okpo Shipyard of Daewoo, S. Korea.
8 A two-day works riot occurred in 1980 during the construction of an Econfeeder at Vulcan Shipyard in Vigo, Spain.
9 The 1994 earthquake in Kobe, Japan shut down operations at Mitsubishi’s shipyard.
10 Hurricane Betsy, in 1964 caused extensive damage to Avondale’s New Orleans shipyard. This extreme storm also sank four Lykes Lines cargo ships which were partially or nearly completed.
PRINCIPAL ELEMENTS OF A SHIPBUILDING CONTRACT

1. Description of Vessel
2. Classification, Rules and Regulations
3. Contract Price
4. Speed Deficiency
5. Excessive Fuel Consumption
6. Deadweight Deficiency
7. Other Deficiencies
8. Late delivery
9. Guarantees
10. Sub-contracting
11. Approvals
12. Buyer’s Supplies
13. Buyer’s Representative
14. Inspections, Tests and Trials
15. Modifications and Changes
16. Changes in Rules and Regulations
17. Sea Trial
18. Delivery
19. Permissible Delays
20. Builder’s Guarantee
21. Guarantee Engineer
22. Insurance
23. Termination
24. Jurisdiction
25. Dispute Resolution
26. Effective date of contract
27. Specification
28. Maker’s List
7.6 Significance of Contract Penalty Clauses

1. Speed deficiency
   a. Lack of competitiveness with others in trade.
   b. For liner services – slower door-to-door service.
   c. Possible missing of frequency of sailing dates, i.e. Friday sailings, Monday arrivals, two trips per day, etc.
   d. Can be severe in liner cargo, LNG, and passenger ships.

2. Fuel excess rate
   a. Loss can be calculated based on fuel prices, days/year at sea, etc.
   b. May decrease resale value of ship.

3. Late delivery
   a. May cause loss of charter.
   b. Very disruptive of part of an intermodal transport chain.
   c. For cruise lines – very catastrophic – loss of sailing, refunds to passengers booked well in advance, injury to reputation.

4. Typical Contract Clauses
   a. **Speed Deficiencies**
      - A margin – say 0.11 to 0.12 knots no penalty
      - A penalty of x dollars for each fraction of a knot between the trial speed and the maximum allowable deficiency.
      - The owner’s right to rescind for deficiency greater than “y.”
      - Trial carried out per standard or protocol – draft, trim, wind, waves, clean hull, 2 directions, etc.
   b. **Fuel Consumption**
      - A margin.
      - A penalty of y dollars for each fraction of the fuel rate (grams per kw-hour) above the guaranteed fuel rate.
      - Owner’s right to rescind with an excess rate of “z”.
      - Done during sea trial, no shop trials. (There is a shop trial, which is performed by the manufacturer for the builder-owner is present and attends.) There are many reasons why it is done during sea trials, including:
        - Possible errors in assembling or installing.
• The contribution to load caused by E.R. environment, gears, clutches, attached auxiliaries, vent systems, etc.
• Real world environment.
• Fuel quality tests performed on samples.
• Decision possible for rate above “v”.

c. **Delay in Delivery**
   - Delivery date stated in contract.
   - Time, place, conditions.
   - Safety, afloat, completed, approved, class, registered, etc.
   - Margin allowance sometimes given – “t” days.
   - $”u”/day for each day delay.
   - Max allowable days “s,” beyond which owner can rescind.
   - *Force majeure* allowed.
   - Owner can sometimes be responsible for delays, such as
     - Late delivery of owner-furnished equipment.
     - Unless specifically excluded in contract as a reason for allowable delay.
       - i. Owner failure to approve drawings in a timely manner.
       - ii. Owner delays in attending tests and trials.
   - Yard will sometimes ask during contract negotiations, for a bond for early delivery. Often, it is of little benefit to owner to get vessel a few days or weeks early – hence seldom agreed to. However, there are occasions where the owner can use the ship early and such bonuses have been agreed to.
8
PRODUCTION PROJECT MANAGEMENT

8.1 Introduction
The fourth phase in the ship acquisition process involves the owner’s activities during PRODUCTION. Immediately following the signing of the contract, the initiative in the process shifts from the buyer (ship owner) to the seller (shipyard). While the center of effort lies with the yard, nevertheless, there are a number of important tasks, which a prudent ship owner must carry out or participate in during construction and immediately after delivery. These require good project management skills.

8.2 Project Management

- Specialized management technique
- To plan and control projects
- To complete defined work
- On schedule
- Within budget
- Meet quality constraints

PURPOSES OF PROJECT MANAGEMENT
- Fulfill original objectives
- Keep project within budget
- Keep project on schedule
- Coordinate project team
- Detect need for and take corrective action
- Communicate progress to management
Kerzner argues that the traditional structure of management is bureaucratic, vertical, emphasizes a strong superior – subordinate relationship and should be replaced by such techniques as PM, “which is ‘highly organic’ and can respond very rapidly as situations develop inside and outside the company.”

*Project* is defined as any series of activities or tasks that:

1. Have a specific objective within certain specs.
2. Have defined start and end dates.
3. Have funding limits.
4. Consume resources such as money, people and equipment.

**DEFINE PROJECT**

- State objectives and goals
- Prepare mission statement
- Develop work plan
- Create Work Breakdown Structure Document (WBSD)

**ESTABLISH SCHEDULE**

- Define Tasks
- Select milestones
- Define interrelationships
- Establish timing and deadlines

**PREPARE BUDGET**

- Identify or estimate all costs
- Allow for margins/contingencies
- Establish timing of expenses
- Adopt financial controls
- Obtain approvals

**TEAM BUDGET ELEMENTS**

- Wages
- Benefits
- Local taxes – if any
- Global taxes – if any
- Travel expenses
- Supplies and equipment
- Communication costs
OWNER’S EXPENSE BUDGET

- Owner furnished equipment
- Crew costs
- Professional costs
  - Legal
  - Accounting
  - Technical
- Stores and supplies
- Fuel and lube
- Entertainment and ceremonies

TEAM

- Select and recruit team leader
- Develop team position/tasks
- Establish timing for each
- Recruit members
- Indoctrinate
- Delegate

MANAGING YOUR TEAM

- Staying in control
- Evaluating your team
- Identifying and dealing with different personality types
- Motivating your team
- Managing clients
- Effective team organization

CONTROL PROJECT

- Communicate
- Coordinate
- Meetings – scheduled and unscheduled
- Review and audit
- Make adjustments/corrections as necessary
- Document
PRODUCTION CONTROL TECHNIQUES

- Full wall scale charts
- Gantt charts
- PERT
- CPM
- Programs

<table>
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GANTT CHART

Gantt charts are useful tools for planning and scheduling projects.

- Gantt charts allow you to assess how long a project should take.
- Gantt charts lay out the order in which tasks need to be carried out.
- Gantt charts help manage the dependencies between tasks.
- Gantt charts determine the resources needed.

Gantt charts are useful tools when a project is under way.

- Gantt charts monitor progress. You can immediately see what should have been achieved at a point in time.
- Gantt charts allow you to see how remedial action may bring the project back on course.
PERT

Complex projects require a series of activities, some of which must be performed sequentially and others that can be performed in parallel with other activities. This collection of series and parallel tasks can be modeled as a network.

In 1957 the Critical Path Method (CPM) was developed as a network model for project management. CPM is a deterministic method that uses a fixed time estimate for each activity. While CPM is easy to understand and use, it does not consider the time variations that can have a great impact on the completion time of a complex project.

The *Program Evaluation and Review Technique* (PERT) is a network model that allows for randomness in activity completion times. PERT was developed in the late 1950's for the U.S. Navy's Polaris project having thousands of contractors. It has the potential to reduce both the time and cost required to complete a project.

The Network Diagram

In a project, an activity is a task that must be performed and an event is a milestone marking the completion of one or more activities. Before an activity can begin, all of its predecessor activities must be completed. Project network models represent activities and milestones by arcs and nodes. PERT originally was an *activity on arc* network, in which the activities are represented on the lines and milestones on the nodes. Over time, some people began to use PERT as an *activity on node* network. For this discussion, we will use the original form of activity on arc.
PERT planning involves the following steps:

1. Identify the specific activities and milestones.
2. Determine the proper sequence of the activities.
3. Construct a network diagram.
4. Estimate the time required for each activity.
5. Determine the critical path.
6. Update the PERT chart as the project progresses.

The activities are the tasks required to complete the project. The milestones are the events marking the beginning and end of one or more activities. It is helpful to list the tasks in a table that in later steps can be expanded to include information on sequence and duration.

This step may be combined with the activity identification step since the activity sequence is evident for some tasks. Other tasks may require more analysis to determine the exact order in which they must be performed.

Using the activity sequence information, a network diagram can be drawn showing the sequence of the serial and parallel activities. For the original activity-on-arc model, the activities are depicted by arrowed lines and milestones are depicted by circles or "bubbles".

If done manually, several drafts may be required to correctly portray the relationships among activities. Software packages simplify this step by automatically converting tabular activity information into a network diagram.

Weeks are a commonly used unit of time for activity completion, but any consistent unit of time can be used.

A distinguishing feature of PERT is its ability to deal with uncertainty in activity completion times. For each activity, the model usually includes three time estimates:

- Optimistic time - generally the shortest time in which the activity can be completed. It is common practice to specify optimistic times to be three standard deviations from the mean so that there is approximately a 1% chance that the activity will be completed within the optimistic time.
- Most likely time - the completion time having the highest probability. Note that this time is different from the expected time.
- Pessimistic time - the longest time that an activity might require. Three standard deviations from the mean are commonly used for the pessimistic time.

PERT assumes a beta probability distribution for the time estimates. For a beta distribution, the expected time for each activity can be approximated using the following weighted average:
Expected time = \( \frac{\text{Optimistic} + 4 \times \text{Most likely} + \text{Pessimistic}}{6} \)

This expected time may be displayed on the network diagram.

To calculate the variance for each activity completion time, if three standard deviation times were selected for the optimistic and pessimistic times, then there are six standard deviations between them, so the variance is given by:

\[ \left( \frac{\text{Pessimistic} - \text{Optimistic}}{6} \right)^2 \]

Determine the Critical Path

The critical path is determined by adding the times for the activities in each sequence and determining the longest path in the project. The critical path determines the total calendar time required for the project. If activities outside the critical path speed up or slow down (within limits), the total project time does not change. The amount of time that a non-critical path activity can be delayed without delaying the project is referred to as slack time. If the critical path is not immediately obvious, it may be helpful to determine the following four quantities for each activity:

- ES - Earliest Start time
- EF - Earliest Finish time
- LS - Latest Start time
- LF - Latest Finish time
- Activity start and end dates.

Limitations

The following are some of PERT's weaknesses:

- The activity time estimates are somewhat subjective and depend on judgment. In cases where there is little experience in performing an activity, the numbers may be only a guess. In other cases, if the person or group performing the activity estimates the time there may be bias in the estimate.

- Even if the activity times are well-estimated, PERT assumes a beta distribution for these time estimates, but the actual distribution may be different.

- Even if the beta distribution assumption holds, PERT assumes that the probability distribution of the project completion time is the same as that of the critical path. Because other paths can become the critical path if their associated activities are delayed, PERT consistently underestimates the expected project completion time.

The underestimation of the project completion time due to alternate paths becoming critical is perhaps the most serious of these issues. To overcome this limitation, Monte Carlo simulations can be performed on the network to eliminate this optimistic bias in the expected project completion time.
MONITOR CRITICAL ELEMENTS

- Require production statistics
- Monitor milestones
- Watch critical paths
- Identify choke points/bottlenecks
- Make projections/extrapolations
- Anticipate problems

WHEN THINGS GO WRONG

- Identify real problems
- Get input from team
- Investigate thoroughly
- Analyze possible solutions
- Take timely corrective action
- Meet with yard
- Communicate with stakeholders

TIPS

- Delegate effectively
- Be a good listener
- Be fair with everyone
- Use good time management
- Avoid bureaucracy
- Be decisive and clear
- Communicate thoroughly
- Insist on ethical behavior

8.3 Owner’s Activities During Production

- Owner’s representative
- Contract management
- Project management
- Plan approval
- Inspection
- Quality control
- Testing
• Crewing, storing, fueling
• Delivery and acceptance
• Post production activities
• Warranty and guaranty
• Closing the project

The contract should clearly spell out the responsibilities and rights of both parties during this production phase. Even greater detail, in this regard, is often included in the shipbuilding specifications. It is essential that all parties who have responsibilities should be familiar with the terms and details of the contract and specifications. It has often been found useful to extract those portions of each, which apply to them and distribute these to each member of the ship owner's inspection team.

The ship owner has a number of obligations under the shipbuilding contract. In order to handle these duties in an orderly manner, it is customary for the ship owner to appoint a Ship Owner's Representative. It is usual for the ship owner's representative to be domiciled for the duration of the project at the shipyard, or lead yard in the case of a multi-yard project.

