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A CONTEMPORARY OUTLOOK ON HUMAN ELEMENT IN ENERGY EFFICIENT SEABORNE TRANSPORTATION

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Abstract. This paper addresses human element issues in the current discussions on energy efficiency in the maritime transport. Shipping is generally known as the most environmentally friendly mode of transport (Boon, 2007) in terms of CO_2 produced per ton nautical mile. Nevertheless, there is still immense potential in various technical and operational areas remained for improving energy efficiency in the sector. These measures, not limited to, include ship design, hull and propeller efficiency, alternative fuels, renewable energy, weather routing, fleet management and so forth. Despite an extensive amount of research available to improve energy efficiency in shipping, the implementation of such measures has not been progressed by the industry as expected (Johnson and Andersson, 2014). In addition, the area of human element when operationalising the concept of energy management in practice is under-researched. This paper draws attention to barriers, human behaviour, and change management theory in the process of integrating energy management measures into the workplace from the organisational to personal level. For example, how does the organisational change influence human behaviour in the context of energy management? How do the personnel in a maritime organization or on board a vessel take on energy management in their routines of work? What leads to cultivate a mindset of energy efficiency among workers in the organisations? This paper revisits the contemporary discussions related to energy efficiency in shipping and focuses on human element to support the process of implementing energy management for a sustainable maritime transport system (IMO, 2013). It can be concluded that more emphasis on human element in the area of energy management will help the development of an implementation mechanism for the sustainable shipping, and thereby human element should be focused both in education and research on energy management. Such academic efforts will make a substantial contribution to the contemporary debates in interdisciplinary science and technology.

Key words: human element, energy efficiency, shipping, sustainability, energy management

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1 INTRODUCTION

There has been a growing attention to "green shipping" or eco-friendly operation of ships in the last couple of decades. In 1992, The United Nations Conference on Environment and Development (UNCED) was held at Rio de Janeiro and the discussions included alternative energy sources to replace the use of fossil fuels in relation to global climate change. This led to an effort to make an international agreement, called Kyoto Protocol, within the United Nations (UN) Framework Convention on Climate Change, setting internationally binding emission reduction targets. Shipping was not an exception in this discussion. According to the Third IMO GHG Study (IMO, 2014), the average green house gas (GHG) emission from shipping accounted for approximately 3.1% of annual global CO_2 during the period of 2007–2012 on average.

Similar to car industry, shipping industry is also expected to contribute to energy efficiency in the design of ships as well as the use of alternative fuels. Undoubtedly, technology in future shipping cannot escape from the political and economic demand of energy efficient seaborne trade and is expected to drive this trend of "green shipping" in even more operational and feasible manners.

While technological development foresees the future landscape of modern green shipping, the element of human should not be forgotten. Even if unmanned ships become realistic, there is still a need of human-beings to operate such ships from the shore. In the event of introducing new technology, there is always a chance of re-define the role of human-beings in a new work scene. This paper thereby aims at discussing the human element in energy management in the pursuit of efficient and environmentally sound shipping operations.

2 WHY GAPS EXIST?

The idea of energy efficient shipping has been welcome both politically and economically since 1990s. The climate change became a serious concern for people around the world and UNCED in 1992 confirmed that it is a global challenge for the earth. Various UN organisations have discussed this global threat from their perspectives. Food and Agriculture Organization (FAO) calls for a strong and collective effort to reduce the risk of intensified food insecurity for many of the world's most vulnerable people (FAO, 2015). World Health Organization (WHO) warns that climate change is expected to cause approximately 250,000 additional deaths per year between 2030 and 2050, from malnutrition, malaria, diarrhoea and heat stress (WHO, 2015). While voices from global and local political arenas were raised, the industry also became aware of its economic incentives for sustainable operations. In the context of energy efficiency in shipping, various measures were developed to reduce CO_2 emission. These measures include, for example, ship design, hull and propeller efficiency, alternative fuels, renewable energy, weather routing, fleet management and a number of new innovative technologies have been investigated for application.

