

a top-down approach identical general support functions are found that will be clustered in practical life. Figure 1.1 is an example of a functional tree that visualises the functional breakdown of machinery plant. The functions of propulsion and electric power supply will be the main subjects of this book.

Figure 1.2 shows the operational function for three specific examples: (A) a container ship, (B) a frigate and (C) an offshore support vessel.

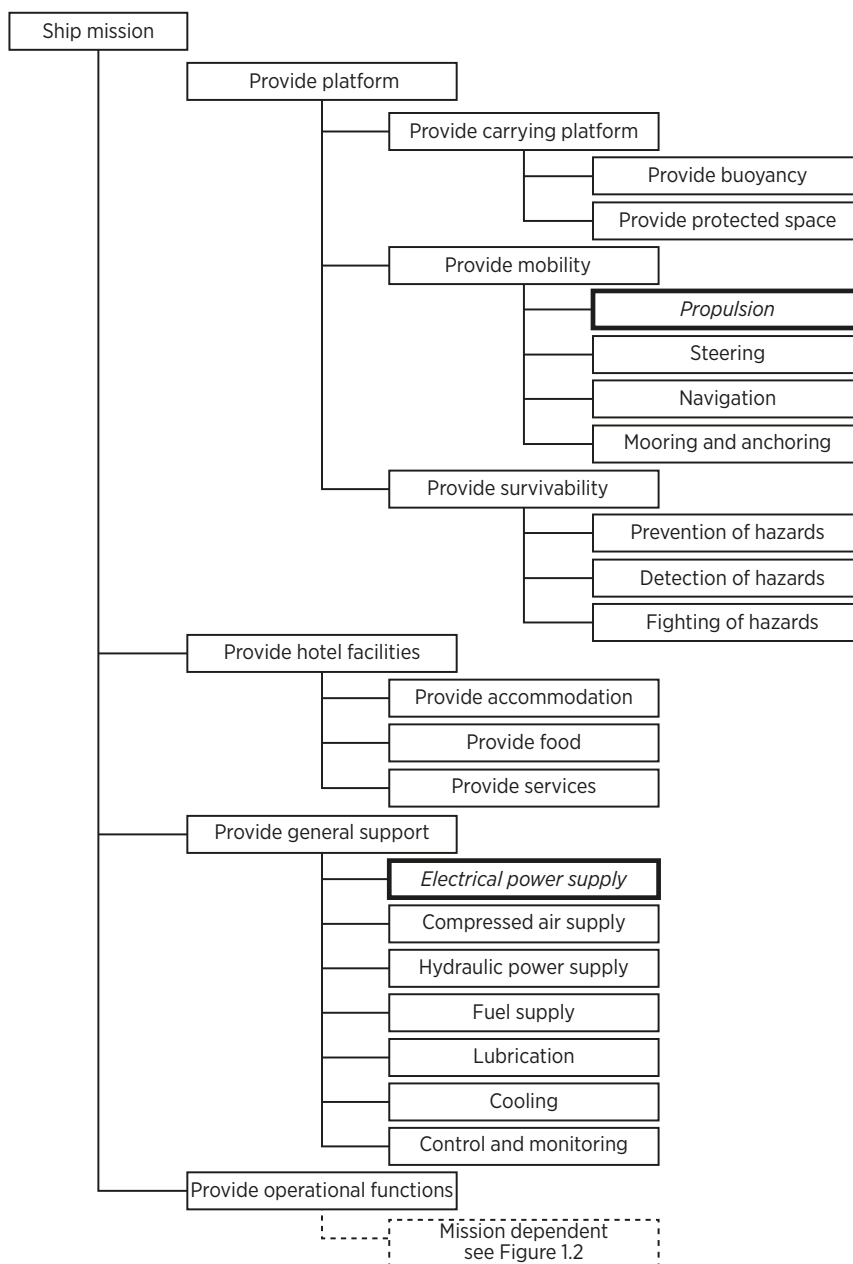


Figure 1.1 Example of functional tree

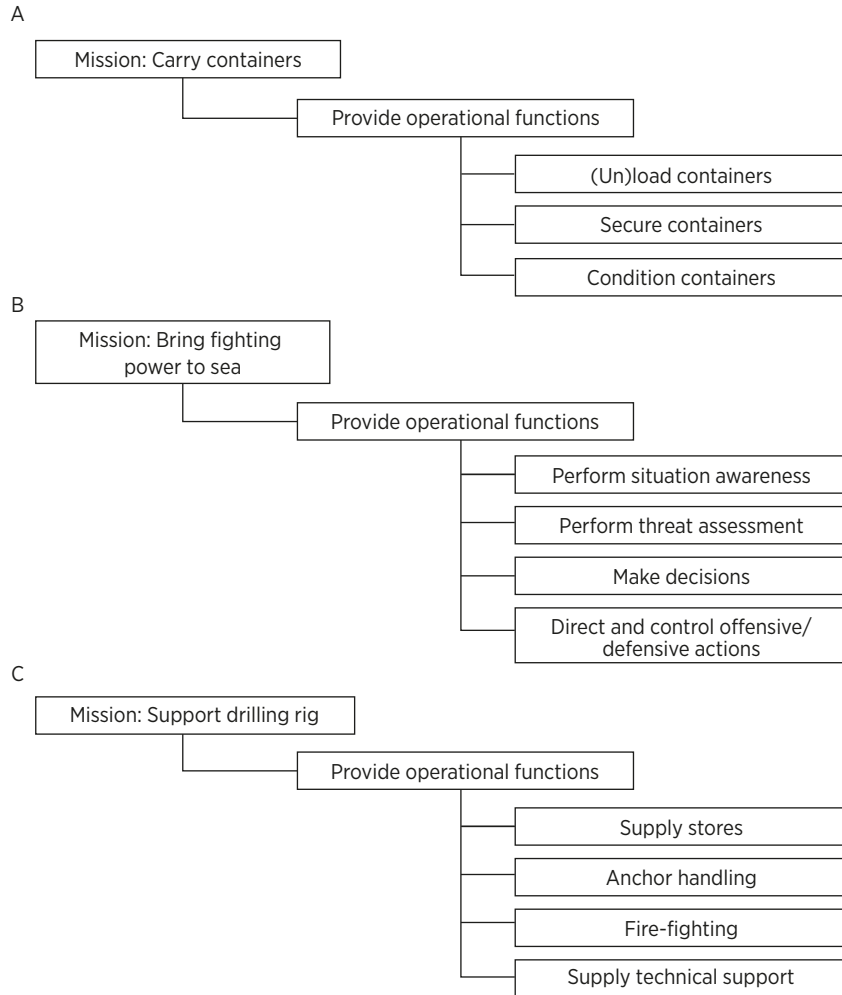


Figure 1.2 Examples of mission specific operational functions

1.3.2 Ship systems and components

Systems

A system is the combination of machinery, equipment and its connections (piping, cabling) that performs the task indicated by a (sub-)function. Systems may be grouped by their function:

Platform systems provide the platform functions. The hull or the offshore platform provides the carrying platform and protection against the environment. The propulsion system, the steering system, the navigation system and the anchoring and mooring systems provide mobility. Fire detection and fire-fighting systems are examples of systems that provide survivability.

Hotel systems provide the hotel facilities. Examples are cabins, galley equipment, laundry equipment, drinking water systems and waste disposal systems.

Support systems provide the support function, e.g: electric power supply systems, hydraulic power supply system, lubrication oil system and compressed air system.

Operational systems provide the operational functions, e.g: cargo-handling and conditioning systems, combat system, fishing gear, oil drilling equipment or pipe laying system.

Systems can be divided into sub-systems and components depending on the complexity and the intended purpose of the description. In some cases it may be sufficient to look at the diesel engine as a component in the propulsion system, while in other cases the diesel engine should be described as a sub-system, which in turn can be split up in components.

Components

A component is a building block of a system. The diesel engine is an example of a component of the propulsion system: its function is to provide mechanical power. Another example is a shaft in the propulsion system: it transfers mechanical power from the engine to the propulsor. Other common components are an electric motor, a cable, piping, a propeller, a bearing, a pump, a compressor and a turbine.