The duties of the ship owner's representative usually include:

1. Represent the interests of the owner.
2. Endeavor to keep the project on budget.
3. Endeavor to keep the project on schedule.
4. Supervise the inspection team.
5. Monitor the construction progress.
6. Assure safe and healthy working conditions for ship owner's staff.
7. Control and approve the change order process.
8. Receive, analyze and report to the owner progress against schedule.
9. Identify, report on, and to the extent possible, resolve production problems.
10. Monitor and record conditions, which may be used as a basis for *force majeure* claims.

Look after the welfare of the inspection team and other ship owner's employees on site including assisting in housing, transportation, visas, taxes, finances, insurance, medical issues, repatriation, replacement, training, etc.

11. Manage the field office and its staff including secretarial/clerical staff, office equipment, furniture, computers, communications, petty cash, expense accounts, vehicles, etc.
12. Monitor the inspection of workmanship, materials, tests and trials.
13. Monitor the yard’s quality, quality assurance and safety programs.
15. Confirm that the shipyard has met payment milestones.
16. Assure that owner furnished equipment and supplies are received, inventoried, stored and protected in warehouses before placement on board.
17. Coordinate with or supervise the plan approval team.
18. Coordinate with ship owner's finance, insurance, legal, personnel and operations departments.
19. Assist ship owner's marketing, sales and public relations departments concerning press releases, ceremonies, visits, display models, photos, etc.
20. Coordinate crewing and crew-related requirements at the shipyard.
21. Assist in the initial storing and fueling of the ship, including lubricants and lube oil.
22. Coordinate with the shipyard’s guarantee engineer, after delivery.
23. Assure that all documents and certificates are provided by the yard.
24. Accept delivery of the ship on behalf of the owner.
25. Provide for an orderly shut down of the project, including resolution and closing of accounts, repatriation of crew, organizing and shipping of files, plans and documents, and providing a written summary of the project.

It is clear that in managing the entire ship acquisition process (planning, design, commercial and production) and particularly the owner representative functions, that good project management skills are essential. It would greatly benefit the prospective manager by taking a short course or reading a book on project management. The importance of good communication and personnel selection, and proper budgeting and scheduling cannot be overemphasized. The success of the ship acquisition process depends upon it.

Continuous Project Management Activities

Critical Path Network: Review of Contractor’s updates of the critical path network to ensure that schedule updates reflect actual project conditions and events (start, percent complete, finish).

Progress Meetings: Leadership at regular progress meetings with Contractor and follow-up to ensure all obligations by both parties arising there from are timely satisfied.

Progress Monitoring: On-site identification of when critical path activities have started and finished to monitor Contractor’s performance vis-à-vis its own planned schedule.
Progress Payments: Review of Contractor’s progress invoices to ensure that all invoiced amounts have been earned.

Classification: Oversight and review of Contractor’s communications with classification organization.

Regulatory: Oversight and review of Contractor’s communications with appropriate regulatory authorities.

Intermittent Project Management Activities

Contract: Maintenance of up-dated contract including changes to price, technical specifications, contract drawings and delivery date.

Change Specifications: Development or review of technical aspects of proposed changes and Shipowner’s estimate of cost of changes.

Delays: Review of Contractor’s requests for *force majeure* delays and oversight of other potential causes of delay.

Extensions: Review of contract extensions requested by Contractor in association with potential changes.

Rework: Identification and documentation of types, areas and timing of Contractor’s own rework necessitated by its own errors.

Later Project Management Activities

Inspections: Identification of work in progress and completed items to be inspected and accepted.

Deficiencies: Development of inspection deficiency reports for transmittal to shipyard and follow-up to ensure correction of cited deficiencies.

Test & Trials: Review of draft agendas for tests and trials, oversight of tests and trials, review of final reports on tests and trials.

Acceptances: Preparation of notices of acceptance of inspections, tests and trials, and conveyance of the acceptance to Contractor.

Compartment Closeouts: Final closeout inspection of each compartment upon presentation by Contractor (includes each tank and void space as well as working spaces), and conveyance of the acceptance or deficiencies to Contractor.

Manuals: Review of draft manuals, including signs and placards, preparation of comments to Contractor, review of final manuals.

Spare Parts: Development of approved spares lists and communications with Contractor to ensure timely arrival of spares.

Delivery: Development of draft vessel delivery documentation and inventorying and filming of status of ship at time of delivery.

Warranty: Accumulation of warranty items identified by operational staff, transmittal of reports to shipyard and follow-up to ensure correction of cited warranty items.
8.4 Plan Approval

The term “plan approval” in the shipbuilding process refers to the ship owner's review of detailed drawings, calculations, field sketches, test agendas and results, vendor drawings, purchase orders and other technical documentation developed during construction. The principal activity relates to a review of working drawings, which are usually prepared by the shipbuilder’s engineering department.

A significant difference between the concept, preliminary and contract design work, on one hand, which we may call the basic design and the detailed design on the other hand, is that the engineering work in the former case may be regarded as developmental and may be subject to constant change and improvement. The engineers preparing the detailed design must make sure that their work conforms to the contract drawings and not make changes, except in strict accordance with the change procedures in the contract.

The detailed design and engineering work that the shipbuilder is responsible for and which the owner may review includes some or all of the following:

**DETAILED DESIGN MATERIALS**

- Working plans
- Finished drawings
- Posted plans
- Vendor drawings
- Field sketches
- Shop drawings
- Schematics
- Drawing changes
- Operating manuals
- Safety manuals
- Maintenance, repair and trouble shooting manuals
- Test agenda, protocols and results
- Tech specs for equipment procurement

In the process of development of the detailed design, or to suit differing yard standards or procedures, the yard may find it necessary or desirable to modify the contract design. This should be done only with the approval of the owner and in accordance with the contract procedures. It is the responsibility of the builder to obtain regulatory body and classification society approval for such changes.

The right to review detailed drawings is usually reserved under the
shipbuilding contract, both explicitly and implicitly. Implicitly, because the owner reserves the right to inspect all work in progress, and engineering work is included in this. Explicitly, because both parties to the contract find it useful to articulate the entire drawing review process.

The plan review usually calls for multiple copies of the detailed plans and other documents to be sent to the owner or his naval architect. The receipt and handling of such drawings should be carried out formally and carefully, since the ship owner's responses, and in some cases, failure to respond may have cost, delivery, warranty and legal implications.

There can be as many as one thousand first issue drawings developed prior to or during construction. It is useful at the outset for the owner or his naval architect to review the proposed plan list and identify those drawings, which he wants to approve, or which he wants only for information purposes.

It is customary for the owner to also receive all revisions to the first issue drawings, for approval or re-approval. The purpose of the plan approval is not to improve upon the design or continue its development. This may occur naturally, but it is not why the procedure is included in the ship acquisition process. The purpose is to assure that when the shipbuilder develops details to the design that the terms and intent of the contract are complied with. In the course of the preparation of details, ways to improve the design may occur to the owner, or changes in his requirements may suggest modifications to the design. However, these must be regarded as changes under the contract and may result in increases or decreases in contract price and/or changes in the delivery date. Such changes requested by the owner may also result in a lessening in the liability of the builder or a diminishment of his warranties, depending on how the changes are requested.

In the course of making comment on drawings under review, the ship owner's comments sometimes might unintentionally be regarded as requests for changes. It is therefore important that the contract (or specifications) include a clause requiring the builder to call the ship owner's attention to the fact that he regards such comments as requests for changes, and state what cost or delivery implications such changes would have.

The receipt and return of reviewed drawings should be accompanied by transmittal letters. At the very least such transmittal letters establish a time record, since certain of the ship owner's rights to review are usually limited to a certain number of days. This drawing review period is subject to agreement between the parties and is recited in the contract. It is a certain number of days, usually somewhere between 10 and 21 days. It will depend on where the plan reviewer or reviewers are located (i.e. at the ship owner's offices, the naval architect’s offices or the ship owner's field office in the shipyard), the complexity of the design, the ship owner's need to review some drawings with the operating department or potential charters, the ship delivery schedule, etc. The period is usually based on date of receipt by the owner, date of returning by the owner, and the intervening number of working days. A typical
contract clause might read:

The CONTRACTOR shall send to the PURCHASER (or its authorized representative for approval three copies of the drawings and the technical information for machinery and equipment, for which such approval is required by the Specification(s). One of the three copies so submitted shall be returned, either approved, or supplemented with remarks and amendments, to reach the CONTRACTOR within 14 days from the date of receipt by the PURCHASER or within 21 days after dispatch by the CONTRACTOR, whichever is the shorter, and if this is not done within this time limit the drawings and technical information shall be regarded as approved, unless additional time is specifically requested in writing by the PURCHASER and agreed in writing by the CONTRACTOR.

If the drawings and technical information are returned to the CONTRACTOR within the said time limit supplemented with remarks and amendments by the PURCHASER and if the said remarks and amendments are not of such a nature or extent as to constitute modifications under Article 3 hereof, then the CONTRACTOR shall start or continue production on the corrected or amended drawings and technical information provided that if such remarks and amendments are not clearly specified or detailed. The CONTRACTOR shall be entitled to place its own interpretation on such remarks and amendments in implementing the same.

It is also possible, in the interest of saving time that field changes, sketches, test memoranda, calculations may be sent and returned by facsimile or by e-mail.

With the advent of computer-aided design (CAD) drawings, it is possible to store, reproduce and transmit such digitized drawings electronically. The storage of technical information can be made on CD-ROM, hard drives, floppy discs and other devices.

Some classification societies (ABS and Lloyd’s Register) currently, are prepared to receive drawings in electronic format, review them on screen, store and return marked-up drawings electronically, that is, without resorting to paper. Within the near future, owners and/or their naval architects should be able to do the same. This should lead to increased accuracy, improved documentation and a shortening in the time required for review.

When the naval architect or ship owner's new shipbuilding department is carrying out the plan review, it is important that they coordinate the ideas and needs of the various other ship owner's departments, particularly marine operations. Other interested departments may include sales, purchasing, stevedoring, insurance, safety, chartering, etc.
In reviewing drawings, a number of factors and objectives should be kept in mind. These would include:

1. Do the drawings comply with the contact?
2. Does the design meet regulatory body requirements?
3. Does the design meet classification society rules?
4. Is the design “first class” and does it reflect “good workmanship.”
5. Does the design reflect modern practice?
6. Is the design safe?
7. Have human factors and ergonomics been considered?
8. Does the design have the appropriate features to protect the environment?
9. Is the equipment maintainable?
10. Is the structure or equipment accessible for inspection, maintenance or repair?
11. Is there continuity of structure?
12. Is the structure aligned, configured and sized to resist the loads?
13. Have margins and safety factors been used and are they sufficient?
14. Are structural butts, seams and joints clear of highly stressed areas?
15. Have cutouts and other apertures been compensated for?
16. Is the design free of stress concentrations?
17. Have the correct welding symbols, and materials been designated?
18. Are the correct materials and alloys called for and are they compatible?
19. Has drainage been provided for?
20. Are there ladder, scaffold or platforms, or other provisions for frequently inspected or maintained equipment?
21. Will the accidental release of liquids (water, oil, etc.) from pipes, joints, tanks, overflows, etc., spray or flow onto electrical equipment, hot components or otherwise cause a problem?
22. Are the quarters, working and public spaces habitable, sanitary, maintainable and comfortable?
23. Do the design and details meet the company’s standards?
24. Are the equipment and its components interchangeable with other equipment in the fleet?
25. Are all corrections and changes clearly marked?
26. Are penetrations in watertight bulkheads and decks sound and watertight themselves?

27. Are the pipes passing through watertight boundaries fitted with non-return valves, where appropriate?

28. Are the ballast and fuel tank vent pipes, vent heads and the absence of paint on the flame screen adequate to prevent over-pressuring tanks?

29. Are pressure vessels, pipes and equipment under pressure fitted with the correct appliances?

30. Are the ship’s structure and fittings, and particularly the bottom and forward structure substantial enough to resist slamming, plunging, boarding seas, etc?

31. Are the quarters, equipment, structure and personnel protected, where appropriate, against ice, snow, rain, sand, wind, waves, sunlight, heat, moisture, noise and other environmental factors?

32. Are the drawings correctly labeled, dimensioned to the correct scale, complete, corrected, numbered, dated, signed and contain sufficient and correct references?

33. Can the ship or its features be made esthetically pleasing at no additional or at an acceptable level of cost?

It is customary for a shipyard to incorporate many repetitive details into the working drawings. These are usually printed into a booklet of yard standards. They may be separated into booklets of structural details, piping, electrical, HVAC, furniture, etc. These standards may vary considerably from yard to yard. Therefore, it is essential that the owner closely examine the yard standards prior to contract. He may not see them again until they are built into the ship, as the working drawings may not show them, but merely incorporate them by reference.

8.5 Inspection

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<tr>
<td>Hull</td>
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<td>Outfitting</td>
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<td>Welding</td>
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Under the terms of virtually all shipbuilding construction contracts, the owner reserves the right to carry out inspections of the work in progress and to witness tests and trials.