The question is how these energy efficiency measures are implemented in practice. Thollander and Palm (2013:35) employ the term, 'energy efficiency gap', to describe 'the existence of a "gap" between potentially cost-effective energy efficiency measures and the measures actually implemented.' It is evident from numerous research that not all the energy efficiency measures may be implemented despite their financial benefits (Thollander and Palm, 2013). This problem, acknowledged as 'energy efficiency gap', refers to policy decision-making, market factors, social barrier, and so forth. Public policy intervention requires certain justification for implementation by balancing cost and benefit. Policy decision-making could, therefore, cause a barrier of adopting certain measures in a given situation. In addition, market factors can be a challenge for certain energy efficiency measure. For example, when oil prices are sufficiently low, it would become difficult to argue that all the energy efficiency measures are cost-effective and therefore they are less likely to be implemented.

Among those gaps, social barrier is somewhat similar to the notion of human element which is the main focus of this paper. It considers the perspectives of workers who exercise energy efficient operations and how the people behave and react to the implementation of energy efficiency measures in their routine work.

3 HUMAN ELEMENT AS SOCIAL BARRIER

The role of human element has been a concern since human beings started to interact with modern technology. 'We are an inseparable part of the entire technological, social and decision-making machine, and of the learning process itself (Duffey and Saull, 2008:xv).' When human beings meet new technology and try to work around it, there would be the area of human element which could help to understand how we tend to behave and react to certain situations.

Human element in the maritime sector has been highlighted by a number of accidents which the shipping industry experienced. For example, the tanker, Torrey Canyon, made the first major oil spill in the

English Channel in 1967 as a consequence of psychological pressure and time demand factor. Today's shipping is even more complicated as the crew is often multi-national and communication issues between seafarers with different cultural backgrounds has been seriously observed as human element in modern shipping (Kitada, 2011, 2015). Human performance factors or behaviours are frequently referred to accident causation. These factors and behaviours include fatigue, stress, health, non-technical skills, situation awareness, decision making and cognitive demands, communication, language and cultural diversity, and teamwork (Hetherington et al, 2006). It should not be under-estimated that industry-driven motivations to push workers to an extremely stressful work environment may incur a danger to human-beings, cargos, and environment.

In terms of energy efficiency in shipping, it was also driven by the industry where they were striving for cost-effective business models. A number of studies have focused on the development of new technology and innovation in maritime energy sector. For example, a ship can be equipped with a device which can lively transmit all the ship operating parameters and weather conditions to the shore-based ship management office via satellite systems. This new technology enables shore-based managers to monitor and analyse the ship data from a distance and to provide effective support, such as an advice for the optimal energy-saving operation (see also Bazari and Longva, 2011). Despite such technological innovation in energy efficiency in shipping, the literature on human elements in the context of maritime energy, including barriers, human behaviours, change management, is rather scarce.

4 AN INQUIRY TO BARRIERS TO ENERGY EFFICIENCY IN SHIPPING

Energy efficiency is becoming one of the mandates for many shipowners as well as policy-makers. Corporate social responsibility (CSR) has been introduced in private sectors, and the reductions of energy consumption and CO_2 emissions became a shared responsibility across various industries. Shipping industries have come to the new phase which their commercial activities were proved to be the most environmentally friendly mode of transport (Boon, 2007) in terms of CO_2 produced per ton nautical mile. Thus, their commitment to the globe is very important and should be sustainable.

While technological development has enabled to find various solutions to energy efficient shipping, the industry has been experiencing a gap between its potential and action. Johnson and Andersson (2014) pointed out that the implementation of energy efficient measures has not been progressed by the industry as expected. Why is it so?

An inquiry to barriers to energy efficiency in shipping is a starting point for such a discussion. Economic barriers are well-known as both market and non-market failures. Market failures include, for example, imperfect or asymmetric information problems, split incentives, principal-agent problems, adverse selection, and moral hazard whilst non-market failures are such as market heterogeneity, hidden costs, access to capital, and risk (Rehmatulla et al., 2013). On the other hand, barriers related to organisation and human behaviour have not been studied as much in shipping. Instead of focusing on technical and economic barriers, this paper draws an attention to socio-economic barriers for the purpose of mitigating a human element gap between energy efficiency expectation and implementation.

