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A study of the implications of the ballast water management convention for flag states

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A STUDY OF THE IMPLICATIONS OF THE BALLAST WATER MANAGEMENT CONVENTION FOR FLAG STATES

A Case Study of the Republic of Korea

By

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Republic of Korea

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DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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ABSTRACT

Title of Dissertation: **A Study of the Implications of the Ballast Water Management Convention for Flag States : A Case Study of the Republic of Korea**

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As a by-product of globalization and international maritime trade, the marine environment, fishery resources and human health have been significantly threatened with the increased risk of invasive alien species transferred by ships' ballast water. In this respect, the BWM Convention adopted by the IMO is a vital measure for the protection of our marine ecosystem.

The BWM Convention is expected to come into force soon since at present less than five percent of world gross tonnage is needed to meet the criteria for its entry into force. Accordingly, this is an important time for flag States to prepare for the forthcoming entry into force of the Convention.

According to the BWM Convention, all ships which carry ballast water are required to install Ballast Water Management Systems by a given time after a transitional period of carrying out Ballast water exchange and ships' Ballast water managements are subject to flag State approval and verification. In this regard, flag States are required to establish appropriate national legislation, conduct relevant ship surveys and approve Ballast Water Management Systems and Plans. Article 94 of the UNCLOS also stipulates that ships are to be controlled by flag States to ensure safety, environment protection and the training of crews. Therefore, flag States' role to ensure the effective implementation of the BWM Convention is imperative.

However, the implementation of the BWM Convention has significant implications for the current practices of flag States since the BWM Convention and its Guidelines are very complex and technical. In this regard, in order to find out how flag States effectively perform their duties, this dissertation introduces the background of the BWM Convention, and discusses major challenges in the implementation and various implications for flag States. Further, a case study of the Republic of Korea is introduced as an example of the implementations of the BWM Convention.

KEY WORDS: Ballast Water Management Convention (BWMC), Flag States, Implementation, Implication, Ballast Water Management System (BWMS) and Ballast Water

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LIST OF ABBREVIATIONS

AIS	Aquatic Invasive Species
AS	Active Substances
BWE	Ballast water exchange
BWM	Ballast Water Management
BWMP	Ballast Water Management Plan
BWMS	Ballast Water Management System
BWRB	Ballast Water Record Book
BWT	Ballast Water Treatment
BWTE	Ballast Water Treatment Equipment
BWTS	Ballast Water Treatment System
GESAMP	Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection
GISIS	Global Integrated Shipping Information System
HAOP	Harmful Aquatic Organisms and Pathogens
IACS	International Association of Classification Societies
IMO	International Maritime Organization
IPPIC	International Paint and Printing Ink Council
JWG	Joint Working Group
KIOST	Korea Institute of Ocean Science and Technology
KOMERI	Korea Marine Equipment Research Institute
KR	Korean Register of Shipping
KST	Korea Ship Safety Technology Authority
KTL	Korea Testing Laboratory
MARPOL	International Convention for the Prevention of Pollution from Ships
MARPOL 73/38	International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto, as amended
MARPOL PROT 1997	Protocol of 1997 to amend the International Convention for the Prevention of Pollution from Ships, as modified by the Protocol of 1978 relating thereto
MEPC	Marine Environment Protection Committee
MOF	Ministry of Oceans and Fisheries
ROK	Republic of Korea
SBT	Segregated Ballast Tank

SOLAS	International Convention for the Safety of Life at Sea
SOLAS 1974	International Convention for the Safety of Life at Sea, 1974, as amended
SOLAS PROT 1978	Protocol of 1978 relating to the International Convention for the Safety of Life at Sea, 1974, as amended
SOLAS PROT 1988	Protocol of 1988 relating to the International Convention for the Safety of Life at Sea, 1974, as amended
STCW 1978	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended
UNCED	United Nations Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
USCG	United States Coast Guard
UV	Ultra Violet

CHAPTER 1
INTRODUCTION

1.1 Study background

Maritime transport plays a core role in world trade and globalization (IMO, 2013f). Ships carry more than 80 percent of world cargos all around the world in the most efficient and economical way. The IMO plays a central role in maritime transport by adopting an international regulatory regime for the sake of safe and environmentally sound shipping.

As one of its achievements in the protection of the marine environment from damage caused by ships' activities, the IMO adopted "the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004" (hereafter referred to as "the BWM Convention"). The BWM Convention consists of twenty two articles covering obligations agreed to by its Parties and an annex containing technical regulations.

To date, the BWM Convention has been ratified by 37 States and less than five per cent of the world's merchant shipping tonnage is required to meet the coming into force criterion of 35 per cent of world gross tonnage. Therefore, it is a good time to examine various implications for flag States which are one of the most important stakeholders in the effective implementation of the BWM Convention.

Although there is wide consensus on the need to protect the marine environment, resources and human health from the adverse effects of harmful aquatic organisms and pathogens transferred by ships' ballast water, the provisions and the full text of the BWM Convention are very complex. This complexity makes it difficult for flag States to appreciate its implications and to evaluate its impact on their maritime interests.

Ships are under the control of flag states according to Article 94 of the UNCLOS and the BWM Convention requires flag States to implement various obligations such as establishing national legislation, conducting ship surveys and approval of Ballast Water Management Plans (hereinafter referred to BWMP) and Ballast Water Management Systems (hereinafter referred to BWMS).

Therefore, it is worthwhile to study various challenges in the implementation of the BWM Convention and implications to be encountered by flag States through an analysis on the BWM Convention, related guidelines, literature review and ongoing discussions at the IMO and a case study of the Republic of Korea.

1.2 Objective

The aim of this dissertation is to find out how the BWM Convention is to be effectively implemented by flag States to achieve its purpose of minimizing the transfer of harmful aquatic organisms to protect the marine environment, resources and human health. Such an analysis is essential for flag States to prepare for the implementation of the BWM Convention or ratification of the BWM Convention.

To achieve this, the following tasks are carried out:

(a) Describe the background of the BWM Convention;
(b) Analyze major ballast water management methods
(c) Discuss major challenges in implementation
(d) Analyze the implications of the BWM Convention for flag States; and
(e) Discuss a case study of the Republic of Korea (ROK) in terms of what it has done in preparation for the implementation of the BWM Convention and how this country deals with several challenges in the implementation.

A case study of the Republic of Korea will be very beneficial at this stage because the ROK acceded to the BWM Convention in 2009 and has its detailed national laws concerning Ballast water management including Type Approval of BWMS. In addition, the ROK is one of leading countries with respect to shipbuilding and Ballast water treatment technology. So far, eight ROK Ballast Water Management Systems have been Type Approved by the ROK Government after IMO Basic and Final approval. Therefore, this study will benefit flag States in their preparation of needed regulations, procedures, policies and schedules for the implementation of the BWM Convention.

1.3 Research methodology

The background of the adoption of the BWM Convention is examined and two practical Ballast water management methods are studied through literature review. The challenges in implementation by flag States of the BWM Convention are identified and analyzed through a study of the relevant books, articles, the Convention, Guidelines, Circulars and ongoing discussions at the IMO. Cross references to other Conventions such as the UNCLOS, the SOLAS and the MARPOL are made. Further, the established relevant ROK national laws, policies and procedures related to the BWM Convention are analyzed.

Interviews were conducted with various maritime stakeholders in the Republic of Korea such as maritime administrators, surveyors in the recognized organizations, ship owners and Ballast water treatment manufacturers. These interviews ascertain what has been done so far in the ROK and what the pending issues are from the perspective of the various stakeholders. They were conducted over the phone and the internet.

After thorough analysis on literature reviews and interviews,
Chapter 2 introduces the background of the BWM Convention through discussing the adverse impacts of invasive alien species carried by ships' ballast water and two

main Ballast water management methods to be utilized by ships to tackle marine environmental damage were examined.

There must be several important reasons why the BWM Convention has not entered into force although it was adopted nine years ago and why there are still many debates on several critical issues with regard to the smooth implementation of the BWM Convention. In this regard, major challenges such as technical, legal and economic challenges which are main obstacles to the implementation of the BWM Convention are discussed in Chapter 3.