The specifications are often more explicit in the inspection procedures which are to be followed.

The purpose of shipbuilding inspection by the owner is to assure that the vessel is constructed in accordance with the contract plans and specifications, and that the workmanship and materials meet the intent of the contract.

It is intended that the scope of the ship owner's inspection program is unrestricted by the shipbuilder, that free and ready access is provided and that it covers all materials and work entering into the construction. It may extend, at the ship owner's option, to every detail in the ship. It includes all aspects of safety, economy, efficiency, maintainability, habitability, esthetics, etc. Owners should not confuse the roles played by classification society and governmental inspectors with that of the ship owner's inspectors. Some owners are shortsighted enough to forego their right to inspect the vessel and defer to the class and regulatory inspections. Obviously, the latter bodies have no responsibility for and very little knowledge of the commercial interests of the owner and are focused on safety issues. Matters such as life of coatings, the appearance of the ship (style), the comfort of the crew, the cost of operation of the ship, the speed of cargo handling equipment, etc. are matters which are of vital concern to the owner, and which are beyond the scope of classification and regulatory body inspection. Furthermore, U.S. courts have held that a ship owner cannot delegate the responsibility for assuring that his ship is seaworthy.

Most shipyards have “quality control,” “quality assurance” and/or “quality” programs in place. Such programs are intended to produce ships, which meet the intended level of quality defined by the contract and specifications. Ideally, the builder would, because of his quality programs, deliver a ship free of defects. Unfortunately, some such quality programs contain defects. It is apparent that there must be a series of “safety nets”, commencing with the builder’s quality control; and including the ship owner's inspection team, the classification society and the regulatory bodies, i.e. flag state control. In some cases such as passenger ships, tankers, gas carriers, an additional safety net, in the form of port state control exists, particularly in the U.S. with foreign flag vessels trading to U.S. ports.

Another reason for the owner to have his inspectors in place is because not every detail of construction is, nor or need be, shown on the drawings which are sent to the owner for approval. However, often, the small details, which emerge on the scene, are of great importance to the owner, and may affect his operations.

During the construction process, it is commonplace, for reasons of improved efficiency, for field changes to be made. These may apply to fasteners, brackets, arrangements, etc. These field changes can be approved by the local
inspectors, if they are not of a significant technical nature. However, the plan approval agent should be advised of such field changes to assure that there is not conflict with other plans or processes.

**Hull Inspection**

The hull inspector’s responsibility is the structure of the ship. On a very large project, the hull inspector would be assisted by a welding inspector. On small jobs, the hull inspector may also handle coatings, deck machinery, superstructure outfitting and other duties. Regardless of the size of the project, a ship’s new construction team will always have at least one hull or structural inspector. Large, complex or multi-ship projects may have more than one hull inspector and might also have a welding inspector.

It is the responsibility of the hull inspector to inspect and follow the progress of the fabrication of the ship’s structure. This work commences upon the arrival of steel plate and shapes (profiles) at the yard. It continues as the steel (or other materials such as aluminum, wood, plastic, etc.) is prepared (straighened, dried, blasted, primed and marked) for cutting, forming and joining.

The hull inspector follows the structure through the fabrication shops, i.e. plate shop (two dimension), and module shop (three-dimension) and at the platens.

The hull inspector will continue to follow the modules into the building (graving) dock or onto the launching ways, where they are assembled into the ship. His work continues through launching and trials to delivery.

**Welding Inspection**

In the event that a welding inspector is part of the team, and if there is no welding inspector, then the hull inspector, shall ensure that:

1. The types and sizes of welds, and the edge preparation are appropriate and correct for the application.
2. Welding sequences are proper and do not create locked in stresses or deformations.
3. All structure is properly aligned and spaced before welding.
4. Welding is carried out in accordance with agreed upon standards, codes and good practice, especially with regard to absence of spatter, porosity, undercutting, strikes, excessive crown, cracks and other irregularities.
5. Welding rods are of the correct type and are kept in a dry environment.
6. Selection of welds, castings and forgings to be specially inspected by non-destructive test methods or for tensile, impact or fatigue tests.
7. Witnessing tests and results of radiographic (x-rays), magnetic particle, ultrasonic, and dye penetrant tests.
8. Assist the hull inspectors, as required.

Coating Inspection

On small projects the structural inspector may handle coating inspection. However, on larger projects a coating specialist may be engaged, as part of the inspection team to carry out this work. In some cases, the coating (paint) supplier will give guarantees of five years or more for his paint. Since the effectiveness of such systems is highly dependent on the surface preparation, environmental conditions during application and thickness of the application, close supervision and monitoring is necessary if such long guarantees are given. Therefore, often the paint manufacturer will have his representative on site. Nevertheless, on large projects, assignment of a ship owner's coating inspector is prudent.

The test instruments most useful to the coatings inspector range from the simple thermometer, hygrometer and anemometer and wet thickness gauge, to more sophisticated electronic dry thickness measurement devices, surface profilers, etc.

Many factors have emerged in recent years to make the assurance of correct coatings vital to the owner. These include:

1. The desire for extended dry-docking periods (5 years).
2. The high cost of recleaning and recoating.
3. The reduction in crew size and unavailability of personnel to perform onboard chipping and painting.
4. Fast port and shipyard turnaround, inhibiting the use of shoreside coating workers.
5. The sheer size of many ships, especially VLCC’s and ULCC’s.
6. The never-empty nature of containerships, inhibiting access to cargo holds.
7. The use of high strength steels (HTS), whose corrosion rates are the same as thicker mild steel structures, and hence waste away sooner.
8. The reduction in structural design safety margins, and use of computers resulting in smaller scantlings, which are subject to more rapid wastage.

Hence, it behooves the owner to give very careful attention to the selection of a good coating manufacturer, proper coatings, an effective specification, a long guarantee and good inspection.

In December of 1006, IMO approved the performance standard for protective coatings for water ballast tanks. Under certain class rules the condition of coating can impact a vessel’s class status.
Electrical Inspection

The electrical inspector is generally responsible for the inspection and witnessing of tests for the following:

1. Electrical generators
2. Switchgear, switchboards, distribution panels and associated instrumentation
3. Transformers, regulators, circuit breakers, synchronizing equipment
4. Motors, brakes, electric clutches
5. Wiring, buses, wireways, wire and cable penetrations
6. Lighting
7. Electronic equipment
8. Communication equipment
9. Automation systems
10. Impressed current system
11. Electrical insulation
12. Monitors, sensors, alarms, annunciators
13. Antennae, wave guides, transducers
14. Electrical and communication shore connections
15. Computers and their networks
16. Fiber optic systems

Because of rapid advances in electronic equipment, especially computers and automation equipment and the difficulty in finding electrical inspectors with expertise in both electrical and electronic fields, it is sometimes necessary to split the tasks between two specialists, one electrical and the other electronic.

Machinery Inspection

Machinery inspectors are required to inspect and witness the testing of all mechanical, hydraulic, and pneumatic equipment and their related instrumentation. These include, but are not limited to:

1. Main propulsion machinery
2. Shafting, bearings and propeller
3. Auxiliary electrical generators
4. Heating, ventilation and air conditioning
5. Refrigeration and dehumidification
6. Rudders and steering gear
7. Cargo handling equipment
8. Auxiliary machinery

9. Deck machinery

In addition to assuring that such equipment is correctly installed and connected to other systems, the inspectors must assure at such equipment and systems.

1. Are assembled correctly.

2. Are installed according to the manufacturers’ instructions and good practice.

3. Are arranged to provide safe access for operation and maintenance.

4. Sufficient room is left for opening, inspection and/or removal.

5. The equipment is not a hazard, through malfunction to equipment in its vicinity.

6. The foundations are appropriate for the equipment.

7. The equipment has the correct size or capacity for the service intended.

8. The equipment is free of abnormal vibrations.

9. The equipment does not generate abnormal noise.

10. The equipment or systems are environmentally sound especially with respect to oil spill, solid waste, or sewage water pollution, air pollution, toxic fume generation, excessive noise, etc.

11. The systems are energy efficient.

12. The equipment is user friendly, properly marked and provided with instruction books, operating guides, trouble shooting information, parts lists, etc.

13. The machinery and equipment meets performance specifications.

It is generally accepted that effective shipbuilding machinery inspectors are former ships’ engineers (usually chief engineers) who have a specialty in the type equipment being installed, such as steam, diesel or gas turbine propulsion plans. Where possible, it is useful to have machinery inspectors who have taken various manufacturers' training courses.

It is customary to have the machinery inspectors work very closely with the vessels’ chief engineer, who usually arrives on site later in the program. Often, one of the ship owner's senior chief engineer’s is assigned to the lead ship and may arrive at the yard early in the construction program (such as when the main engine is on the test bed at the engine plant).
8.6 Crewing, Storing and Fueling

The initial crewing of the vessel is a ship owner's function and may involve considerable expense and effort. It is obvious that the owner will want to minimize the costs associated with this activity. Therefore, he will want to delay the assignment of the officers and unlicensed crewmembers until the last possible moment, consistent with many other considerations. For this reason, it is essential that the ship owner's representative work very closely with the ship owner's operating department, vessel managers and/or crewing agents to keep them informed of the shipbuilding schedule, and particularly of any factors which may delay delivery of the ship.

While it is customary to assign and position the crewmembers before delivery for familiarization and training, certain key crewmembers may be assigned even earlier.

On the other hand, the owner may furnish the initial supply of foodstuff, linens, navigation charts, extra spare parts, cleaning materials, and other consumables. He may also elect to furnish portable computers and their software. If these owner-furnished items arrive at the shipyard before the ship is delivered, they must be inventoried and warehoused in a dry, climate-controlled, and secure place before placement on board. Many ship owners find it useful to accumulate, transport and marshal many of these ship owner's items in sealed, steel intermodal shipping containers.

It may be necessary for the shipyard to put consumable stores on board for the trial trip. It is mutually advantageous for the owner and the yard to agree, in advance, for the owner to take over appropriate unbroached stores.

Similarly, the vessel will require fuel, lube oil, hydraulic oil, greases and other lubricants in order for the yard to conduct tests, dock trials and sea trials. In some cases, for tax reasons, the place of delivery is distant from the yard. This positioning also requires fuel and lube oil. Since the quantities and value of this may be considerable and it is very impractical to remove the yard’s fuels and lubricants to replace them with the ship owner's, it is customary for the owner to take over, and pay for the fuel and lubes. In this regard, it is important that a very accurate inventory be taken immediately prior to delivery.

Since the fuels and particularly lubes of some manufacturers are incompatible with those of others, the usual practice is for the owner to specify to the shipyard which brand of lubricants to be used in the initial charge.

While it is seldom done, it is prudent for the owner to ask for a laboratory analysis on the fuel remaining on board at delivery. A spectrographic analysis of the lube oils in the various systems is also useful in establishing baseline condition for future analyses in any predictive maintenance program.
8.7 Delivery and Acceptance

This phase of the effort is the *raison d’etre* for the new ship acquisition process. It has many important aspects: logistical, financial, but most important, legal. It should not be executed without proper legal advice and guidance, since many of the seemingly unimportant or trivial tasks and events surrounding it, in fact, have real significance.

The protocol for delivery and acceptance are usually detailed in the shipbuilding contract. The standard forms (AWES, SAJ, MARAD, etc.) are varied in their approach. Custom written shipbuilding contracts tend to be more detailed, as they address the peculiar complexities of the process.

In the United States, under the Uniform Commercial Code, title passes when the seller completes his performance with reference to the physical delivery of goods, although the buyer may obtain a special right in the ship when the ship is “marked” or identified (as the goods referred to in the contract). In other countries, title may pass when it is in a deliverable state, or when both parties agree, or when the vessel is registered, or when it is physically delivered.

**DELIVERY AND ACCEPTANCE**

Title passes in different jurisdictions:

- physically delivered
- at another time, if both parties contractually agree
- vessel registered
- execution of bill of sale
- when both parties so declare
- when ship is in a “deliverable” state
- bill is paid
- builder completes his performance progressively

8.8 Post Production Activities

- Deficiencies
- Unfinished work
- Temporary and permanent documents
- Warranty and guaranty

Other complications arise regarding third party rights, ownership of owner-supplied materials which are incorporated in the construction or items owned by the builder which are not physically part of the ship. It is for these and other reasons that the prudent buyer of a ship will seek the assistance of a lawyer.
It is convenient for the shipbuilder and owner to agree upon the conditions precedent and method for the delivery to take place. It is customary for the necessary certificates and documents to be identified in the contract.

Deficiencies and Unfinished Work

While the ship acquisition process mainly involves four principal phases, namely planning, design, commercial and production activities, there does remain a fifth phase which occurs after a vessel or vessels are delivered to the buyer. This last phase involves the completion of outstanding or incomplete work by the shipyard or the correction of defects, which become apparent through inspection or testing. This unfinished work may be of a minor nature or not consequential enough for an owner to want to delay taking delivery of the vessel.

