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ELECTRICAL POWER ENGINEERING

Development of Transport Efficiency of Merchant Vessels by the Research on Historical Change of Specific Power Output and Engine Trend

Hlaing Thiri
Department of Marine Electrical Systems and Electronics
Myanmar Maritime University
Yangon, Myanmar
hlaingthiri.met@gmail.com

Abstract - **The object of this paper is to provide how technological innovation makes advantageous to shipping industry by the concept of transport efficiency showing the historical change of the specific power output versus the product of speed and payload (P/W_PV). In this paper, research on LNG carriers, Tankers and Container ships within 1970-2008 are carried out and the data, fleet size, Dead Weight Tonnage (DWT), speed, power output and engine trend for each type of vessels are retrieved from Fairplay Encyclopaedia online data base.**

Keywords: **transport efficiency, power output, speed, payload, LNG, Tanker, Container, engine trend**

I. INTRODUCTION

The maritime commercial shipping industry moves more than 90 percent of the world trade [21]. According to the energy use (kW-hr/t-km), shipping is the most efficient mean to move cargo over long distances by comparing other transportations. This high efficiency level can reduce transportation costs and greenhouse gas emissions per tonne-mile of cargo moved [16]. Aiming at supporting the maritime transport to be efficient, technological innovation is essential requirement for shipping industry to cope both qualitative demands, regarding reliability of transport, and quantitative demand, regarding the volume of cargoes [15].

To get better transport efficiency, the relationship between economy and technology, innovation of ship design according to the speed merit and size merit aiming at faster and cheaper [15], the important factors are designed speed, route length, vessel's size; and payload/displacement ratio [7] and also trading volume is included [9]. For being matched higher levels, both the size and the speed of the vessels have to be emerged in designing the ships [10] from engineering point of view and also economical aspects [6].

Aiming at future innovation for shipping industry that has to be carried on, research on past experiences should be done. Therefore, to know how transport efficiency has developed due to technological innovation in merchant ships, the historical change of specific power output (P/W_PV) within 1970-2008 was researched.

For transporting people, raw materials and manufactured goods, merchant ships which are different in shapes and sizes, are used [14]. Cargo ships, ocean liners, ferries, sailboats, and many other types are included in merchant ships. Nevertheless, only LNG carriers, Tankers and Container ships are under study in this paper.

Because of different functions and carrying different cargoes, the ship's characteristics such as speed, design and size are also different. For these differences, in this research paper, the development of each type of ship is analyzed for the period of 1970 to 2008.

According to the function, a ship which is designed for transporting liquefied natural gas (LNG) is known as LNG carrier while the purpose of a tanker is to transport liquids in bulk and a container is intended to carry the cargo in truck-size containers by the use of containerization technique [11]. Because of different functions, and ship particulars, different development of transportation efficiency for each vessel is analyzed to know how innovation was brought and put into practice to add value for the existing market.

In this paper, the analysis of the development of ship particulars such as ship numbers, speed, engine output, dead weight tonnage, and engine trend between 1970 to 2008 are retrieved from Fairplay Encyclopedia online data base [3]-[4]-[5] and for the purpose of clear comparison to know the change of each data, data from 1970 to 1979 is used as a base and all changes or growths are shown as per unit value.

II. TRANSPORT EFFICIENCY FOR VESSELS

Transport efficiency, the energy efficiency used for transport facilities; depend on the type and size of the vessels and also type of cargoes carried, therefore different types of vessels give different levels of transport efficiency[7]. However, the basic concept of transport efficiency is dependent on the speed and size of the ship.

$$\eta_{TP} = W_P \times \frac{L}{E} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

where η_{TP} = Transport efficiency; W_P = Payload
L = Distance; E = Energy used for transport

$E = H_f \times$ fuel consumption ..... (a)

Where, H_f = Heat value of fuel

Fuel Consumption = $(S_{foc}) \times$ Output (P) $\times$ (t) ..... (b)

S_{foc} = Specific Fuel Consumption

P = Output Power and t = time

But speed V = Distance (L) /Time (t)..... (c)