The complexity of the implementation of the BWM Convention is mainly related to the complicated procedures, requires technical knowledge for approval of BWMS by flag States and installation of costly equipment onboard both new and existing ships by a given time. In this respect, Chapter 4 discusses specific implications and possible solutions for flag States which are very essential at this stage.

As a contracting State, the Republic of Korea (ROK) has established its national legislation concerning ballast water management and the ROK flag Administration has issued several Type Approval Certificates for different types of BWMS. In this respect, Chapter 5 discusses a case study of the Republic of Korea to find out how this country deals with various challenges and implications concerning Ballast water management.

CHAPTER 2
OVERVIEW OF THE BWM CONVENTION

It is essential to understand the relationship between ballast water and invasive alien species, and the main requirements of the BWM Convention in order to identify its major implications and thus properly implement the BWM Convention.

This Chapter, as shown in Figure 1, examines the background of ballast water (BW) and invasive alien species (IAS), history of adoption and current status of the BWM Convention, and Ballast water exchange and Ballast water treatment as two main management methods with the aim of achieving the objectives of the BWM Convention. In addition, IMO's technical Guidelines and Circulars are introduced.

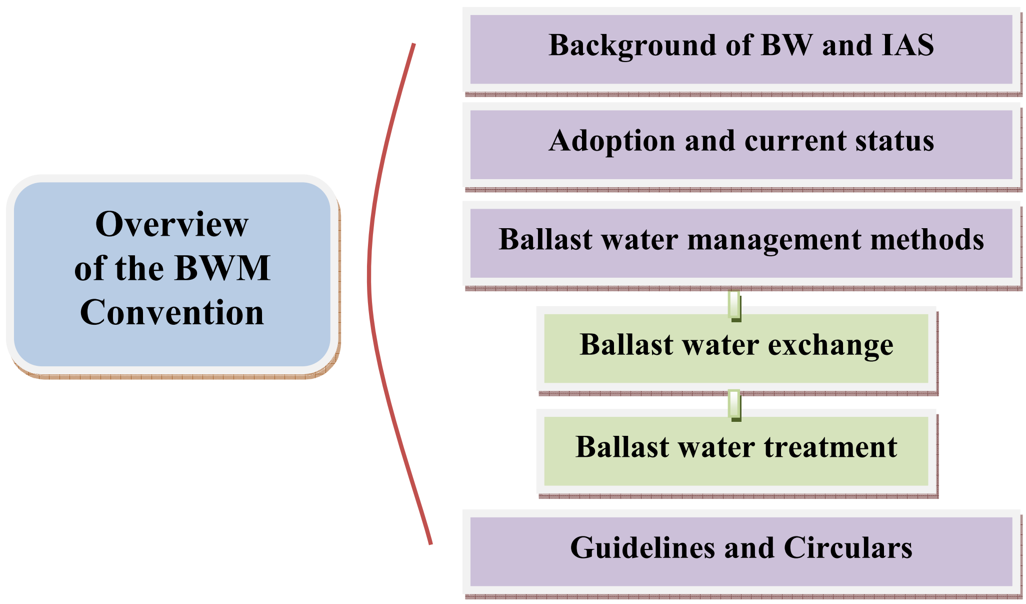


Figure 1 Overview of the BWM Convention

(Source: Author)

2.1 Background

2.1.1 Ballast water

Shipping carries approximately 80 per cent of world trade in volume and more than 70 per cent in value (UNCTAD, 2012) and it is known as the most cost effective transportation means. Ships are designed and constructed to operate safely when loaded with cargo but ships need additional weight when they are sailing without cargo or when partially laden with cargo in order to ensure appropriate stability and manage stress on the hull. The additional weight is called ballast.

Ballast water is defined as "water with its suspended matter taken on board a ship to control trim, list, draught, stability or stresses of the ship" in the Article 1 of the BWM Convention (IMO, 2004). In earlier days, ships used rocks, sand and metal as ballast but technical developments brought ships to use water since it is easier to load and discharge and more economical than solid ballast, thus these days ballast water is indispensable for ships to operate efficiently and safely (GEF-UNDP-IMO GloBallast Partnerships and IOI, 2009).

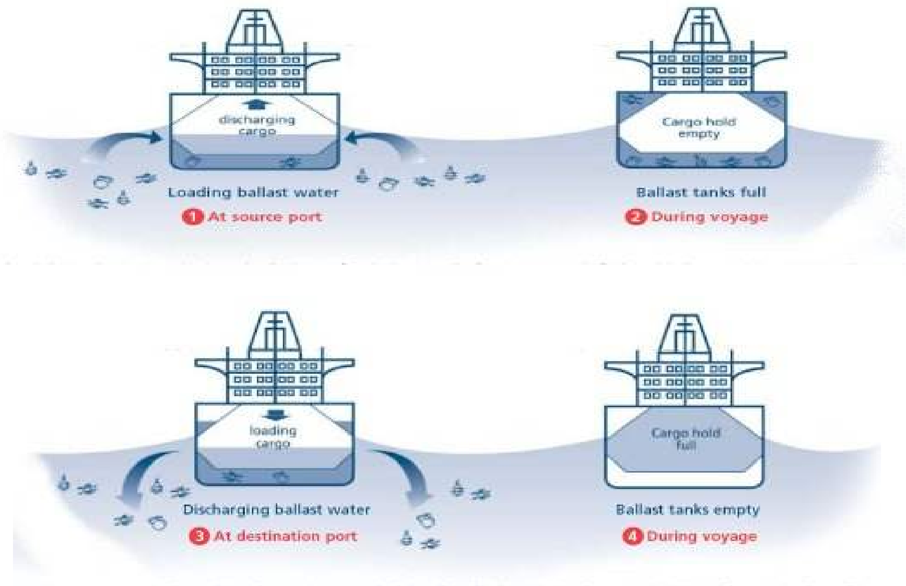


Figure 2 Ships' ballast operation cycle

(Source: http://www.globallast.imo.org/problem.htm, 2013)

Figure 2 shows ships' ballast operation cycle in a port where cargo is discharged and de-ballast operation in another port where cargo is loaded.

Table 2 below shows representative ballast water (BW) capacities for each ship type. According to this table, ships carry BW from 30% to 40% of Dead weight tonnage (DWT) of ships in normal ballast condition; 38% to 57% in heavy ballast condition. It is estimated that shipping moves around 10 billion tonnes of BW around the world each year (GEF-UNDP-IMO GloBallast Partnerships Programme and IUCN, 2010).

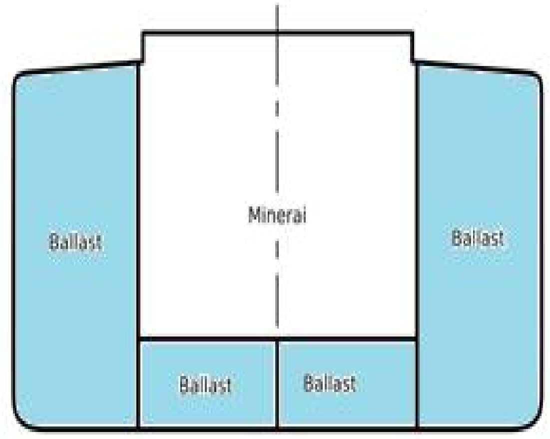
Ship Type	DWT	Ballast Condition			
		Normal (tonnes)	% of DWT	Heavy (tonnes)	% of DWT
Bulk carrier	250,000	75,000	30	113,000	45
Bulk carrier	150,000	45,000	30	67,000	45
Bulk carrier	70,000	25,000	36	40,000	57
Bulk carrier	35,000	10,000	30	17,000	49
Tanker	100,000	40,000	40	45,000	45
Tanker	40,000	12,000	30	15,000	38
Container	40,000	12,000	30	15,000	38
Container	15,000	5,000	30	n/a	
General cargo	17,000	6,000	35	n/a	
General cargo	8,000	3,000	38	n/a	
Passenger/RORO	3,000	1,000	33	n/a	