It is customary for the inspection team to compile a list of unfinished or incorrect work during the project, and check off various items as they are completed or corrected. Such lists are known by different names, such as “punch lists”, deficiency lists, etc. As the project draws to a close and delivery day nears, the lists of each inspector are merged into a master list. The ship owner's representative must work very closely with the shipyard’s project manager to prioritize the items on the list and assure that all work is completed.

It is of considerable importance that nothing should remain on the list, which would effect the seaworthiness, safety or reliability of the vessel nor impair the vessel from performing its mission.

At the delivery of the vessel, the buyer should take exception to any remaining deficiencies. There should be a clear understanding of the nature of the items, when they will be corrected, where (return to the builder or at a remote yard or by riding gangs while vessel is in service), who will pay for the work and whether any additional compensation is due because of possible disruption to the ship owner's plans. These items, after discussion and agreement between the parties should be reduced to writing and made a part of the delivery protocol.

Temporary and Permanent Documents

It is frequently the case that governmental authorities delay executing the official documents of the vessel. In such cases, governments will issue provisional or temporary certificates. It is the responsibility of the shipyard to deliver the vessel fully documented (there are some exceptions, such as the issuance of a radio license in some countries). Therefore, it is necessary that a designated person in the shipyard monitor and expedite the completion of this work.

In some cases, the ship owner's final payment, typically two or three percent, is withheld until all permanent certificates and other paperwork is completed. This is a harsh but effective procedure in seeing that this remaining work is not ignored.
Warranty

Corley and Roberts (10) define “Warranty” as “an undertaking, either expressed or implied, that a certain fact regarding subject matter of a contract is presently true or will be true.” The word relates to quality. To warrant is to assure that a state of fact exists. Rothenberg defines a warranty as an agreement to make up for any damages that result from a false representation of the facts. The term guarantee (sometimes spelled “guaranty”) is more explicit, in that it is defined as “a statement by a producer that his product meets certain standards, and that if it proves defective, he will make restitution. “Warranty” has many meanings, but in the law of the sale of goods it means the obligations of the seller with respect to the goods sold. In the case of ships and their equipment, expressed warranties are provided to the owner in the building contract and are given to the shipyard in the purchasing documents by the equipment suppliers. These equipment warranties are transferred to the owner at the time of delivery of the ship. In expressed warranties, consequential damages or loss of earnings are seldom provided for.

It is important that the owner use every effort, before the signing of the contract, to assure that the yard will obtain vendor warranties that commence at the time of delivery of the ship rather than at the time of delivery of the material at the yard or at time of installation. In the former case, the warranty can nearly run out before the equipment is ever put into service.

During the first months of operation of a vessel, and especially the lead vessel in a series, the majority of failures of equipment will occur. During this intense period of breakdown, claims and repairs, owners and shipyards alike have found it useful to assign a guarantee engineer to ride the ship. Since the ship usually will have to be repaired in areas remote from the builder’s yard, the guarantee engineer acts as the builder’s representative in negotiating and settling repair costs. The guarantee engineer is also in an excellent position to judge the reasonableness of the ship owner's claims. Most warranties are limited to failures under “normal wear and tear”. If the equipment is abused or if the new crew lacks training or skill in operating the machinery and this is the cause for breakdown, the guarantee engineer, is in a position to dispute the claim and document the reasons.

It is usual for the builder to pay the wages of the guarantee engineer, whereas, the owner provides quarters and subsistence aboard ship.

Closing the Project

While this final step is often omitted in ship acquisition projects, it is nevertheless an important one and deserves consideration.

There may be a number of open issues at the time of delivery of the ship or last ship in a series. These might include unfinished work, mistakes requiring correction, incomplete or temporary documents, unpaid accounts, unresolved insurance claims, open personnel matters, etc. Some of these items do not
need the services of the acquisition team, and can be attended to by the ship owner's administrative or operating personnel. Therefore, it is important that the ship owner's representative provide an orderly and well-documented turnover of all open items to those who will inherit them.

The project manager should settle the question of personnel reassignment or termination. This includes settlement of wages, expense accounts, advances, medical claims, termination of leases, repatriation and similar matters.

The closing of the project office also includes culling and organizing the files. A complete set of construction drawings, calculations, vendors’ drawings, progress photographs, certificates, etc. should be indexed and neatly boxed for return to the ship owner's home office.

It has been found to be of great use for the project manager to prepare a project completion report, which should include a summary of the major events and milestones, key progress photos, a summary of the construction costs and other project costs as measured against the original budget. The closing reports should identify and give credit to personnel who made important contributions to the project.

The report should include a section with recommendations on improvements in the project planning, project design, project procedures, and/or project management. These suggestions can improve the process when the ship acquisition process is repeated.

Warranty Deficiencies and Remedies

The warranty clause of the Agreement must address several specific issues, but the order in which the issues are addressed is not significant. It should be understood, however, that a warranty claim can apply only to an item which was working or completed at the time of Vessel Delivery, and subsequently broke or ceased to work sometime during the Warranty Period. An item which was not working or not completed at the time of Vessel Delivery may be corrected or completed during the Warranty Period, but it is financially treated in a different manner, as described below in the section on Special Retainages.

The duration of the warranty period should be defined. Related to that, the warranty clause should address how, if at all, the warranty period pertaining to some equipment, or perhaps the entire ship, is extended if that item or the entire ship is out of service due to a warranty defect.

The warranty clause must also define what is subject to the warranty: the Contractor’s workmanship, the materials and equipment supplied by the Contractor, or both. Further, the warranty clause must define which entity is giving the warranty on each particular aspect of the ship. The clause may allow the Contractor to pass through any manufacturing warranties from vendors, such as pump manufacturers or coating suppliers, and provide that the Contractor does not otherwise warrant that item; however, the Contractor always warrants the workmanship of installing or applying those items. This
may present some risk to the Purchaser if the manufacturer’s warranty expires before the balance of the contractual warranty is to expire.

If an item of equipment is subject to the manufacturer’s warranty, the Purchaser may find, subsequent to a breakage, that the manufacturer identifies the cause as one of improper installation. That is, for the Contractor to remedy, and the Contractor identifies it as a manufacturing defect, that is, for the manufacturer to remedy. This will create for the Purchaser a potentially unsatisfactory situation, which is best addressed by a contract retainage, as, discussed in Sub-section 9.2.30.

The matter of which party is to expend resources to correct a warranty item must also be defined. This can be complex since it must allow for:

- emergency repairs,
- possible remote location of the ship relative to the shipyard,
- timing of notification by the Purchaser to the Contractor of the existence of a warranty defect, and
- location at which it is possible to effect the warranty correction.

Subsection 9.2.30, Contract Retainages, addresses possible use of those retained funds to effect warranty repairs.
APPENDIX A

MANAGEMENT SCIENCES

A- Introduction

Throughout the Ship Acquisition Process, there is a constant need for creativity and innovation. This is especially true in the early stages of the process where many options are open. During the Strategic Planning Phase where alternative strategies are developed, innovative thinking is essential. Similarly during the Concept Design Phase the designers must be as creative as possible to assure that no competitive opportunities are overlooked. However, as the process matures and optimal decisions are made, the need for creativity diminishes as the selected strategy is executed and the design is “frozen.” There are always opportunities to be creative, but in the latter stages this may apply to details rather than the overall plan or design.

Changes in the late stages may be disruptive and result in change orders, cost overruns and delays. These may outweigh the advantages of “better” solutions. An evaluation of the benefits and risks in such changes should be carefully evaluated.

During the entire Ship Acquisition Process, alternatives will arise and decisions will have to be made. The experienced manager or professional is usually able to make these decisions based on his or her education, training experience or reasoning ability. The manager is also able to call upon specialist professional assistance for advice and counsel in decision making. The manager may also use any of a number of well known and successful techniques to aid in decision making.

Often the challenge may involve a problem that calls for a mathematical methodology to select the correct alternative or optional solution. Management science makes available a variety of such techniques.

A-2 Innovation

Creativity may be regarded as the process of creating something original that has value. It may apply to a physical product or it may apply to a system, methodology or process. The ideas for such improvements come from creative people, i.e. idea generators. Often these are engineers, scientists, researchers and inventors. They may be businessmen, workers or other lay people.

Innovation is a follow on step from creativity. It takes the creation and turns it into something of significant value that is useful to business, society or even to individuals. In the case of business, innovation usually results in improvements in profitability, efficiency, productivity, quality, customer satisfaction, competitive advantages, safety and/or comfort.
Innovation has been variously defined as the process of introducing something new,\textsuperscript{12,13} translating new ideas into tangible societal impact \textsuperscript{14}, a new idea, method or device \textsuperscript{15}, the successful exploitation of new ideas \textsuperscript{16}, a change that creates a new dimension of performance \textsuperscript{17}, a creative idea that is realized \textsuperscript{18}, and the staging of value and/or the conservation of value.\textsuperscript{19}

Innovation should not be confused with invention, which is the creation of a new product or method. Innovation occurs when the product or method is put to use.

“All innovation begins with creative ideas…creativity by individuals and teams are a starting point for innovation.”\textsuperscript{20} “Innovation, like many business functions, is a management process that requires specific tools, rules and discipline.”\textsuperscript{21}

Whereas creativity comes from individuals, innovation is usually the result of teamwork. The innovation may be incremental and sustained, minor and almost daily improvements. Or they may be radical or breakthrough innovations. Innovations can be disruptive and they carry risks. One school of thought believes that fifty percent of all innovations fail. Failure can lead to cynicism and resistance to future change. This negativism can be the result of poor leadership or management and should be guarded against. The failure to innovate can lead to lost opportunities and competitive disadvantage. The success of innovative efforts depends on clear goals, definition and effective communication of those goals to all participants in the innovative process.

Since all innovation begins with creative ideas, it is useful to examine some of the techniques that are used to stimulate creativity and innovation. Such techniques usually involve several steps, namely:

“Problem Definition – Analysis, redefinition and all aspects of defining the problem clearly.
Idea Generation – The divergent process of coming up with the ideas.
Idea Selection – The convergent process of reducing all the many ideas into realistic solutions.
Idea Implementation – Turning the refined ideas into reality.”\textsuperscript{22}

\textsuperscript{12} American Heritage Dictionary
\textsuperscript{13} Merriam – Webster Online
\textsuperscript{14} K. Holly, University of Southern California
\textsuperscript{15} Merriam – Webster Online
\textsuperscript{16} D.O.T. – U.K.
\textsuperscript{17} Peter Drucker, 2002
\textsuperscript{18} F. Johansson, Harvard Business School, 2004
\textsuperscript{19} D. Montano, 2006
\textsuperscript{20} T. Amabile, Westview Press, 1996
\textsuperscript{21} T. Davila, Wharton Publishing, 2006
\textsuperscript{22} www.mycoted.com
An expanded view of the CPS method is found in “101 Problem Solving Techniques.” These are outlined as follows:

1. environmental analysis
2. problem recognition
3. problem identification
4. making assumptions
5. generating alternatives
6. evaluation and choice
7. implementation
8. control

Steps 1 through 6 are called “decision making,” whereas Steps 1 through 8 are called “problem solving.”

Suggestions for techniques to be used in each of the above 8 stages can be found in Appendix II.

Mycoted identifies 183 techniques for the stimulation of creativity and innovation. Some are well known and popular, such as Brainstorming, Delphi, Lateral Thinking, SWOT and Force-Field Analysis. Many others are little known, seldom used, esoteric or seldom of value. Many are variations of the same, such as Devil’s Advocate and Angel’s Advocate. It is useful to become familiar with several of the most widely used methods. These should include:

- Attribute listing
- Brainstorming
- Brainwriting
- Creative problem solving – CPS
- Delphi
- Force-Field Analysis
- Heuristic Ideation Technique
- Lateral Thinking
- Morphological Analysis
- PIPS
- PMI
- SWOT Analysis
A-3 Quantitative Decision Making

There are occasions in the Ship Acquisition process where quantitative approaches are called for. These problems may involve selecting one of two alternatives. Or it may call for maximizing or minimizing some objective. Or it may involve multi criteria decision making.

A summary of the more familiar techniques is found in Appendix III. The more important of these include:

1. Linear programming – A problem solving technique for maximizing or minimizing some quantity. The model has a linear objective function, linear constraints and non-negative variables.

2. Goal programming – A variation of linear programming involving multi criteria decision making.

3. Analytic hierarchy process – A multi criteria decision method that includes subjective factors.

Markov Models – Markov processes or chains involve the way in which systems evolve over time, with the condition of the system at a particular time being probabilistic.

Dynamic Programming – A technique involving breaking large problems into smaller multiple stages whereby the smaller problems are solved sequentially, i.e. recursive optimization.

Simplex Method – An iterative algebraic method for solving linear programming problems, using elementary row operations.

Integer Linear Programming – A linear programming model where some or all variables are integers.

Queuing Theory – Waiting line problems where mathematical relationships are used to create models which can determine the operating or performance characteristics of the queue.

Calculus – based procedures – Useful for determining optimal values of decision variables in non-linear models.