One of the socio-economic barriers to be highlighted is a limited extent of information dissemination in smaller firms. Compared to large shipping companies, small firms do not have as much resources as large ones, including human and capital. Banks et al. (2012) argue that larger shipping companies may be able to invest in new technologies, innovations and training regarding energy efficiency than smaller companies. The evidences from their research on energy efficient operation of ships do not seem to successfully motivate those small ship operators and owners to exercise energy efficient practices as expected (Banks et al., 2012). If collective efforts as an industry to save energy are not made because of the lack of consensus, the impact would be smaller than potential. It is, therefore, important to increase the awareness of energy efficiency through the dissemination and sharing the research-based information and the shipping industry could work for more effective implementation.

Another consideration in the socio-economic barriers arises from organisational theories. Max Weber understands organisations as hierarchy which admits the relationship between superiors and subordinates (Weber 1968). In such organisations, decisions to implement energy efficiency measures are not necessarily made by practitioners and there may be a gap between the leaders and followers in terms of the lack of understanding of human element. On the other hand, systems theory explains that the organisation is an open system, which interacts with the environment and is continually adapting and improving. If the organisation implements energy efficiency, it needs to be systematic in adapting such changes which may bring a larger impact than anticipated. The research reveals that 'many shipping companies appear to lack the ability to systematically address energy efficiency within

their organisations' (Johnson and Andersson, 2014). From the neo-classical perspective, human behaviour in organisations is further emphasised and concerns about social and psychological aspects of human behaviour. In the context of energy efficiency in shipping, such social and psychological impact of human behaviour should not be under-estimated and it needs to be a central of the discussions in examining the energy efficiency gap in shipping.

5 ENERGY MANAGEMENT FROM INDIVIDUAL TO ORGANISATIONAL LEVEL

The area of human element in energy efficiency in shipping is not a single dimension but rather multi-layered and intertwined with other technical, political, social and cultural aspects of the industry. Bearing in mind a limitation of developing a comprehensive understanding of human element issues in this short paper, the attempt is made to discuss three sub-set questions in order to facilitate some important human element considerations in energy management from individual to organisational level.

The first question is posed as how the organisational change influences human behaviour in the context of energy management? Today's organisations are exposed to various changes from both external and internal factors. External changes include, for example, the effect of globalisation, technological development, legal forces, market change, and political tensions with neighbouring countries. Internal changes can be structural, cultural, and new directions and processes resulted from leadership and management changes. Organisational changes may occur at various stages of organisational development. When energy efficiency is first introduced in the organisation, how would the visions and strategies of energy management be shared and promoted among the workers? Human behaviour deeply rooted in the organisation for a long time may be challenged if the energy management requires the workers to change their behaviour. Therefore, from the management point of view, it is crucial that organisational change would bring new and pragmatic framework (By, 2005) in which workers can understand the meaning of change both at organisational and individual levels. Moreover, such an examination of organisational change impacting individual workers can be further discussed in other situations, for example, in their routines of work.

Routine work where various policies and procedures take place is something difficult to understand from the top-down approach. Without organisational change, ordinary patterns of work are heavily involved in human behaviour where workers' knowledge and experiences are pervaded. The second question comes, therefore, as how the personnel in a maritime organisation or on board a vessel take on energy management in their routines of work. It is widely acknowledged that the Master and the crew tend to experience a gap in their perceptions of routine work on board when the managers in shore-based offices try to enforce new policies and procedures into the ship. Johnson and Andersson (2014) also observe such organisational barriers that the ship crew who directly influence actual energy use may be organisationally far from those responsible for implementing energy efficiency improvements and hardly be included in the decision-making process. In this context, energy management should not be introduced as an additional burden for seafarers and considered to employ a bottom-up approach. This standpoint is actually answering to the next question relating to human element in energy management.