Table 1 Representative ballast water capacities

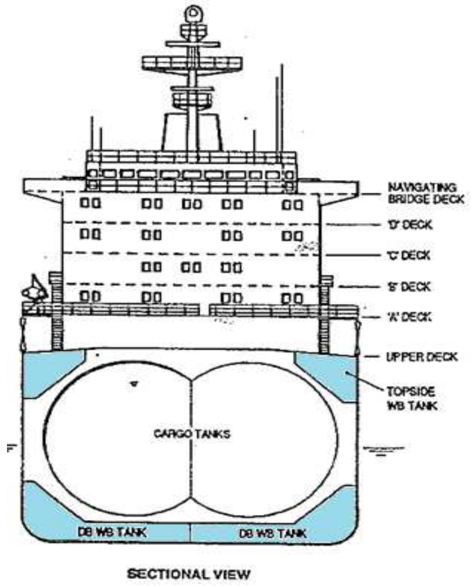
(Source: http://www.globallast.imo.org/problem.htm, 2013)

In addition, Figure 3 shows ballast tank arrangements of an ore carrier, gas carrier, container and double hull tanker, showing where ballast water is loaded on board.

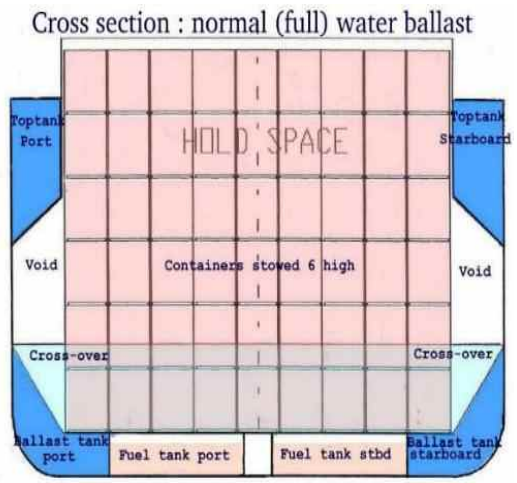
Ballast Tank Arrangements



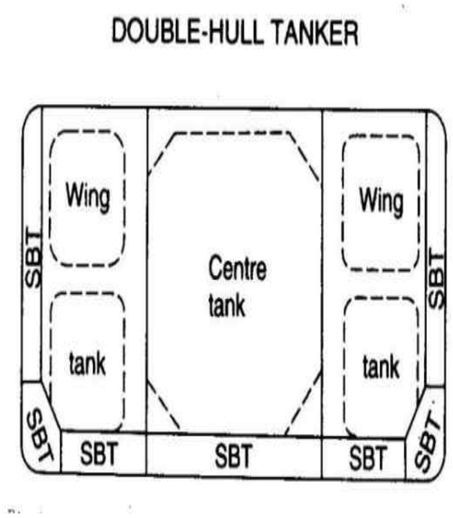
Cross section / an ore carrier



Cross section / a gas carrier



Cross section / a container ship



Cross section / a double hull tanker

Figure 3 Ballast Tank Arrangements for different types of ships

(Source: http://www.globallast.imo.org/problem.htm, 2013)

2.1.2 Invasive alien species

Around 10 billion tonnes of ballast water moved by shipping globally each year contains enormous numbers of living organisms and they are moved with ballast water from region to region and country to country; it is anticipated that every day ballast water moves approximately 7,000 species around the world (USGS, 2005; GEF *et al.*, 2010). Therefore, shipping is responsible for introductions of marine species as a key vector for movement of species (Cohen & Carlton, 1998; Ruiz *et al.*, 2000a; Hewitt *et al.*, 2004; GEF *et al.*, 2010).

The introduction of invasive alien species by ballast water is severely threatening marine ecosystems around the world. Invasive alien species (IAS) are species which are transferred outside of their natural areas and transported to new areas where they do not typically appear, under certain circumstances, species become established, and, in the lack of natural controls, for example, parasites or predators, multiply and become invasive, thereby threaten the original ecosystem and its species (Molnar *et al.*, 2008; GEF *et al.*, 2010). Invasive alien species (IAS) introduce environmental and economic harm and may become a threat to human health (Clinton, 1999).

The current main concern over IAS is that the impacts of IAS are already large and are quickly growing larger because the international movement of cargo and people is increasing due to globalization (Dalmazzone *et al.*, 2005). IAS is considered as one of the major threats to worldwide biodiversity because it is almost impossible to eradicate the problem caused by IAS once it is established in the marine environment. Therefore, it is important to take prompt appropriate measures by international community before IAS is established and affect native marine environment around the world.

Figure 4 shows the invasion process of alien species from the beginning stage to spread after establishment in new areas.

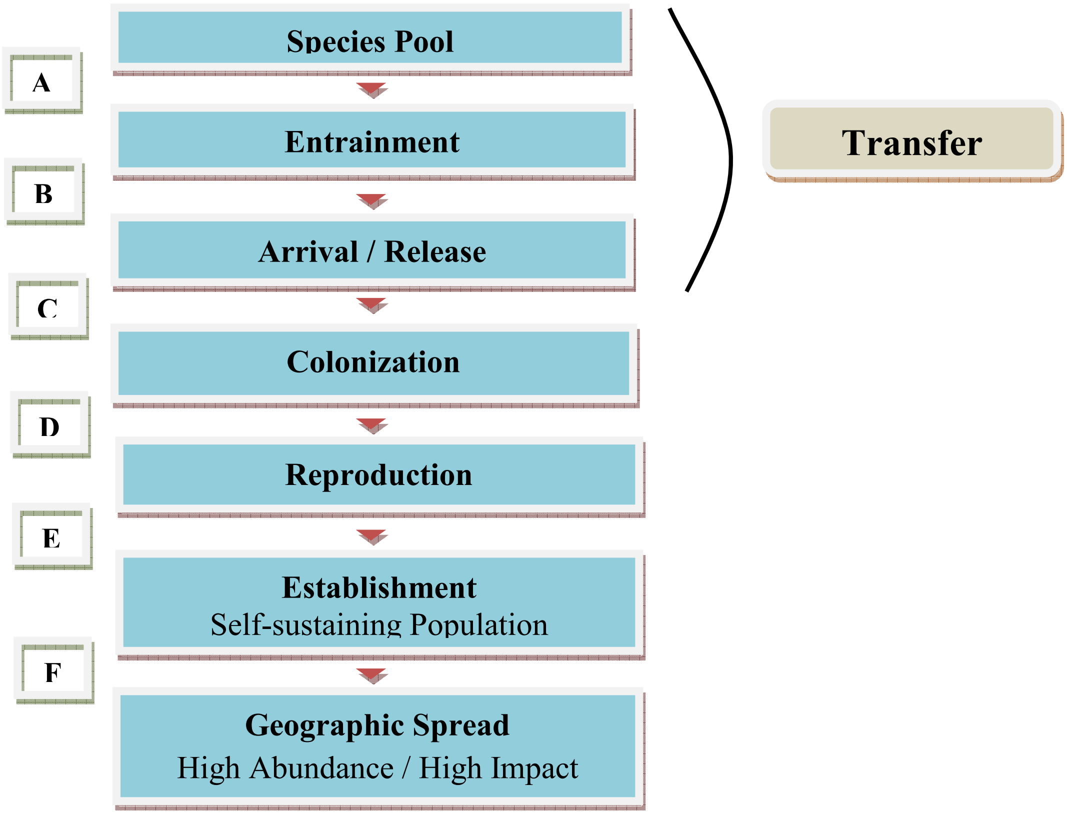


Figure 4 Stages of the invasion process

(Source: Drawn by Author based on Ruiz and Carlton, 2003)

The process occurs in six stages: Stage A - a subset of the local organisms is entrained by a certain vector (e.g. ships' ballast water or biofouling). Stage B - only a small number of the entrained organisms survives. Stage C - a smaller subset of the surviving organisms still may be released to a recipient environment. Stage D - many of those released will not survive. Stage E - many of those that survive will not successfully reproduce and establish self-sustaining populations. Stage F - successfully colonized species will achieve local abundance, spread, and/or have significant impacts. Stages A to C are considered as the transfer process of IAS (Ruiz and Carlton, 2003).