Lagrangian – Optimal solutions found solving for the first and second partial derivatives of Lagrangian functions (combination of the objective function and constraint).

Stochastic Model – Also called probabilistic model. A model where at least one uncontrollable input is uncertain and subject to variation.

Monte Carlo Simulations – Simulations where the values of probabilistic components are generated using random numbers.

Minimax Regret – A method where for each alternative a maximum regret is calculated and the solution is the alternative that produces the minimum maximum regret.
Pareto or min-max optimization – A method which produces an optimum where no criterion can improve without degrading at least one other criteria.

Weighted Sum – Multi-dimensional decision making process based on a single criterion, a figure of merit (FOM).

Hierarchical Weighted Sum - Multi-dimensional decision making process based on a single criterion, a figure of merit (FOM).

Analytical Hierarchy Process - Multi-dimensional decision making process based on a single criterion, a figure of merit (FOM).

Multi-Attribute Utility Analysis - Multi-dimensional decision making process based on a single criterion, a figure of merit (FOM).

Nonlinear Programming – A method for solving a system of equalities and inequalities (i.e. constraints) over a set of unknown real variables, and an objective function which is to be maximized or minimized where some of the constraints or objective function is nonlinear.

Downhill Simplex Method – A numerical process for optimizing a multi-dimensional, unconstrained problem.

Newton’s Optimization Method – An algorithm for finding the roots of equations by using curvature information (gradient descent) to develop a more direct search pattern.

Hill Climbing – A search method which seeks the steepest ascent to find local maxima.

Goal Programming – Method for solving multi-criteria with in the framework of linear programming.

“AHP” Analytic Hierarchy Process – Includes subjective factors relating relative importance for each decision.

Dynamic Programming – Breaks up a large problem – solve all small problems – leaving an optimal solution for the large problem.

Linear Programming – Method for situations involving maximizing or minimizing a linear function.


   b. Simplex Method – solved algebraically for complex problems.

Computer Simulation – For problems too complex for linear programs.
A-4 Demand Forecasting

- Constant growth rate forecasts: Sometimes referred to as “hockey stick” projections, these forecasts are driven by a posited growth rate that is expected to continue over the forecast horizon. Such unconstrained forecasts can lead to illogical projections over long periods of time (e.g. a projection based on a constant unconstrained reproduction rate could lead to a forecast of rabbits taking over the world).

- Constrained forecasts (based on the assumption of limited supply or demand): To overcome the limitations of constant growth rate forecasts, limits are imposed on growth rates to ensure reasonable results.

- Industrial analysis forecasts: The forecast is based on manufacturing capabilities, with industrial development and investment as the primary predictors of growth.

- Market research-based forecasts: Surveys of individual opinions, purchasing plans, and consumer expectations are used to develop growth rates and other information, on which the forecast is then based.

- Time series forecasts: Historical data are analyzed, typically on the basis of regression analyses, to predict future demand or supply. Critics of projections based on historical data liken them to driving a car by looking in the rearview mirror.

- Scenario forecasts: Scenario-based forecasts are based on a set of assumptions about future conditions. War gaming, such as that used by the Department of Defense, is an example of scenario-based forecasting.

- Simulation-driven (Monte Carlo) forecasts: Ranges of expected outcomes, rather than single data points, are used for inputs and combined into an expected outcome distribution. Simulation-driven forecasts can provide insight into the range of potential outcomes and their likelihood.

- Multivariate modeling forecasts: These forecasts develop an internally consistent model of future trade through the use of a large number of independent variables and multiple constraints. High-speed computers have facilitated the generation of these complex models, which are used for national and world trade models.

Source: Marine Transportation Demand, NAS, TRB
APPENDIX B

ECONOMIC ANALYSES – (Source H. Benford)

B-1 GENERAL

Engineers, by definition, aim to use scientific knowledge for the good of society. In a free-market economy, society makes its needs known through its purchases; engineers can therefore ill afford to overlook economics when making design decisions. Those who misuse or ignore economics will waste human and natural resources, thus subverting the profession’s central aim. These facts apply to marine technology as well as any other kind of engineering.

Ship design involves countless decisions on matters large and small. In practically every case, we must weigh an odd assortment of factors before reaching a decision. And that raises the question: in choosing between alternatives, how can we balance factors measured in diverse units? There is but one way – with economics – for dollars are the nearest thing we have to a universal measure of engineering merit. This is particularly true in a commercial ship for here we create something – not to demonstrate ideal hull form or minimum fuel rate – but to carry cargo for a price and thereby return a profit. Even in non-commercial ships, the dollar plays its role for no other yardstick can even pretend to measure a project’s total present and future demand on the nation’s resources.

a. Formerly, engineers were not privy to economic information.

b. Engineers cannot optimize anything in absence of economic data.

c. Ship acquisition teams also have to know what are the: Objectives of the Firm in order to select the correct criterion.

d. Objectives of the firm questions are very philosophical – however, all agree that in a commercial activity it is paramount to “Maximize the value of the firm to the owners or shareholders.”

e. Other objectives include:

   i. Reliability of service
   ii. Frequency of service
   iii. Comfort/luxury/quality of service
   iv. Market domination
   v. Long term stability
   vi. Minimum financial risk
   vii. Safety
Fundamental Concept

Our common confusion about ship economics stems in part from our uncommon ability to forget what a ship is for. Adherence to the following principles may clarify our thinking:

a. A commercial ship is a capital investment that earns its returns as a socially useful instrument of water transport.

b. The best tangible measure of engineering success is profitability; and the only meaningful measure of profitability is the returned profit (after tax) expressed as equivalent interest on the investment.

Universal Principles

Buxtown tells us that: It is only in the last decade or so that rigorous economic evaluations have been seriously applied to ships. There would appear to be three principal reasons for this change:

a. The scope for making the wrong decisions in ship design has increased greatly with the expansion in ship sizes and types. Until recently, the decision depended more on whether to build rather than what to build, as each succeeding ship design was usually a modification of an earlier one. Now, as one design of ocean-going ship can easily be 100 times larger than another, the scope for poor investment multiplies correspondingly.

b. It is axiomatic that a ship design must be the best for the job, but technical criteria such as minimum resistance are not enough. It is now widely recognized that the main criterion must be of an economic nature, giving full weight to technical factors in its calculation. The optimal design is that which is most profitable.

c. There has been increasing complexity in the financial conditions surrounding ship procurement. Traditionally, many new ships have been largely financed out of retained profits, but now cheap loans, accelerated depreciation, subsidies and tax relief all add greatly to the difficulties of calculating ship profitability.

These are the economic facts of life on which the experts agree:

a. A dollar in the future is less important than one at hand. This is what we mean by the term “time value of money.” It has nothing directly to do with inflation.

b. The wisdom of a decision is weighed by looking at the amount and timing of the cash that flows in or out of the corporation (or whatever entity is being served) as a result of that decision. In choosing between alternatives, cash flows that occur regardless of the decision should usually be ignored.
c. In deciding between alternatives, the cash flow lost through rejecting one opportunity is as important as the cash flow gained through accepting another.

d. Except under special circumstances, incomes from commercial operations are subject to taxes. If those taxes are overlooked (and they often are) poor decisions are likely to follow.

e. Public investments such as military ships should be analyzed using interest rates that reflect the taxpayer’s time value of money. This also applies to government owned merchant ships.

**B-2 THE TIME-VALUE OF MONEY AND CASH FLOW**

**The Human Logic**

The subject of time-value of money is not confined to inflation or deflation. Primarily it is concerned with the natural human instinct for finding more pleasure from money in hand today than the firm expectation of acquiring an exactly equal amount, corrected for inflation, at some time in the future.

For example, which would a person rather have today: a $1,000 bill or a legal document entitling a withdrawal of $1,000; plus increment for any inflation, from a bank a year from now? Most people would select the first alternative.

Carrying this analysis a bit further, would a person rather have $1,000 now or the firm promise of a million dollars a year from now? Against most people would surely have enough patience to wait for the million dollars. So what specific amount to be received a year from now would leave a person hesitant to decide? If that figure happens to be $1,200, then that individual’s personal time value of money amounts to twenty percent annual interest. Interest, is in effect, rent paid for the use of money. It is commonly expressed as a percentage of the initial capital, with rent falling due at the end of every year.

**The Financial Logic**

So far the discussion has concerned the logic of interest in purely human, psychological terms. One can also think about it in cold-blooded financial terms. Let us consider the case of a person who inherits a million dollars. One possible investment might be an apartment house that costs exactly a million dollars and promises clear annual profits of $50,000, amounting to, five percent of the investment. If some reliable bank offers six percent annual interest, that might be considered a superior investment.
Three Ways of Thinking About Interest

The time-value of money can be thought about in three distinct settings:

1. Contact interest is the kind with which most people are most familiar. Savings deposits in banks, loans from banks, mortgages, and bonds all carry mutually agreed-upon interest rates.

2. Implied interest is appropriately considered when funds are tied up to no advantage. If a person hides money under the mattress, that action is in effect costing at least as much as the interest that could have been earned by putting the money in a savings account in a bank. (This is an example of a lost opportunity cost.)

3. Returned interest is a measure of gain, if any, from risk capital invested in an enterprise. This is called by various names including internally generated interest, interest rate of return, or simply yield. It is one good measure of profitability, expressing the benefits of an investment as equivalent to returns from a bank at the derived rate of interest. Most nations impose a tax on business incomes, so one must differentiate between returns before and after tax.

In all of the above, the important thing to remember is to weigh the time value of money by the exact same mathematical expressions in all three cases. Another important rule in engineering economics:

In deciding between alternatives, one must consider for each not only how much money flows in or out, but also when.

It is important to clearly understand that throughout this chapter the discussion is about compound, as distinct from simple, interest. In the former, the interest payments are due at the end of each period. If they are left unpaid, they will be added to the debt. Thus the debt would increase exponentially over time. With simple interest, no payments become due until the debt is paid. That is less logical and the plan is seldom used.
Ships have long economic lives, usually twenty to thirty years. Therefore one can treat cash flows on annual basis. Shorter-term studies can be used in some studies. However methods are the same.

2. Diagrams are from the perspective of the investor or lender. For example:

3. Use standard single letter conventions
   - P=initial amount
   - A=uniform annual amounts
   - F=future amount
   - N=number of years (or other time periods)
   - i= interest rate in %

4.

5.
6. Relationships

Single investment—single payment

i. Present worth or present value

\[ F = P \times \text{compounded amount factor} \]
\[ F = P + iP = P(1 + i) \text{ for one year} \]
\[ F - P + iP = P(1 + i)^n \text{ for n years} \]
\[ (1 + i)^n \equiv \text{Compounded amount factor (CA)} \]

Then

\[ P = \frac{F}{(1 - (1 + i)^n)} = F \times \frac{1}{(1 - (1 + i)^n)} \]

\[ \frac{1}{(1 - (1 + i)^n)} \equiv \text{single present worth factor (PW)} \]

[ Note \( \frac{1}{(1 + i)^n} \) is the reciprocal of \( (1 + i)^n \) and PW is the reciprocal of CA ]

iii. Single investment, uniform annual payments
iv. If initial amount is known what are the equivalent annual payments:

\[ P = \frac{A[(1 + i)^n - 1]}{i(1 + i)^n} \]

"Series present worth" factor \( \equiv \text{SPW} \)

v. Uniform annual deposits, Single withdrawal

\[ A = \text{annual payments} \]
\[ = \frac{P \times i(1 + i)^N}{i[(1 + i)^N - 1]} \]

Capital recovery factor \( \equiv \text{CR} \)

**SCA.** Series Compound amount" Factor

\[ F = (\text{SCA} - i - N) \times A \]

\[ \text{SCA.} = \text{Series Compound amount" Factor} \]

**SF.** Series Factor

\[ A = (\text{SF} - i - N) \times F \]
8. Measures of merit
   i. Net present value\[\text{NPV}\]

\[
\text{NPV} = A(\text{SPW} - i - N) - P
\]

Present Value of cash flows (must be positive)

ii. Yield also called:
   “Discounted Cash Flow rate of return”
   “Internally generated interest rate”
   “Rate of return”
   “Probability index”

Derives the actual interest rate where the NPV is zero
Calculation in values assuming interest rates and calculation of NPV to find an \(i\) that let NPV be zero.

iii. Average Annual Cost AAC
\[
\text{AAC} = P(\text{CR} - i - N) + Y
\]

Where \(Y\)=annual operating costs

iv. Required Freight Rate RFR
\[
\text{RFR} = \frac{\text{AAC}}{\text{tons of cargo carried per year}}
\]
### Interest Tables

<table>
<thead>
<tr>
<th>( n )</th>
<th>12%</th>
<th>22%</th>
<th>32%</th>
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### Table for Present Worth Factors

The present worth factor (SPWF) is given by the formula:

\[
SPWF = \frac{1}{(1+\frac{r}{100})^n}
\]

Where:
- \( r \) is the interest rate (as a percentage)
- \( n \) is the number of periods

The present worth factor allows for the calculation of the present value of future cash flows. It takes into account the time value of money, discounting future cash flows to their current value.
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**Appendix 10 Capital Recovery Factors**

\[
CRF = \frac{i(1+i)^n}{(1+i)^n-1}
\]

\[
UPWF = \frac{1}{CRF}
\]

Principles of Engineering Economy in Ship Design
### Appendix 11: Sharing Fund Factors

\[
R = \left[ \frac{SFF}{S} \right] R \\
S = \left[ \frac{UCAF}{R} \right] S
\]

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Principles of Engineering Economy in Ship Design

A-17
B-4 EXAMPLES

Single Payment Compound Amount

Two examples will illustrate these concepts. First, suppose a person has $100 spare cash and decides to put it into a savings deposit with a bank. The bank offers 7% annual interest. If the $100 is left in the bank for two years, how much could be withdrawn at the end of that period?