In this book, a component is generally described using a black box approach. The goal is to provide the student with sufficient technical knowledge and skill to integrate equipment and machinery into systems in a well-founded manner both technically and economically. This means that the component's function in the system, its behaviour (e.g. physical and electrical principles), its interaction with other components and the operational (control) characteristics are important. The detailed design or construction of the components will not be described.

Some commonly used components in the propulsion and electric power plants are described in Chapter 6, and the diesel engine and the gas turbine will be discussed in more detail in Chapter 7 and Chapter 8.

1.4 Underlying principles of marine engineering

The design of machinery systems requires knowledge of ships, machinery and equipment. More specifically, the marine engineer has to be familiar with physical principles, economics, RAMS (reliability, availability, maintainability and safety) requirements, space and weight limitations and control and monitoring. All principles are explained briefly, although not necessarily in order of importance.

Physical and electrical principles

Studying marine engineering requires basic knowledge of the physical principles that govern the operation of systems, machinery and components. In this book thermodynamics, fluid dynamics, heat transfer and electrical engineering are applied. It provides an effective way

to understand the working principles of the machinery and it shows the commonality of different types of machinery.

Economic principles

The design of a machinery plant is not complete without economic considerations. Not only the costs of acquisition should be considered but also the operational costs, such as costs for energy, maintenance and manning and the lifecycle costs.

Reliability, availability, maintainability and safety (RAMS)

Systems need to comply with accepted standards for reliability, availability, maintainability and safety. RAMS considerations are important for the operation and economics of the ship, and also for crew safety and environmental impact.

Space and weight considerations

Space and weight considerations capture the naval architecture side of marine engineering. As the systems are part of a marine structure, space and weight need to be considered. The design of a ship influences the location of systems and the available space. The weight and location of a system influence a ship's deadweight and stability.

Control and monitoring

Control and monitoring requirements influence the design of the plant directly, for instance by the number of sensors and actuators. The requirements are based on operations (remote or local and manual or automatic control), manning (skill, man hours, crew reduction) and safety (automatic shutdown, emergency stop).

Chapter 2

Underlying Physical Principles