Thus, although the survival rate in a new environment is small, once invasive alien species (IAS) are established, their impacts are significant with regard to **environment, economy and human health**.

There are well-known invasive alien species which severely disrupt indigenous eco-systems and cause enormous economic impacts. For example, the North American Jellyfish (*Mnemiopsis ieidyi*) was introduced from the Eastern seaboard of North and South America to the Black Sea where it severely destroyed the fishing industry in the Black Sea (Anwar, 2010). Conversely, Zebra Mussel (*Dreissena polymorpha*) was transferred from the Black Sea to North America and it caused blockage of cooling pipes of power plants and changed the aquatic food web (Anwar, 2010). Zebra mussels which are very small in size severely restrict the water flow to municipal facilities and power plants by attaching to cooling systems and they attach to native mussels and clams to feed, grow, move and reproduce themselves which causes that native mussels and clams are not able to open their shell to eat (National Alatlas, 2013).

When the IMO adopted the BWM Convention, the term **"Harmful Aquatic Organisms and Pathogens (HAOP)"** was used instead of "Invasive alien species (IAS)". The definition of "Harmful Aquatic Organisms and Pathogens" can be found in Article 1.8 of the BWM Convention as follows (IMO, 2004):

> ***Harmful Aquatic Organisms and Pathogens (HAOP)*** *means aquatic organisms or pathogens which, if introduced into the sea including estuaries, or into fresh water courses, may create hazards to the environment, human health, property or resources, impair biological diversity or interfere with other legitimate uses of such areas.*

Ballast water is vital to ensure safe operation of shipping which controls ships' stability appropriately. However, ballast water may contain harmful aquatic organisms and pathogens which disrupt the marine ecosystem and may cause severe human health problems. Therefore, an International mandatory instrument for ballast water management was required to ensure protection of the marine environment, human health, ship safety and resources of States. In this regard, the following section examines the history of the adoption and current status of the BWM Convention.

2.2 Adoption and current status

The international society has been making various effort to cope with IAS and ships' ballast water issues through the IMO because preventing the transfer of IAS requires timely and effective global response and the UNCLOS requires States to work together to prevent marine pollution, including introduction of alien or harmful species to a specific marine area.

The IMO started to discuss the possibilities of establishing an internationally mandatory regime controlling ships' transfer of harmful aquatic organisms and pathogens after the UN Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992 (IMO, n.d). In further discussion during the World Summit on Sustainable Development held in 2002, proper action for the establishment of legal actions to cope with invasive alien species in ballast water was urged to speed up. As a result, in order to adopt an internationally binding instrument, the opening of a Diplomatic Conference was approved in the eighty-ninth session of the Council in November 2002 (IMO, n.d).

Finally, on 13 February 2004, the International Conference on Ballast Water Management for Ships adopted "the International Convention for the Control and Management of Ships' Ballast Water and Sediments" (the BWM Convention) whose purpose is "to prevent, minimize and ultimately eliminate the risks to the environment, human health, property and resources arising from the transfer of harmful aquatic organisms and pathogens" (IMO, n.d; IMO, 2004). The criteria for the entry into force are stipulated in Article 17 of the BWM Convention as follows (IMO, 2004):

> *The Convention will enter into force twelve months after the date on which not less than 30 States, the combined merchant fleets of which constitute not less than 35 % of the gross tonnage of the world's merchant shipping, have either signed it without reservation as to ratification, acceptance or approval, or have deposited the requisite instrument of ratification, acceptance, approval or accession.*

As of 31 July 2013, 37 countries representing 30.32% of world gross tonnage became Contracting States; the latest Contracting State is Germany, which acceded on 20 June 2013 (IMO, 2013e). Therefore, 4.68 % of the gross tonnage of the world's merchant fleet is required to satisfy the criteria of entry into force. It is expected that the remaining percentage will be achieved and the BWM Convention will enter into force soon because ratification, acceptance, approval or accession by one of IMO's Member States which has a large registered fleet will satisfy the gross tonnage requirements of entry into force of the BWM Convention.

2.3 Ballast water management methods

The purpose of the BWM Convention can be achieved mainly by two ballast water management methods which are undertaken by ships. One is Ballast water exchange (BWE) and the other is Ballast water treatment (BWT).

A third option for ballast water management is discharging ballast water to reception facilities in ports. This method provides economies of scale and involves well skilled persons on shore who are better suited to the task than ship crews who do not have enough knowledge about operating BWMS or chemicals (Donner, 2010). However, since providing ballast water reception facilities is not a mandatory requirement for Parties when they implement the BWM Convention, this dissertation discusses only BWE and BWT methods.

The basic concept of ballast water management is to remove the harmful aquatic organisms and pathogens by means of mechanical, physical, chemical or biological methods. According the BWM Convention, until 2016, ships shall carry out Ballast water exchange or shall satisfy Ballast water performance standard. After 2016, Ballast water exchange will not be allowed anymore in accordance with the BWM Convention due to the uncertainty with regard to ships' safety and biological effectiveness, thus Ballast water performance standard will be the only option that the international shipping shall comply with by installing BWMS.

2.3.1 Ballast water exchange

The concept of Ballast water exchange (BWE) is to replace the ballast water taken at the port of origin by mid ocean water during the voyage. Subsequently, the mid-ocean water is discharged at the destination ports where cargo is loaded. This exchange prevents the translocation of species because most organisms contained in mid-ocean water cannot survive in the coastal port environment (CEPA, 2002). There are a number of different sea water conditions between coastal areas and open seas such as salinity, tide, water temperature, turbidity and nutrient levels. All these factors influence photosynthesis. These differences may make it difficult for the organisms in the ships' ballast tank which are transferred to new habitats to survive.

During the voyage, mid-sea ballasting and de-ballasting operations are performed on board by gravity or by using ballast water pumps. In most ships ballast tanks are connected with pipes leading to a ballast water pump and overboard valves for discharge (CEPA, 2002).

Ballast water exchange methods

Ballast water exchange is carried out mainly by three methods. These are sequential method, flow through method and dilution method. The IMO evaluated and accepted these three methods (IMO, 2005a). Ships may use one or a combination of these methods depending on the ships' conditions, its ballast tank systems, ship type and sailing route.

Regulation B-4 of the BWM Convention stipulates the required conditions under which Ballast water exchange should be carried out. Assisting guidelines are provided, namely "Guidelines for Ballast water exchange (G6)" which were adopted by Res.MEPC.124(53) on 22 July 2005. The three Ballast water exchange methods are stipulated in the G6 as below (IMO, 2005a):

> ***Sequential method****: a process by which a ballast tank intended for the carriage of ballast water is first emptied and then refilled with replacement ballast water to achieve at least a 95 per cent volumetric exchange.*
>
> ***Flow-through method****: a process by which replacement ballast water is pumped into a ballast tank intended for the carriage of ballast water, allowing water to flow through overflow or other arrangements.*
>
> ***Dilution method****: a process by which replacement ballast water is filled through the top of the ballast tank intended for the carriage of ballast water with simultaneous discharge from the bottom at the same flow rate and maintaining a constant level in the tank throughout the ballast exchange operation.*

According to the BWM Convention, Ballast water exchange should be carried out at least 200 nautical miles from the nearest land and in water at least 200 metres in depth and if this is not possible, it is required to be carried out at least 50 nautical miles from the nearest land and in water at least 200 metres in depth (IMO, 2004). In addition, Regulation D-1 of the BWM Convention specifies that "ships performing Ballast water exchange shall conduct such operation with an efficiency of a minimum 95 per cent volumetric exchange" (IMO, 2004). In order to provide supplementary guidance for ships conducting Ballast water exchange, "Guidelines for Ballast water exchange design and construction standard (G11)" was adopted by Res.MEPC.149(55) in 2006 (IMO, 2006c).