This calls for the use of compound amount factor

\[ F = P \left( CA - 7\% - 2\right) \]
\[ = $100 \left( 1 + i \right)^2 \]
\[ = $100 \left( 1.07 \right)^2 \]

To derive the numerical value of the compound amount factor interest tables such as 6.1 (A) can be used. It is the reciprocal of the present worth factor shown in the table. In this case the PW factor is 0.8734, so

\[ F = \frac{100 \times 1}{0.873} = $64.50 \]

Simply stated, if $100 were put in the bank today and allowed to compound at 7% per year, that would allow a withdrawal of $64.50 two years hence. It could be said that, given a time-value of money equivalent to 7% interest, $100 today is equal in desirability to $64.50 two years from now. Conversely, then, the firm promise of $64.50 two years from now has a present worth of $100.

Second, assume a given individual has a personal time value of money amounting to 12% interest. What should he be willing to pay for a financial document that promises to pay $1,000 five years from now? Applying the present worth factor (PW).

\[ P = F(PW - 12\% - 5) \]
\[ = $1,000 \left( 0.5674 \right) \]
\[ = $567.40 \]

Now suppose instead of 12% interest, the decision is made to use 20% because that is what is promised by another investment opportunity. This leads to

\[ P = $1,000 \left( PW - 20\% - 5 \right) \]
\[ = $1,000 \left( 0.4019 \right) \]
\[ = $401.90 \]

Comparing this new present value of $401.90 against the previously found $567.40, one can see that the higher interest rate has reduced the present worth of the future $1,000. In short, ascribing high numbers to the time-value of money diminishes the importance of future benefits. This fact is important to keep in mind.
Present Worth Example

An example involving the present worth of a future uniform annual cash flow is as follows:

A company that commonly earns 10% interest on its investments has a chance to buy an existing ship with a remaining life of 5 years and estimated annual clear profits of $750,000. What is the maximum price the company should offer for the ship?

The decision maker should use the series present worth factor (SPW) to convert an expected annual cash flow of $750,000 for 5 years into an equivalent single amount today.

\[ P = $75,000 \times (SPW - 10\% - 5) = $2,843,000 \]

To be realistic, it would be better form to present the above as $2.843 million.

Again reversing the approach, suppose the initial amount \( P \) is known and it is desired to find the uniform annual amounts of equal present worth. This is the common situation in which one borrows money from a bank in order to buy an automobile and must make uniform periodic repayments that incorporate both return of the initial loan and interest on the residual debt. In that sort of loan the payments usually fall due every month, but the principle is still the same as with annual payments. The relationship is now

\[ A = P \times \frac{(1 + i)^N}{[i(1+i)^N - 1]} \]

The component \( i(1 + i)^N / [i(1+i)^N - 1] \) is called the capital recovery factor and is abbreviated CR. When associated with a given interest rate per compounding period, \( i \), and number of compounding periods, \( N \), we show it as (CR – I – N).

As another example:

A proposed fishing boat is estimated to cost $2,500,000. The owner has a time value of money as 12% annual interest. The life of the boat is expected to be 20 years. In order to justify the investment, what is the minimum annual cash flow the boat should be able to generate? Now the owner can use the capital recovery factor (CR) to convert the first cost of $2,500,000 to a uniform annual cash flow of equal desirability (A).

\[ A = P \times (CR - 12\% - 20) \]
\[ = $2,500,000 \times (CR - 12\% - 20) \]
\[ = $334,700 \]

Uniform Annual Deposits/Single Withdrawal

For example, if $100 is deposited each year into a bank account paying 7% annual interest, how much should the depositor be able to withdraw at the end of 10 years?

\[ F = $100 \times (SCA - 7\% - 10) = $1,381.64 \]
If it is desired to reverse the procedure and find out how much must be deposited each year in order to build up some specific future amount (F), one would multiply that future amount by what is called the sinking fund factor (SF), which would of course be the reciprocal of the series compound amount factor.

\[(SF - I - N) = I / [(1 + 1)^N - 1]\]

Say it is desired to build up an amount of $15,000 five years from now so a sailboat may be bought. The decision is made to place annual amounts in a bank offering 8% interest compounded annually. How much must be deposited each year?

**B–5 TAXES AND DEPRECIATION**

**Perspective**

Today, very few maritime nations impose an annual tax on corporate earnings of shipping companies. The U.S. is still one that does. Therefore, naval architects involved in the design of a commercial ship for U.S. shipowners and flag should have at least a rudimentary idea about the applicable tax structure. In many cases a proper recognition of the tax law will have a major impact on design decisions. In other cases, as shown later, taxes can be ignored. In any event, a naval architect should understand enough about the subject to discuss it intelligently with business managers.

Tax laws are written by politicians who are swayed by pressures coming from many directions and are changed over time. As a result, tax laws are almost always complex and continually changing. Thus, most large companies employ experts whose careers are devoted to understanding the tax laws and finding ways to minimize their impact. No attempt is made here to explain all the complexity of current tax laws; but some simple tax concepts are outlined and their effects on cash flow explained.

Among other entangling vines in the jungle of taxation is something called the *investment tax credit* (also *accelerated depreciation*, *fast write off*, etc.) When a government finds the economy slowing, it will want to encourage business managers to spur the economy through new capital investments. The obvious way to do this would be to lower the corporate tax rate. Political leaders may lack the courage to do that, so they look for less visible ways. One such way is the investment tax credit. This allows the organization to reduce its first year’s tax on a new project by some modest fraction of the initial investment. This tax reduction in no way reduces the depreciation allocations and gives business managers added confidence that they will be able to get their money back in a hurry.

**Depreciation**

Depreciation is, in a way, a legal fiction with roots in long-established accounting practices. When a company makes a major investment it exchanges a large amount of cash for a physical asset of equal value. In its
annual report it takes credit for that asset and shows no sudden drop in company net worth. Over the years, however, as the asset becomes less valuable for various reasons, its contribution to the company’s worth declines; that is, it depreciates.

Depreciation is a legal fiction to the extent that the tax laws treat it as an expense in a time period other than when the money was actually spent. Remember the rule: accurate economic assessment recognizes not only how much cash flows in or out, but also when. Another fictitious element is found in the fact that few nations allow owners to recognize inflation when figuring depreciation.

In summary of what has been covered so far, it has been shown that the tax collector’s target is not the company’s actual annual cash flow (income minus costs), but a distorted version of that cash flow. Depreciation allocations recognize capital investments, not in the year they are made, but rather distributed over a period of years. The principal objective of this chapter, then, is to explain some of the major schemes for assigning annual depreciation allocations and their effects on tax liabilities.

**Straight-line Depreciation**

In its simplest form, the ship (or other facility) is assumed to lose the same amount of value every year until the end of its economic life. This is called straight-line depreciation. It is found by dividing the depreciable value by the number of years of life.

\[ D = \frac{(P - L)}{N} \]

In most cases one is justified in ignoring the disposal value. It is typically less than 5% of the initial investment; it is hard to predict; and, being many years off, has little impact on overall economics. Thus, for design studies, straight-line depreciation is usually taken as

\[ D = \frac{P}{N} \]

**B-6 OTHER FACTORS**

**Inflation**

This section explains how to analyze monetary inflation, particularly how it may influence decision-making in ship design. It will be shown that in most cases the effects will be trivial. There may, however, be special situations in which inflation should not be overlooked.

If one can assume that a shipowner is free to raise freight rates commensurate with any future inflation in operating costs, then all financial and economic factors will float upward on the same uniform tide. If that occurs, the optimum ship based on no inflation will also be the optimum ship in which inflation is taken into account. Inflation need be of concern only when some major economic factors are expected to change appreciably faster or slower than the general trend.
Cash Flows Before and After Tax

The bar diagram in Figure 6.13 shows how annual revenues are treated when figuring corporate income taxes. It is assumed here that all factors remain constant over the N years of the project’s economic life. (This is what economists call a heroic assumption, but it is frequently good enough for design studies.)

The bar diagram shows that the annual cash flow after tax \(A'\) is related to the cash flow before tax \(A\) by this simple expression

\[ A' = A(1 - t) + \frac{t P}{N} \]

or, turning it around

\[ A = \frac{(A' - tP/N)}{(1 - t)} \]

An important thing to note is that all of our rational measures of merit are based on after-tax cash flows, not profits. *In short, one should not use profits to measure profitability, but use cash flows instead.* Profits are misleading because they are polluted with depreciation, an expense that is misallocated in time.

**B-7 MEASURES OF MERIT**

Sound Criteria

a. Rate of Return on Investment  
b. Payback Period  
c. Capital Recovery

Acceptable criteria, at times:

a. Required freight rate (RFR)  
b. Cost benefit ratio  
c. Present worth  
d. Discounted cash flow

Unsound criteria include:

a. Present worth, without interest  
b. Minimum operating cost  
c. Maximum profit (as distinct from profitability)  
d. Cost per ton-rule  
e. Minimum fuel rate  
f. Payload times speed divided by horsepower, etc.
Selecting Criteria

The major combinations of pertinent circumstances affecting most ship design decisions and one or more appropriate economic criteria for each set of circumstances are shown above. These apply to feasibility as well as optimization studies, and may be applied to complete transport systems or to major units such as ships.

Having selected the best ship, or other system, someone must decide whether the investment should be made at all. (We assume a free enterprise decision.) Here the alternative is not another ship, but other proposals competing for the same capital; or perhaps the decision is between investment in a ship and buying securities, or simply foregoing an opportunity to borrow the necessary capital. At this stage RFR could get you into trouble. What is the point in building the ship with the lowest attainable RFR if expected freight rates are well below that level? Although RFR saves you the trouble of predicting revenues during the design stage, someone with faith in his crystal ball must do so before triggering an investment. Use RFR to select your candidate, but then use one of the criteria involving predictable income for the go-no-go decision.

For non-income producing ships or captive fleets, the decision maker should look at the AAC for each of two alternatives: building and operating, or paying someone else to provide the same service. For a proposed government-owned unit, benefit-cost ratio is often employed. This ratio is found by dividing the present worth of the benefits by the present worth of the costs.

Economic Criteria

**Net Present Value (NPV)** – The present value of all cash flows, in or out, discounted to the present time at a stipulated interest rate that reflects the minimum acceptable level of profitability. Try to maximize.

**Net Present Value Index (NPVI)** – The net present value per dollar invested. Try to maximize.

**Yield** – The interest rate that brings the net present value to zero. Try to maximize.

**Required Freight Rate (RFR)** – The unit charge to the customer that must be earned if the owner is to gain a reasonable (usually 10 percent after tax) yield on his investment. Try to minimize.

**Average Annual Cost (AAC)** - A uniform annual expense equivalent in present value to the investment and operating costs. Discounts future amounts at an interest rate reflecting owner’s (perhaps public’s) time value of money. Try to minimize.

**Present Worth (PW)** – The present worth of both investment and operating costs. Uses same interest rate as AAC to discount future amounts. Try to minimize.
Life Cycle Cost (LCC) – Same as PW.

Capitalized Cost (CC) – The present worth of providing a perpetual service. Try to minimize.

Returns ($A'$) – Uniform annual after-tax cash flow. Try to maximize.

Operating Costs ($Y$) – Uniform annual operating costs. (Marginal costs of operation, exclusive of costs of capital recovery.) Try to minimize.

Capital Recovery Factor (CRF) – Ratio of uniform annual returns before tax to initial investment. Try to maximize.

Payback period ($PBP$) – Years to regain initial investment. If cash flows are uniform, this is the reciprocal of CRF. Try to minimize.

Benefit Cost Ratio

This is the reduction in cost to the public criterion –

$$BCR = \frac{U_o - U_i}{F_i + Y_i - F_i - Y_o}$$

$U$ = Average annual cost to public
$F$ = Average annual cost of investment
$Y$ = Average annual cost of operating Facility
$O$ = Original
$i$ = improved

(Note: $F = P \times CRF$)

U.S. Law requires BCR must be greater than 1.0

Single payment present worth factor

$$P = (SPWF) S$$

Capital Recover Factor

$$R = (CRF) P$$

Uniform Present Worth Factor

$$UPWF = 1/CRF$$

Sinking Fund Factors

$$R = (SFF) S$$

Measures of Merit When Incomes Are Known

Where the incomes of the alternatives can be predicted, or are treated parametrically, there are two leading methods of analysis commonly used by well-informed businessmen: net present value (NPV) and discounted cash flow (DCF), or yield. In normal usage the two lead to different results and therefore merit some little discussion.

