



Chapter 5

Digital Transformation in Ship Operations and Management: Digital Twin Technology Applications

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ABSTRACT

Many businesses around the world have begun to take advantage of digital technology in recent years. Making use of digital technology enables one to do things in less time, need fewer employees, reduce costs, use information and resources effectively, produce the most products with the least resources, and consequently, increase the profitability of the enterprises. The shipping sector is one of the building blocks of the maritime industry. It aims to increase its profitability by digitizing in today's increasingly competitive conditions. In recent years, digital twin (DT) technology has been used extensively for the digitalization of the sector. This chapter introduces the current and potential uses of DT technology in ship operations and management and gives an idea about how DT technology will create an opportunity to develop the shipping sector.

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INTRODUCTION

Organizations operating in a classical structure lose time, money, and therefore their competitive power day by day, compared to organizations that use digital technology available today. This is because works on paper require more time and manpower. Today, there is almost no institution left that is still working on paper, however using computers in an organization does not necessarily mean that digital transformation is fully realized. Digital transformation also defines an organizational transformation. Using digital systems is only a means of full scale transformation. Digital transformation can be defined as organizational transformation in the digital age, where people's purchasing preferences are shaped by developments in information technologies (Tanniru, Xi, & Sandhu, 2020). Digital transformation strategies have four basic dimensions: the use of technologies, changes in value creation, structural changes, and financial aspects (Matt, Hess, & Benlian, 2015). Although digital transformation is a difficult and time-consuming process, it still helps organizations to achieve more profit by ensuring sustainability and competitiveness. However, current efforts to realize digital transformation do not yet have clear standards and they may require different processes for individual institution. Despite the difficulties in the transformation period, due to the magnitude of the benefits to be achieved, today all organizations in the world are trying to achieve digital transformation. With the encouragement of increasing competition in recent years, digital transformation efforts in the maritime industry have also gained momentum. DT technology, as an integral part of this transformation, has become a step ahead and found a wider place in maritime industry.

Ship operations and management, which covers all maritime trade, is a sub-field under the maritime industry. The maritime industry includes shipbuilding, marine resources and marine fisheries, marine tourism, and ship operations and management (Stopford, 2009). In this chapter, the "Ship operations and management" sub-field of the maritime industry has been focused on, studies conducted with digital twin technology have been examined and future projections have been made.

The concept of DT refers to a copy of a real object in a virtual environment. The twin-generated object can be a simple device or a complex system. Talking about the twin of an object is possible by transferring all its information to its twin. For this reason, the created twin needs to be constantly updated with current data. This is the most evident difference between the DT and the simulation. While there is no information transfer from the real object in simulation technology, there is a continuous data flow from the real object to the twin in the DT technology. On the other hand simulations use assumptions whereas DT uses real data to perform their functions. A DT is an integrated multi-physics, multi-scale, and probabilistic simulation of a complex object. It consists of a physical object, a virtual object, and

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