Although Ballast water exchange (BWE) has been accepted by IMO as an approved ballast water management method, the effectiveness of the exchange method for treating ballast water is uncertain and BWE introduces a number of safety issues.

<u>Effectiveness of Ballast water exchange</u>

The effectiveness of Ballast water exchange varies depending on what kinds of methods are used and how Ballast water exchange is conducted onboard. In this regard, several studies have been conducted on an extensive range of ballast water systems with different ship types such as container ships and bulk carriers.

Reference	Effectiveness	Type of BWE	Type of Ships
Locke *et al.*, 1993	67% reduction in organism	Unknown	Various
Locke *et al.*, 1993	86% reduction in organism	Unknown	Various
Zhang and Dickman, 1999	87% reduction in organism	Sequential method	Container
Zhang and Dickman, 1999	83% reduction in organism	Sequential method	Container
Zhang and Dickman, 1999	48% reduction in organism	Sequential method	Container
Rigby and Hallegraeff, 1995	95% reduction in organism	Flow-through method	Bulk carrier

Table 2 Estimates of Ballast water exchange effectiveness

(Source: Drawn by Author based on CEPA, 2002)

Table 2 shows some published BWE effectiveness data using Sequential method and Flow-through method (CEPA, 2002). According to the data, the effectiveness of Ballast water exchange methods varies from 48% to 95% reduction in organisms.

Safety issue of Ballast water exchange

A number of safety aspects of Ballast water exchange which affect both ships and crew should be considered. These are stability, longitudinal stress, wave-induced hull vibrations, forward and aft draughts and bridge visibility (IMO, 2006c). For example, some reports found that Sequential method is not safe for several ship types because this method requires ballast tanks to be fully emptied before a ballast tank is refilled and the ship's stability and maneuverability may be affected during the ballasting and de-ballasting process (CEPA, 2002). Flow-through method also might cause some safety issue since ballast water is needed to overflow through venting and sounding systems of ballast tanks onto ships' deck.

According to Regulation B-4.4 of the BWM Convention, in case of severe weather conditions, equipment failure or any other unexpected conditions which severely affect the safety of ships, crews or passengers, ships may not conduct Ballast water exchange upon the reasonable decision of the master (IMO, 2004). In case of any circumstance where Ballast water exchange cannot be conducted, it should be inscribed in the Ballast Water Record Book (BWRB) as evidence. In this case, the master is also required to inform the port authority at the next destination to avoid a PSC detention. Additionally, training of crews, especially those who are in charge of ballast water operations should be carried out regularly.

Having considered the uncertainty of effectiveness and introduction of many safety issues, the BWM Convention allows Ballast water exchange only as a limited short-term measure. For example, Ballast water exchange requirements are not applicable to new ships constructed in or after 2009 with a ballast water capacity of less than

5,000 cubic metres (IMO, 2004). In addition, after 2016, ships constructed before 2009 are required to install BWMS satisfying the D-2 standard of the BWM Convention (IMO, 2004). However, due to the adjusted schedule which is expected to be adopted by the Assembly 28th in December 2013, Ballast water exchange may be allowed to be carried until 2021. The changeable schedule concerning BW exchange and BW treatment will be further discussed in section 3.2.1 of this dissertation.

2.3.2 Ballast water treatment

According to the BWM Convention, Ballast water performance standard (D-2) will be the only option after a transitional period of Ballast water exchange and thus, ships are required to install BWMS to comply with the D-2 standard by a given time.

The definitions of Ballast Water Management System (BWMS) and Ballast Water Treatment Equipment (BWTE) can be found in Paragraph 3 of "Guidelines for approval of ballast water management systems (G8)" as follows (IMO, 2008a).

> ***Ballast Water Management System (BWMS)*** *means any system which processes ballast water such that it meets or exceeds the ballast water performance standard in regulation D-2. The BWMS includes <u>ballast water treatment equipment</u>, all associated control equipment, monitoring equipment and sampling facilities.*
>
> ***Ballast Water Treatment Equipment*** *means equipment which <u>mechanically, physically, chemically, or biologically processes</u>, either singularly or in combination, to remove, render harmless, or avoid the uptake or discharge of harmful aquatic organisms and pathogens within ballast water and sediments.*

Although there are the two terms, BWMS and BWTE, and their definitions in the G8, the term, Ballast Water Management System (BWMS) or Ballast Water Treatment System (BWTS), is widely used instead of Ballast Water Treatment Equipment (BWTE). Therefore, this dissertation only uses the term, Ballast Water Management System (BWMS), to avoid any confusion.

Regulation D-2 (Ballast water performance standard) of the BWM Convention is concerned with biological standards and provides detailed criteria to that effect. As shown in Table 3 below, this regulation contains the organism criteria that the treated water should be met in terms of organism species numbers and size. Since this regulation requires very specific numbers of organisms in the treated ships' ballast water, its verification of ships' compliance by flag States and Port States requires costly and time-consuming procedures to decide accurate levels of organisms and pathogens.

Organisms / Size		**Criteria**
Viable organism (plankton)	Size ≥ 50 μm	< 10 organisms per m^3
	10 μm ≤ Size < 50 μm	< 10 organisms per ml
Toxicogenic *Vibrio cholera* (O1 & O139)		< 1 cfu* per 100 ml or < 1 cfu per 1 g of Zooplankton samples
Escherichia coli		< 250 cfu per 100 ml
Intestinal Enterococci		< 100 cfu per 100 ml

*cfu: colony forming unit

Table 3 Ballast water performance standard (Regulation D-2)

(Source: Tabulated by Author based on IMO, 2004)

There are several Ballast water treatment methods to eliminate aquatic organisms to meet IMO standards. In this regard, many Ballast Water Management Systems use Physical Solid-liquid Separation methods such as filters to eliminate larger organisms (i.e. size ≥ 50 μm) in combination with one or two disinfection methods as shown in Table 4 (Greensmith, 2010).

Physical Solid-liquid Separation	Disinfection	
	Chemical	Physical
Filter	Chlorination	De-oxygenation
Hydrocyclone	Electro chlorination	Ultraviolet
Coagulant	Chlorine dioxide	Ultrasonic
	Hydrogen peroxide	
	Peracetic acid	
	Vitamin K	
	Ozonation	

Table 4 Ballast Water Treatment Process Types

(Source: Greensmith, G.J., 2010)

Further, Figure 5 shows a basic arrangement of BWMS in which these two processes occur. Ballast water first passes through a filter as physical separation treatment to remove larger organisms (i.e. size ≥ 50 μm). Then, the filtered ballast water is treated by a chemical process (e.g. chlorination, electro chlorination and chlorine dioxide etc). The treated water is sent to a ballast tank, and then it passes through a neutralization process to remove toxins which could potentially harm to the environment and crew safety. Finally, the ballast water is discharged into a destined port by a ballast pump (Korean Register of Shipping, 2010).

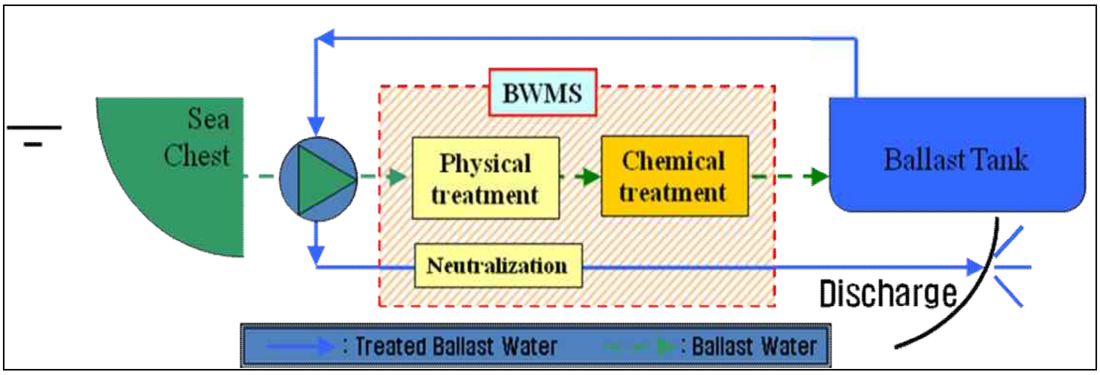


Figure 5 Schematic diagram of BWMS basic arrangement

(Source: KR, 2010)

Complying with D-2 standard by using chemical methods can introduce a number of safety issues such as crew safety, human health and adverse effects to the receiving port environment due to the toxic characteristics of the chemical. For example, chlorine, hydrogen peroxide and ozone are highly corrosive oxidants. Very careful procedures should be followed to protect the crew from injuries due to exposure (Werschkun, 2011). By-products of chlorination such as chloroform, bromoform, and other halogenated organic chemicals are strictly regulated in drinking water because they have carcinogenic and mutagenic potential (Werschkun, 2011).