The net present value criterion is a number, with dollar units, found by discounting all cash flows to time zero. (Time zero can be any convenient
reference time: the present, the time of making the decision, or the time when
the investment starts generating returns.) Discount factors are based on a
somewhat arbitrary interest rate, usually dictated by management. This is the
cutoff rate, and any investment promising a lower yield is
considered unacceptable. In typical large United States oil corporations the
current cutoff rates are running about 8 to 11 percent. Proposals are
compared as to their net present value, in dollars, above this level, and the one
with highest NPV is considered best (assuming all have equal risks).
Buxton's Decision Chart

OPERATING COSTS KNOWN?

FIRST COST KNOWN?

REQUIRED RATE OF RETURN KNOWN?

INCOME PREDICTABLE?

CALCULATE N.R.Y

CALCULATE R.R. OR A.A.C.

CALCULATE YIELD

INSUFFICIENT DATA FOR CALCULATION

CALCULATE PERMISSIBLE FIRST COST
# APPENDIX C

## GLOSSARY

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAC</td>
<td>Average annual cost.</td>
</tr>
<tr>
<td>ABS</td>
<td>American Bureau of Shipping</td>
</tr>
<tr>
<td>Aframax</td>
<td>A tanker with a deadweight under 80,000 tons.</td>
</tr>
<tr>
<td>AHP</td>
<td>Analytic hierarchy process.</td>
</tr>
<tr>
<td>Alpha</td>
<td>Risk adjusted performance – high number reflects manager has outperformed considering beta (volatility).</td>
</tr>
<tr>
<td>Analytic Hierarchy Process</td>
<td>An approach to multiple-criteria decision making based in part on pairwise comparisons of preference for elements in a hierarchy.</td>
</tr>
<tr>
<td>Archangel</td>
<td>A respected leader in the private investor community, often an ultra-high-net-worth individual who can influence other angel investors to make an investment.</td>
</tr>
<tr>
<td>AWES</td>
<td>Association of West European Shipbuilders.</td>
</tr>
<tr>
<td>Basel I and II</td>
<td>A method to reduce bank failures by tying the banks capital reserve ratio to the riskiness of its loans.</td>
</tr>
<tr>
<td>BEIAL URBUN</td>
<td>Acceptable only to Hanbali school of Islamic jurisprudence, an Islamic option. Islamic investor purchases goods on behalf of real purchaser and keeps 10% of real purchaser’s deposit. (Islamic Financing)</td>
</tr>
<tr>
<td>BEIBI SALAM/BEI BISALAF</td>
<td>Forward financing transactions to provide working capital to buy raw materials. SALAM identifies the goods. SALIF refers to goods in general generic terms. (The goods must exist at time of sale.) (Islamic Financing)</td>
</tr>
<tr>
<td>BIMCO</td>
<td>Baltic and International Maritime Council, a London-based trade association of owners, brokers and others in the maritime industry.</td>
</tr>
<tr>
<td>Boehm Bawerk’s Law</td>
<td>Production yields greater economic performance through greater uncertainty or risk.</td>
</tr>
<tr>
<td>Bond</td>
<td>A debt instrument wherein the issuer (borrower or debtor) issues a bond to a lender (creditor), wherein the loan is repaid at fixed intervals over time and the payments of interest (the coupon).</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Brainstorming</td>
<td>A general data gathering and creativity technique that can be used to identify risks, ideas, or solutions to issues by using a group of team members or subject-matter experts. (PMBOK)</td>
</tr>
<tr>
<td>BV</td>
<td>Bureau Veritas</td>
</tr>
<tr>
<td>CAF</td>
<td>Compound amount factor.</td>
</tr>
<tr>
<td>Cap</td>
<td>The lender pays interest over an agreed level.</td>
</tr>
<tr>
<td>Capacity</td>
<td>Ability to repay a loan. Capacity compares a company’s cash flow to the monthly minimum loan payment due.</td>
</tr>
<tr>
<td>Capesize</td>
<td>A bulk carrier with a deadweight over 150,000 tons, unable to transit the Suez Canal.</td>
</tr>
<tr>
<td>Caveat emptor</td>
<td>Let the buyer beware.</td>
</tr>
<tr>
<td>CBM</td>
<td>Cubic meters</td>
</tr>
<tr>
<td>CCS</td>
<td>China Classification Society</td>
</tr>
<tr>
<td>Collar</td>
<td>A combination of a cap and a floor.</td>
</tr>
<tr>
<td>Convertible debt</td>
<td>A loan that can be converted to stock, either by election or automatically upon reaching certain business milestones.</td>
</tr>
<tr>
<td>CPCD</td>
<td>A design process: concept/preliminary/contract/detailed.</td>
</tr>
<tr>
<td>CPM</td>
<td>Critical Path Method.</td>
</tr>
<tr>
<td>Creativity</td>
<td>That thinking, which results in the production of ideas that are novel and worthwhile.</td>
</tr>
<tr>
<td>CRF</td>
<td>Capital recovery factor.</td>
</tr>
<tr>
<td>Critical Path Methodology (CPM)</td>
<td>A schedule network analysis technique used to determine the amount of scheduling flexibility (the amount of float) on various logical network paths in the project schedule network, and to determine the minimum total project duration. Early start and finish dates are calculated by means of a forward pass, using a specified start date. Late start and finish dates are calculated by means of a backward pass, starting from a specified completion date, which sometimes is the project early finish date determined during the forward pass calculation. (PMBOK)</td>
</tr>
<tr>
<td>Term</td>
<td>Definition/Explanation</td>
</tr>
<tr>
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<td>------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>CRS</td>
<td>Croatian Register of Shipping</td>
</tr>
<tr>
<td>DCF</td>
<td>Discounted cash flow.</td>
</tr>
<tr>
<td>Debt</td>
<td>A debt is created when a creditor agrees to lend a sum of money to a debtor with a requirement for repayment with interest according to agreed terms.</td>
</tr>
<tr>
<td>Decision Tree Analysis</td>
<td>The decision tree is a diagram that describes a decision under consideration and the implications of choosing one or another of the available alternatives. It is used when some future scenarios or outcomes of actions are uncertain. It incorporates probabilities and the costs or rewards of each logical path of events and future decisions, and uses expected monetary value analysis to help the organization identify the relative values of alternate actions. (PMBOK)</td>
</tr>
<tr>
<td>Delphi Approach</td>
<td>A qualitative forecasting method that obtains forecasts through group consensus.</td>
</tr>
<tr>
<td>Delphi Technique</td>
<td>An information gathering technique used as a way to reach a consensus of experts on a subject. Experts on the subject participate in this technique anonymously. A facilitator uses a questionnaire to solicit ideas about the important project points related to the subject. The responses are summarized and are then recirculated to the experts for further comment. Consensus may be reached in a few rounds of this process. The Delphi technique helps reduce bias in the data and keeps any one person from having undue influence on the outcome. (PMBOK)</td>
</tr>
<tr>
<td>Derivatives</td>
<td>A financial product whose value changes with variations in one or more underlying market variables.</td>
</tr>
<tr>
<td>Design</td>
<td>The preparation of drawings, specifications and models, supported by calculations, testing, research and development.</td>
</tr>
<tr>
<td>DIFKO</td>
<td>Danish hybrid finance scheme. (K/S plus equity finance plus bonds.)</td>
</tr>
<tr>
<td>Dilution</td>
<td>The loss of ownership (as a percentage), which naturally results from selling company stock to new investors.</td>
</tr>
<tr>
<td>DNV</td>
<td>Det Norske Veritas</td>
</tr>
</tbody>
</table>

A-30
Down round  An equity investment (stock purchase) at a price lower than previous investors paid. Down rounds can cause extreme dilution to prior shareholders.

Duress  Compulsion by threat.

Dynamic Programming  A recursive problem – solving technique where a large problem is broken into smaller multiple stages.

EBITDA  Earnings before interest, tax, depreciation and amortization.

Engineering  The application of mathematics and technology by which the properties of material and energy are made useful to people through the creation of structures, machines and systems.

Engineering  The art of applying knowledge and scientific principles to useful purposes.

Equity  The money value of property or an interest in property.

Express Contracts  Contracts which are stated in writing or orally, as distinct from implied contracts.

Failure Mode and Effect Analysis (FMEA)  An analytical procedure in which each potential failure mode in every component of a product is analyzed to determine its effect on the reliability of that component and, by itself or in combination with other possible failure modes, on the reliability of the product or system and on the required function of the component; or the examination of a product (at the system and/or lower levels) for all ways that a failure may occur. For each potential failure, an estimate is made of its effect on the total system and of its impact. In addition, a review is undertaken of the action planned to minimize the probability of failure and to minimize its effects. (PMBOK)

FAR  Federal (v.s.) Acquisition Regulations.

FEA  Finite element analysis

FEU  Forty-foot equivalent unit container.

Floor  Protects buyer from downward movement in interest rates, opposite of a cap.

Flowcharting  The depiction in a diagram format of the inputs, process actions, and outputs of one or more processes within a system. (PMBOK)
<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Force Majeure</td>
<td>Clauses in a shipbuilding contract which define events outside the control of the shipbuilders.</td>
</tr>
<tr>
<td>Fraud</td>
<td>An act of deceiving or misrepresenting.</td>
</tr>
<tr>
<td>Free Float</td>
<td>The amount of time that a schedule activity can be delayed without delaying the early start date of any immediately following schedule activities. (PMBOK)</td>
</tr>
<tr>
<td>FRICT</td>
<td>Flexible/risk/income/control/timing</td>
</tr>
<tr>
<td>GAAP</td>
<td>Generally accepted accounting practice.</td>
</tr>
<tr>
<td>GANTT</td>
<td>A graphical chart of the duration of tasks against the progression of time.</td>
</tr>
<tr>
<td>GHARAR</td>
<td>Uncertainty – excessive uncertainty, risk or ambiguous outcome. (Islamic Financing)</td>
</tr>
<tr>
<td>GL</td>
<td>Germanisher Lloyd’s</td>
</tr>
<tr>
<td>Goal</td>
<td>The end toward which effort or ambition is directed. Aim – purpose.</td>
</tr>
<tr>
<td>Goal Programming</td>
<td>A linear programming-based approach developed for problems involving multiple criteria, where the objective function for goal programming models is designed to minimize deviations from goals.</td>
</tr>
<tr>
<td>GRT</td>
<td>Gross registered tons</td>
</tr>
<tr>
<td>Guarantee</td>
<td>A statement by a producer that his product meets certain standards, and that if it proves defective, he will make restitution.</td>
</tr>
<tr>
<td>Handymax</td>
<td>A dry bulk vessel with a deadweight between 35,000 and 50,000 tons.</td>
</tr>
<tr>
<td>Hedge Funds</td>
<td>Funds that use one or more alternative investment strategies, i.e. leverage, derivatives a arbitrage, etc.</td>
</tr>
<tr>
<td>Herative</td>
<td>A computational process where a cycle of operations produce more accurate results.</td>
</tr>
<tr>
<td>IACS</td>
<td>International Association of Classification Societies.</td>
</tr>
<tr>
<td>Idiosyncratic</td>
<td>The turns you get that can’t be explained by the market.</td>
</tr>
</tbody>
</table>
**Ijara – leasing**

A contract where a bank buys and leases out equipment required by the client for a rental fee with ownership resting with the lessor bank, which will seek to recover the capital cost plus a profit margin from rentals. (Islamic Financing)

Equivalent to leasing. Bank purchases asset and rents to 3rd party. (Islamic Financing)

**IPO**

Initial public offerings.

**IRR**

Internal rate of return.

**IRS**

Indian Register of Shipping, Internal Revenue Service

**ISM**

International Safety Management

**ISO**

International Standards Organization.

**ISTISNA**

Islamic institution places order to build project and sells on agreed terms. (Islamic Financing)

**Japanmax**

82,000 DWT, max dwt for a panamax while keeping an LOA of 225 m, allowing entry to all Japanese grain berths.

**JOALAH**

Simply a fee for rendering a service. (Islamic Financing)

**K/G**

Limited partnership (Kommandit-Gellschaft) - Germany

**K/S**

Limited partnership. (Kommandit Selskap) - Norway

**Laker**

A ship capable of transiting the St. Lawrence Seaway, maximum beam 23.15 meters, about 20,000 DWT.

**Law**

A binding rule of action established by authority with the intent of enforcing justice. Rules of civil conduct, which commands what is right and prohibits what is wrong, which must be obeyed, subject to sanctions or legal consequences. A philosophy of what society feels is the right and proper way to behave.

**LCC**

Life cycle costing.