The third question concerns about a sustainable issue of workers' education and training: what leads to cultivate a mindset of energy efficiency among workers in the organisations? As discussed earlier, a top-down approach would face a limitation to encourage and motivate workers, especially seafarers, to understand the meaning of energy efficiency on board and proactively contribute to a sustainable development of ship operations. Banks et al. (2012) conducted a study on seafarers' awareness, knowledge, motivation and ideas in energy efficient operation by using a questionnaire and received 317 responses from more than 20 countries. The research highlights that seafarers tend to feel uncertain or a lack of sufficient knowledge or motivation about how they can contribute to carbon reductions. It also reveals that the current education and training for seafarers does not focus on energy efficient operation. Meanwhile, cultivation of seafarers' mindset of energy efficiency may also result in modifying their behaviour and routine work if necessary. 'Energy management is not an immediate fit to existing organizational structures, but may require new organizational forms and new infrastructure for performance monitoring (Johnson, 2013)'. In order to successfully implement energy efficiency in organisations, a dialogue between managers and workers is necessary, including a possibility of incentives, such as a bonus resulted from saved fuel costs by implementing the company's energy efficient policies and procedures. Without such consultations, psychological barriers would not be removed. For the better sake of healthy management and operation of ships, unnecessary tensions between managers and workers should be avoided.

6 SUSTAINABLE SHIPPING: THE ROLES OF HUMAN AND TECHNOLOGY

According to the IMO concept document on a sustainable maritime transportation system (IMO 2013), the IMO Secretary-General, Mr. Koji Sekimizu emphasises the role of shipping industry to serve sustainability in a wider context under the UN visions. Seaborne trade is crucial in terms of supporting countless of wealth-creating and poverty-alleviating activities in both developed and developing countries. In addition, shipping offers job opportunities to people around the world and it is worth noting that over 1.5 million seafarers are employed largely from developing countries. In this document, energy efficiency and ship-port interface as well as energy supply for ships are highlighted as the key components of the IMO's sustainable development approach.

Technology in energy efficiency will continue to provide wide options and solutions for different stakeholders to implement energy management in their organisations. From all available measures for energy efficiency, companies have to make a decision of which solution is suitable and appropriate and explain their employees why a particular solution is chosen in their work environment. If the workers are given an opportunity to address their concerns and preferences when choosing a solution for energy management, it would help the organisation to learn the process of adopting a new system and a potential gap related to human element could be reduced. Otherwise, it is suggested that managers should explain how the chosen-measure for energy efficiency will influence the employee's patterns of work. Managers are also expected to be flexible in designing the implementation process by discussing with workers, hence both managers and workers can learn from each other.

The role of human element in the energy management, therefore, needs to be more emphasised in both education and research. The lack of human element would cause a gap in the implementation mechanism for the sustainable shipping. In the past decade, the shipping industry failed to address human element issues in the implementation process of energy efficiency. Under the IMO's effort as well as the United Nations Decade of Sustainable Energy for All 2014–2024 (SE4All) (UN 2014), all the stakeholders in the maritime sector are invited to promote such advocacy campaigns and develop a strategy for action. In response to this call, the shipping industry should be fully aware of the importance of human element in energy efficiency and contribute to the establishment of an implementation mechanism, namely, 'a sustainable maritime transport system' (IMO, 2013).

7 CONCLUSION

Energy is an essential engine for growth, and thereby energy management is vital for human beings, within their capacity, to keep our environment, including oceans, sustainable. The paper highlighted that a focus made by the shipping industry in energy efficiency has been based on technological, economic and political debates without linking to human element issues, such as barriers. It draws a conclusion that more emphasis on human element in the area of energy management should be facilitated to develop an implementation mechanism for the sustainable shipping.

Awareness of human element issues in energy management can be effectively raised via education and research on energy efficiency in shipping. More and more interdisciplinary research which connects technology to socio-economic approaches is expected to increase, and such discourses would help filling in the current gap observed in energy efficiency implementations. While shipping is committing to continuously operate the most environmentally friendly mode of transport around the world, socially responsible attitude of the industry would picture a positive image of the industry itself. Thus, the shipping industry will be more attractive to people and adaptable to change.

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