<u>IMO approval of BWMS</u>

Due to the aforementioned dangerous characteristics of using chemicals for BWMS to meet D-2 requirement, BWMS shall be approved by the IMO to verify whether it is safe for the receiving environment and crew. The approval requirement is stipulated in Regulation D-3.2 of the BWM Convention as follows (IMO, 2004):

> *Ballast Water Management systems which make use of Active Substances or preparations containing one or more Active Substances to comply with this Convention shall be approved by the Organization, based on a procedure developed by the Organization.*

The IMO uses a broad term “active substance” instead of “chemical”. In this regard, the definition of “active substance” can be found in Regulation A-1 of the BWM Convention as follows (IMO, 2004):

> ***Active Substance*** *means a substance or organism, including a virus or a fungus, that has a general or specific action on or against Harmful Aquatic Organisms and Pathogens.*

If a BWMS does not make use of an active substance, IMO approval is not required but it should be approved by a flag State. As shown in Figure 6, BWMS-A which uses active substances, requires both IMO approval to verify its safety to human health and the receiving environment, and Type Approval by the flag State to verify its compliance with biological criteria (D-2). On the other hand, BWMS-B which does not use active substances only requires Type Approval by the flag State.

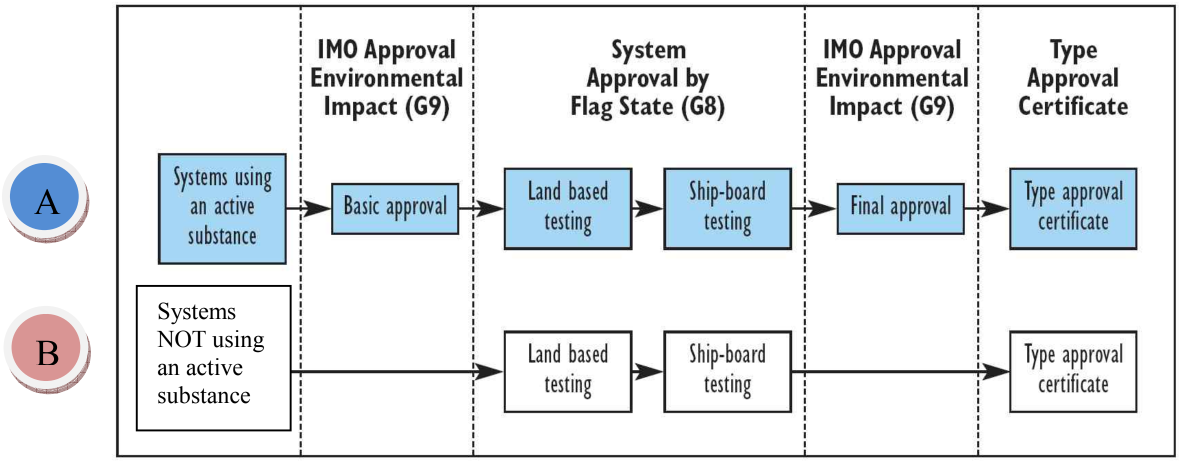


Figure 6 Approval process of BWMS

(Source: Greensmith, 2010)

<u>GESAMP-BWWG</u>

IMO approvals (i.e. Basic and Final approval) for BWMS are conducted by the GESAMP ballast water working group (GESAMP-BWWG) which is a technical expert group because the approval of BWMS requires scientific and assessment knowledge. The background of the establishment of GESAMP-BWWG is stipulated in BWM.2/Circ.2. The purpose of the establishment of GESAMP - Ballast Water Working Group (BWWG) is to evaluate proposals for approval of Active Substances used for BWMS in accordance with resolution MEPC.126(53) (IMO, 2005b).

GESAMP is an advisory body composed of specialised experts selected by the GESAMP Sponsoring Agencies (FAO, IAEA, IMO, UNESCO-IOC, UNIDO, WMO, UN, UNEP and UNDP). Its primary task is to present scientific advice relating to the control, prevention and reduction of the degradation of the marine environment to the Sponsoring Agencies (GESAMP, 2012).

The GESAMP-BWWG plays a consultative role to the IMO MEPC in the process of the basic and final approval for BWMS which makes use of active substances (Bouyssou, 2011; IMO, 2008b). With regard to Basic Approval, the Group reviews the comprehensive proposal, any additional data and other concerned information, and reports the result to the MEPC (IMO, 2005b). With regard to Final Approval, the Group reviews the shipboard test results and confirms that the residual toxicity of the real discharge is consistent with the previous results conducted for Basic Approval. It also verifies whether the previous assessment of the risks to the ships and the crew including handling, and the application and storage of the active substance are still suitable, and reports the result to the MEPC (IMO, 2005b).

2.4 Technical Guidelines and Circulars

There are various guidelines and circulars adopted and issued by the IMO to ensure the smooth and effective implementation of the BWM Convention. Table 5 shows the fifteen technical guidelines with relevant MEPC resolutions. Among those Guidelines, flag States are required to pay attention to Guidelines 8 and 9 for Type approval of BWMS and Guidelines 4 for approval of BW Management Plans.

G1	Guidelines for Sediment Reception Facilities	Res.MEPC.152(55)
G2	Guidelines for Ballast Water Sampling	Res.MEPC.173(58)
G3	Guidelines for Ballast Water Management Equivalent Compliance	Res.MEPC.123(53)
G4	Guidelines for Ballast Water Management and Development of Ballast Water Management Plans	Res.MEPC.127(53)
G5	Guidelines for Ballast Water Reception Facilities	Res.MEPC.153(55)
G6	Guidelines for Ballast water exchange	Res.MEPC.124(53)
G7	Guidelines for Risk Assessment under Regulation A-4	Res.MEPC.162(56)
G8	Guidelines for Approval of Ballast Water Management Systems	Res.MEPC.174(58)
G9	Procedure for Approval of Ballast Water Management Systems that make use of Active Substances	Res.MEPC.169(57)
G10	Guidelines for Approval and Oversight of Prototype Ballast Water Treatment Technology Programmers	Res.MEPC.140(54)
G11	Guidelines for Ballast water exchange Design and Construction Standards	Res.MEPC.149(55)
G12	Guidelines on Design and Construction to Facilitate Sediment Control on Ships	Res.MEPC.150(55)
G13	Guidelines for Additional Measures regarding Ballast Water Management including Emergency Situation	Res.MEPC.161(56)
G14	Guidelines on Designation of Areas for Ballast water exchange	Res.MEPC.151(55) Res.MEPC.163(56)
	Guidelines for Ballast water exchange in the Antarctic Treaty Area	Res.MEPC.163(56)

Table 5 IMO ballast water technical Guidelines

(Source: Tabulated by Author based on IMO, 2004)

In addition to the guidelines above, to assist in differentiating between BWM.1 and BWM.2, IMO has issued the circulars concerning the status of the BWM Convention under the symbol (BWM.1/Circ..) and circulars related to technical aspects of ballast water management under the symbol (BWM.2/Circ..). To date, forty nine BWM.2/Circulars have been issued for these purposes.