**LEAP**

Long term equity anticipation security.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lease</td>
<td>A conveyance of property for a specified term and payment.</td>
</tr>
<tr>
<td>Lexus/Nexus</td>
<td>Legal search engines.</td>
</tr>
<tr>
<td>LIBOR</td>
<td>London Interbank Offered Rate.</td>
</tr>
<tr>
<td>Linear Program</td>
<td>A mathematical model with a linear objective function, a set of linear constraints and non-negative variables.</td>
</tr>
<tr>
<td>LR</td>
<td>Lloyd’s Register of Shipping</td>
</tr>
<tr>
<td>Malaccamax</td>
<td>A vessel capable of transiting the Straits of Malacca, maximum allowed beam of 60 meters and maximum draft 21 meters, about 280,000 to 300,000 tons.</td>
</tr>
<tr>
<td>MARAD</td>
<td>U.S. Maritime Administration</td>
</tr>
<tr>
<td>Markov Process</td>
<td>A process whereby transition probabilities describe the manner in which the system makes transitions for one period to the next.</td>
</tr>
<tr>
<td>MAYSIR</td>
<td>Gambling is used to criticize insurance or derivatives. (Islamic Financing)</td>
</tr>
<tr>
<td>Mezzanine financing</td>
<td>A finance package made up of an unsecured loan combined with a grant of warrants. A mixture of debt and equity.</td>
</tr>
<tr>
<td>Mission</td>
<td>A specific task with which a person or group is charged. An assignment given to a person or group in an official capacity. A continuing task or responsibility that one is destined or fitted to do.</td>
</tr>
<tr>
<td>Monte Carlo Analysis</td>
<td>A technique that computes or iterates, the project cost or project schedule many times using input values selected at random from probability distributions of possible costs or durations, to calculate a distribution of possible total project cost of completion dates. <em>(PMBOK)</em></td>
</tr>
<tr>
<td>Monte Carlo Simulation</td>
<td>A process which generates hundreds or thousands of probable performance outcomes based on probability distributions for cost and schedule on individual tasks. The outcomes are then used to generate a probability distribution for the project as a whole. <em>(PMBOK)</em></td>
</tr>
<tr>
<td>Mortgage</td>
<td>A conveyance of property such that the conveyance becomes void upon performance or payment according to terms.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>----------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Mudaraba</td>
<td>Profit sharing – A contract in which one party provides 100% financing and the other party provides the expertise to invest the capital and manage a project.</td>
</tr>
<tr>
<td>MUDARABA</td>
<td>Fund where customers subscribe to fund – where bank manages investment. Percentage of profits go to investor-customers. Bank charges fees. Shares in funds can be bought and sold. (Islamic Financing)</td>
</tr>
<tr>
<td>MUQARADA</td>
<td>Bank issues bonds to finance projects. (Islamic Financing)</td>
</tr>
<tr>
<td>MURABAHA</td>
<td>Cost-plus method for project financings. (Islamic Financing)</td>
</tr>
<tr>
<td>Murahaba</td>
<td>Cost plus financing – A contract between bank and client for the sale of goods at an agree price that includes an agreed profit margin.</td>
</tr>
<tr>
<td>Musharaka</td>
<td>Partnership financing – A contract between two parties who both provide the capital to finance a project. Both parties share the profits in an agreed ratio or share losses on the basis of equity participation. One or both can manage the project with suitable renumeration.</td>
</tr>
<tr>
<td>MUSHARAKA</td>
<td>Provides venture capital by establishing a special purpose company. (Bank and customer are shareholders and share profits and losses.) (Islamic Financing)</td>
</tr>
<tr>
<td>MUSQOT</td>
<td>Irrigation financing. (Islamic Financing)</td>
</tr>
<tr>
<td>MUZARA’A</td>
<td>Farming equipment financing, where farmer supplies the farm land, labor, management and shares in profits with bank. (Islamic Financing)</td>
</tr>
<tr>
<td>NASDAQ</td>
<td>A large American stock exchange formerly known as the National Association of Security Dealers automated quotations.</td>
</tr>
<tr>
<td>Negotiation</td>
<td>A transaction between parties to reach a mutually acceptable agreement on objectives, where both parties have a veto.</td>
</tr>
<tr>
<td>NKK</td>
<td>Nippon Kaiji Kyokai</td>
</tr>
<tr>
<td>NPV</td>
<td>Net present value.</td>
</tr>
<tr>
<td>NYSE</td>
<td>New York Stock Exchange</td>
</tr>
<tr>
<td>Objective</td>
<td>Something toward which effort is directed. An aim or end of action goal. A strategic position to be obtained.</td>
</tr>
</tbody>
</table>
Pact Sund Serventa  A promise should be binding.

Panamax  A ship capable of transiting the Panama Canal, beam 32.3 meters and draft 12 meters (fresh water) about 55,000 DWT.

Pareto Chart  A histogram, ordered by frequency of occurrence, that shows how many results were generated by each identified cause. (PMBOK)

Pareto Principle  Wealth is controlled by few people. Napuk refines this to say 20% of your customers account for 80% of your profits.

Participating preferred  A class of investor stock that, in case of any sale or liquidation, requires the company to pay back the initial investment before any other distributions, and also entitles the holder to participate in capital gains along with common shareholders.

PBP  Pay back period.

PERT  Program evaluation and review document technique.

Planning  The process of setting goals and objectives and forming policies and strategies to meet them.

Policy  Prudence or wisdom in the management of public or private affairs.
  – Management, administration or procedures based primarily on temporal or material interest.
  – Specific decision or set of decisions designed to carry out such a chosen course of action.
  – A projected program consisting of desired objectives and means to achieve them.
  – A statement generally written, which guides or channels subordinates in their thinking or decision making.

Portfolio  A collection of projects or programs and other work that are grouped together to facilitate effective management of that work to meet strategic business objectives. The projects or programs of the portfolio may not necessarily be interdependent or directly related. (PMBOK)

PRC  Polish Register of Shipping, People’s Republic of China

Precedence Diagramming Method (PMBOK)  A schedule network diagramming technique in which schedule activities are represented by boxes (or nodes). Schedule activities are graphically linked by one or more logical relationships to show the sequence in which the activities are performed.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private equity group</td>
<td>Any organized fund or institutional investor that specializes in purchasing, and sometimes managing private companies.</td>
</tr>
<tr>
<td>Program Management</td>
<td>The centralized coordinated management of a program to achieve the program’s strategic objectives and benefits.</td>
</tr>
<tr>
<td>Queuing theory</td>
<td>Sometimes called “waiting line theory” – uses models consisting of mathematical formulae and relationships, which can be used to determine the operating characteristics for a waiting line.</td>
</tr>
<tr>
<td>Research</td>
<td>The search for new principles and processes using scientific concepts, experimental methods and inductive reasoning.</td>
</tr>
<tr>
<td>RFJP</td>
<td>Request for proposals.</td>
</tr>
<tr>
<td>RFP</td>
<td>Request for proposal.</td>
</tr>
<tr>
<td>RFR</td>
<td>Required freight rate.</td>
</tr>
<tr>
<td>RIBA</td>
<td>“Increase, growth,” usuary, interest. (Islamic Financing)</td>
</tr>
<tr>
<td>RINA</td>
<td>Registro Italiano Navale, Royal Institute of Naval Architects</td>
</tr>
<tr>
<td>RS</td>
<td>Russian Register</td>
</tr>
<tr>
<td>SAJ</td>
<td>Shipowner Association of Japan</td>
</tr>
<tr>
<td>Scensim</td>
<td>Scenario Simulation</td>
</tr>
<tr>
<td>Sharia</td>
<td>Islamic law. (Islamic Financing)</td>
</tr>
<tr>
<td>Sharp Ratio</td>
<td>Reward per unit risk – higher is better – based on standard deviation and excess ratio.</td>
</tr>
<tr>
<td>Simplex Method</td>
<td>An algebraic procedure for solving linear programming problems, using elementary rout operations to iterate from one basic feasible solution to another until the optimal solution is reached.</td>
</tr>
<tr>
<td>Spread</td>
<td>The difference in the cost of money to the lender from other sources and revenue from the borrower.</td>
</tr>
<tr>
<td>SPWF</td>
<td>Series present worth factor.</td>
</tr>
</tbody>
</table>
SSF  
**Sinking fund factor.**

Standard Deviation  
**Measure of fund’s absolute volatility – higher is more volatility.**

Stochastic Model  
**A model in which at least one uncontrollable input is uncertain and subject to variation (sometimes referred to as “probabilistic models”).**

Stock  
**An equity certificate wherein a shareholder buys shares or ownership stake in a company.**

Stockbrokerage margin acct.  
**Investment account which allows you to purchase securities with funds borrowed from a broker at a specified interest rate.**

Strategy  
**A planned course of action undertaken to achieve aims and objectives. A general means for accomplishing something, a broad plan which gives guidance to a business.**

Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis  
**This information gathering technique examines the project from the perspective of each project’s strengths, weaknesses, opportunities, and threats to increase the breadth of the risks considered by risk management. (PMBOK)**

Suezmax  
**A tanker capable of transiting the Suez Canal maximum draft allowed 52 feet 6 inches, about 150,000 DWT.**

Sukuk – bonds  
**Sukuk, or bonds, are usually used in conjunction with Ijara leases. The bonds must represent ownership of an undivided part of the asset with all its rights and obligations. Lease payments are passed to the sukuk investors. (Islamic Financing)**

Swap  
**Lender and third party who have excess variable and fixed rate funds agree to exchange.**

SWOT  
**A strength and weakness analysis.**

Target  
**Something that is to be aimed at.**

Term sheet  
**A simple, plain-English memo which outlines the parameters of an investment or loan prior to the formal contract. Term sheets are the basis for negotiation between investor and business owner.**

TEU  
**Twenty-foot equivalent units (containers)**
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time-Scaled Schedule Network Diagram</td>
<td>Any project schedule network diagram drawn in such a way that the positioning and length of the schedule activity represents its duration. Essentially, it is a bar chart that includes schedule network logic. (PMBOK)</td>
</tr>
<tr>
<td>Tort</td>
<td>A wrongful act for which a civil action will be except breach of contract.</td>
</tr>
<tr>
<td>Total Float (PMBOK)</td>
<td>The total amount of time that a schedule activity may be delayed from its early start date without delaying the project finish date, or violating a schedule constraint. Calculated using the critical path method technique and determining the difference between the early finish dates and late finish dates.</td>
</tr>
<tr>
<td>Tracking Error</td>
<td></td>
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<tr>
<td>Transshipment Problem</td>
<td>An extension of the transportation problem to distribution problems involving transfer points and possible shipments between any pair of nodes.</td>
</tr>
<tr>
<td>ULCC</td>
<td>Ultra large crude carrier tanker with more than 300,000 DWT.</td>
</tr>
<tr>
<td>Ultra Handymax</td>
<td>60,000 DWT, limit of 190 m LOA.</td>
</tr>
<tr>
<td>UNCITRAL</td>
<td>United Nations Commission on Uniform Trade Law.</td>
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<tr>
<td>UNIDRUIT</td>
<td>International Institute for the Unification of Private Law</td>
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<tr>
<td>UPWF</td>
<td>Uniform present worth factor.</td>
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<tr>
<td>Usury</td>
<td>An unconscionable or exorbitant rate of interest, interest in excess of the legal rate charged to a borrower for the use of money. Original usage meant “interest.” It has come to mean excessive interest. National banks may charge 1% above the Federal Reserve bank discount rate on 90-day commercial paper.</td>
</tr>
<tr>
<td>Valuation</td>
<td>The dollar value of 100% of the company stock. If an investor buys 25% of the stock for $10,000, then the valuation of the business is $40,000.</td>
</tr>
<tr>
<td>Value Engineering</td>
<td>An approach used to optimize project life cycle costs, save time, increase profits, improve quality, expand market share, solve problems, and/or use resources more effectively. (PMBOK)</td>
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<td>------------------</td>
<td>-----------------------------------------------------------------------------</td>
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<tr>
<td>VLCC</td>
<td>Very large crude carrier tanker with a deadweight between 200,000 and 300,000 DWT.</td>
</tr>
<tr>
<td>Warrants</td>
<td>The right to purchase stock in the future at a predetermined price (called the strike price). Similar to options of a public company, warrants are commonly used to reward early investors, consultants or lenders.</td>
</tr>
<tr>
<td>Warranty</td>
<td>A written guarantee of the integrity of a product and the maker’s responsibility to repair or replace.</td>
</tr>
<tr>
<td>WBS</td>
<td>Work breakdown structure.</td>
</tr>
<tr>
<td>Work Breakdown Structure (WBS)</td>
<td>A deliverable-oriented hierarchical decomposition of the work to be executed by the project team to accomplish the project objectives and create the required deliverables. It organizes and defines the total scope of the project. (PMBOK)</td>
</tr>
<tr>
<td>Yield</td>
<td>A measure of merit, called discounted cash flow rate of return, internally generated interest, rate of return, investor’s method and equivalent return on investment.</td>
</tr>
<tr>
<td>Yield</td>
<td>Rate of return.</td>
</tr>
</tbody>
</table>