2.5 Conclusion

Shipping which is the most cost effective means of transportation needs to use ballast water for its safe activities. However, Ballast water is the main vector for moving invasive alien species which cause serious marine environmental problems around the world. To cope with this issue, the BWM Convention was adopted by the IMO in 2004. Since its adoption, various technical guidelines were adopted and 37 countries have ratified this Convention. Although some technical, legal and economic challenges in the effective implementation of the BWM Convention exist which are discussed in the following Chapter, the remaining 4.68 % of the gross tonnages of the world's merchant fleet is expected to be achieved soon. Once the BWM Convention enters into force, ships are required to undertake mainly two ballast water management methods (i.e. BW exchange and BW treatment) which are required to be approved and verified by flag States.

CHAPTER 3
CHALLENGES IN THE IMPLEMENTATION OF THE BWM CONVENTION

The successful implementation of the BWM Convention primarily depends on its ratification by IMO Member States. Nine years have passed since the adoption of the BWM Convention but the requirements for entry into force are yet to be achieved due to some challenges. Identifying and properly dealing with these challenges will promote an increase in number of Contracting States to the BWM Convention and contribute to its smooth implementation, even after the entry into force of the Convention.

This Chapter discusses three kinds of challenges which are considered as the main obstacles to the implementation of the BWM Convention. They are technical, legal and economic challenges.

Figure 7 Challenges in the implementation of the BWM Convention

(Source: Author)

As technical challenges, the uncertainty of BW sampling and BWMS performance will be discussed. As legal challenges, the installation schedule of BWMS and Type Approval Certificates issue will be discussed. And lastly, as an economic challenge, shipowners and flag States' economic burden in connection with the implementation of the BWM Convention will be discussed.

3.1 Technical challenges

3.1.1 Ballast water sampling issue

At present, the uncertainty of Ballast water sampling techniques is one of the most serious challenges for the proper implementation of the BWM Convention. States cannot ratify the BWM Convention due to lack of enforcement methods, thus there has been significant discussion concerning the development of BW sampling guidance (Elliott, 2013).

Two kinds of sampling are required to verify compliance with the BWM Convention. One is to verify compliance with Regulation D-1 (BW exchange standard) and the other is to verify compliance with Regulation D-2 (BW performance standard). D-1 sampling may not be complex or costly since this sampling is mainly intended to confirm whether a certain ship has correctly conducted BW exchange and it might be carried out using a salinometer. On the other hand, BW sampling and analysis in order to verify D-2 compliance is mostly costly and time-consuming, particularly in terms of deciding accurate levels of organisms and pathogens (LR, 2010). Therefore, comprehensive technical guidelines are required to properly verify conformity with the BWM Convention because D-2 sampling engages complex and novel procedures.

Article 9 of the BWM Convention stipulates that a ship may, in any port or offshore terminal of another Party, be inspected by officers duly authorized by that Party (i.e. PSC Inspection) in order to determine the ship's compliance with the applicable requirements. Such an inspection involves checking certificates, crew familiarization and BW sampling. The latter shall be conducted in accordance with "Guidelines for ballast water sampling (G2)" adopted by Res.MEPC.173(58) in 2008.

The problem is that the G2 is not sufficient for practical use by PSC officers in many aspects. For example, the Guidelines stipulate that "the sampling and analysis methodologies to test for compliance with the Convention are still in development and at the present time, there are no specific sampling or analysis protocols that can be recommended for Administrations to use". Accordingly, after long discussion at the MEPC 65th session held in May 2013, "Guidance on ballast water sampling and analysis for trial use in accordance with the BWM Convention and Guidelines (G2)" was approved to provide sampling and analysis methodologies and disseminated by BWM.2/Circ.42.

However, the aforementioned Guidance will be used for trial purposes only because there is still technical uncertainty with regard to BW sampling and negative opinion about BW sampling. For example, some member States and ship owners insist that inspection of documentation such as BWMP, Type Approval Certificate of BWMS and Ballast Water Record Book (BWRB) should be enough for conformity with no need to conduct BW sampling. They argue that sampling is not required and Type Approved BWMS should be considered as operationally compliant if correctly maintained and operated (IMO, 2013a).

Therefore, technical uncertainty with regard to ballast water sampling remains a considerable barrier to the implementation of the BWM Convention.

3.1.2 BWMS performance issue

Since the adoption of the BWM Convention in 2004, so far 33 BWMS were Type Approved by various flag State Administrations (IMO, 2013b) and there is a concern about the performance of the Type Approved BWMS during the real operation of ships.

Ships which have been installed with Type Approved BWMS and operated according to manufacturers' manuals, may be still deemed as not conforming to the D-2 (BW Performance Standard) because of intrinsic performance weakness of particular BWMS in some operational conditions. In this case, the ship would be liable to detention (IMO, 2009). For example, limitations on the operability of BWMS to comply with D-2 performance standard have been experienced: BWMS using electro-chlorination or electrolysis has limitations in freshwater or brackish water; BWMS using Ultra Violet (UV) in turbid or high-sediment-load water is not very effective, and; likewise BWMS using filtration in sediment-rich or muddy water is not functioning (IMO, 2012a).

Another technical challenge is that the effect on ballast tank coating of BWMS operations is unknown. As shown in Figure 8, at present 67% of Type Approved BWMS make use of Active Substances (AS) to meet biological criteria stipulated in Regulation D-2 of the BWM Convention. BWMS using AS may adversely affect the ballast tank coating, piping system and anodes within the ballast tank depending on the types of AS, exposure duration and operating condition (IMO, 2012b). For example, BWMS that work with AS such as ozone, electrolysis, peroxyacetic acid, sodium hypochlorite and chlorine dioxide directly influence the performance of the coating system (IMO, 2011a).

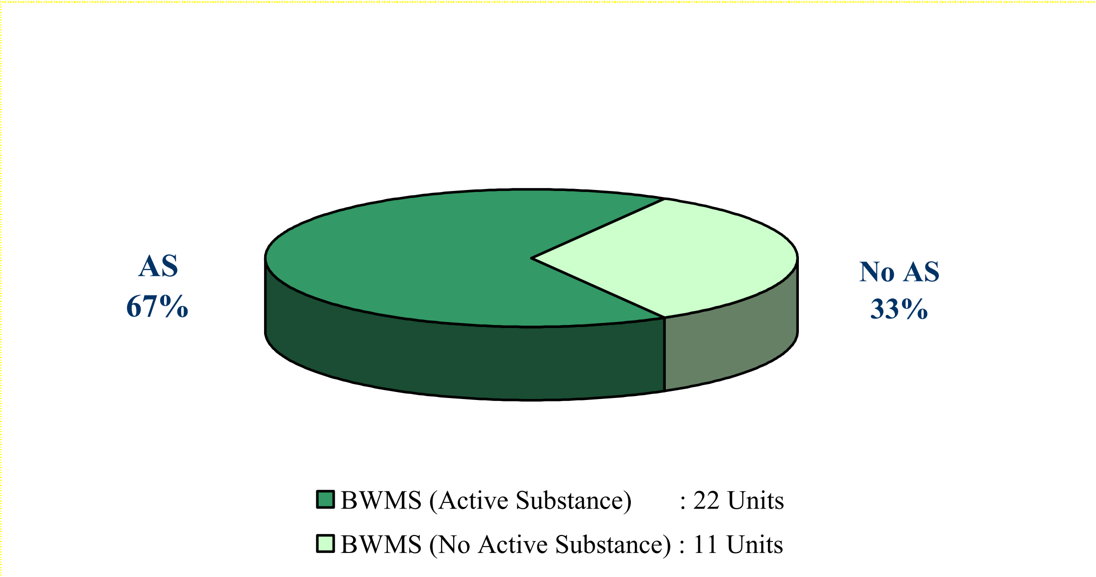


Figure 8 Type Approved BWMS (Total: 33 updated in May 2013)

(Source: Drawn by Author based on IMO, 2013c)

Although paragraph 1.3 of the annex to the Guidelines (G8) requires flag States to consider the effects of BWMS on corrosion in the ballast water system and further paragraph 4.2.1 of the Procedure (G9) requires the information on corrosivity to the materials or equipment of ships to be included for IMO approval, there are no references for applicable standards for corrosion testing in those Guidelines (IMO, 2012b).

In this regard, the coating industry representative, the International Paint and Printing Ink Council (IPPIC) insists that BWMS manufacturers should perform appropriate corrosivity testing during the development stage of their equipment and corrosion standards are to be prepared and comprehensively verified in order to know the potential effects on ballast tank coating (IMO, 2011a).

3.2 Legal challenges

This paper discusses two legal challenges to the implementation of the BWM Convention. One is related to the installation schedule of BWMS which is still being discussed at the IMO and the other legal challenge is related to USCG requirements which are more stringent than IMO's and require additional Type Approval.

3.2.1 BWMS installation schedule issue

All ships engaged in international voyages shall install BWMS onboard by a given time in accordance with schedules stipulated in Regulation B-3 of the BWM Convention in order to achieve the goal of the Convention. In case of existing ships, it is allowed to carry out Ballast water exchange for a certain period depending on the ships' construction year and capacity of ballast water. In this regard, for flag States administrators and ship owners it is very important to understand the schedule correctly for the effective implementation of the BWM Convention.

Figure 9 shows approximately how many ships should install BWMS depending on the categories of ships from the year of 2009 to 2020.

Category 1: ships constructed before 2009
(BW capacity between 1,500 and 5,000 m^3)
Category 2: ships constructed before 2009
(BW capacity less than 1.500 or more than 5.000 m^3)
Category 3: ships constructed in or after 2009
(BW capacity less than 5000 m^3)
Category 4: ships constructed in or after 2009, but before 2012
(BW capacity 5000 m^3 or more)
Category 5: ships constructed in or after 2009 (BW capacity 5000 m^3 or more)

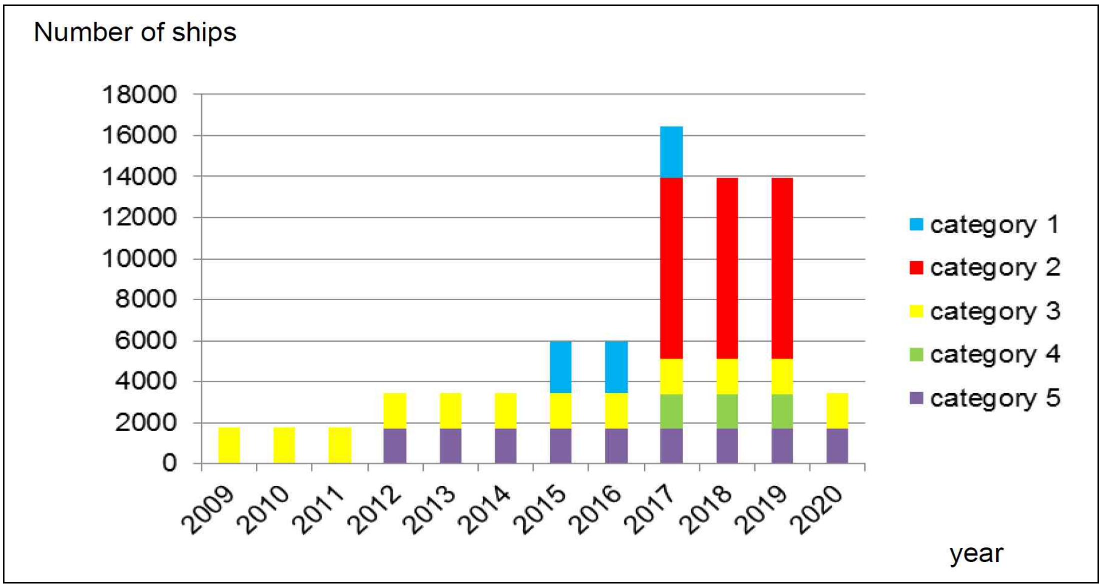


Figure 9 Estimated number of ships required to install BWMS

(Source: IMO, 2012c)

It is construed that the complicated B-3 schedule was developed because of the lack of technical development of BWMS at that time the BWM Convention was adopted and a desire for a smooth transition from Ballast water exchange to ballast water performance standard (i.e. BWMS) between 2009 and 2020.

Adjustment to the installation schedule of BWMS

There has been a lot of debate on the installation schedule (B-3). Some member States and ship owners associations have argued that there is not enough technology on the market to comply with the requirements. After lengthy debate on the installation schedule at the IMO, a Draft Assembly resolution was prepared by MEPC 65 and it will be submitted to IMO Assembly 28 for adoption which is scheduled to be held from 25 November to 4 December, 2013. Although a consensus of Contracting States is needed to adopt the resolution at the Assembly meeting, it is expected that the resolution will be adopted since it was supported by the majority of States during its preparation.

According to the draft resolution schedule, it is expected that the installation of BWMS on board could be significantly delayed even after the entry into force of the Convention. For example, a ship constructed in or after 2012 with BWcapacity of 5,000 m^3 and more was supposed to have installed BWMS by the time of the entry into force of the Convention in accordance with Regulation B-3.5. However, the ship will be allowed to install a BWMS by the first renewal survey after entry force of the Convention in accordance with the adjusted schedule. This means that such ships may not install BWMS until the first renewal survey which will be carried out in 2018. If the BWM Convention enters into force in 2014, this ship will have additional 4 years compared to the original B-3 schedule.

Appendix A of this dissertation shows the comparison table between the original schedule stipulated in Regulation B-3 of the BWM Convention and the adjusted one stipulated in the draft Assembly resolution. Although the adjusted schedule is recommendatory in nature for flag States and it was prepared based on the reason that the conventions cannot be amended before entry into force, if it is adopted as is, the impact of the resolution would be significant on the implementation of the BWM Convention.

In this regard, there is a growing concern about the adjustment of the installation schedule. The BWM Convention including Regulation B-3 containing installation schedule of BWMS for all ships was adopted nine years ago which was in 2004 and various stakeholders such as flag States, shipowners, BWMS manufacturers and classification societies have been prepared to achieve the goal of the BWM Convention. If the original installation schedule of BWMS is changed significantly as stipulated in the draft Assembly resolution, it will have a negative effect on many aspects.

The BWM Convention was adopted to protect the marine environment from the introduction of invasive species carried by ships' ballast water which is a major problem the world is facing. The adjusted schedule will delay the installation of BWMS extensively and thereby the serious problem cannot be solved. In addition, the changed schedule will cause unfairness for shipowners who have already installed BWMS on their ships according to the original schedule (B-3) and for the States who have already ratified or acceded to the BWM Convention because they need to review or amend their national legislation (IMO, 2013b).

3.2.2 Type Approval Certificate issue

The BWM Convention allows Parties to take additional or more stringent measures than the requirements stipulated in the Convention. In this regard, Article 2.3 of the BWM Convention stipulates as follows:

> *Nothing in this Convention shall be interpreted as preventing a Party from taking, individually or jointly with other Parties, more stringent measures with respect to the prevention, reduction or elimination of the transfer of Harmful Aquatic Organisms and Pathogens through the control and management of ships. Ballast Water and Sediments, consistent with international law.*

Therefore, it can be construed that any Administration has a right to take more stringent measures than the requirements of the BWM Convention to protect their jurisdictional water by adopting and enforcing their national legislation.

One of shipowners' main concerns is whether one BWMS Type Approved by a certain flag State will be accepted by other flag States. This flexibility of Type Approval Certificates is important because it allows shipowners to have more choices when they select BWMS.

However, the real situation could be different from the shipowners' expectation. For example, the United States Coast Guard (USCG) issued requirements concerning installation of BWMS on ships calling at U.S ports on 23 March 2012, which became effective 21 June 2012. The requirements are entitled "Standards for Living Organisms in Ship's Ballast Water Discharged in U.S. Waters", Vol.77, Federal Register Reg.17254. The requirements were accommodated in 33 CFR Part 151 Subpart C and D and 46 CFR Part 162 Subpart 162.060 (USCG, 2012).

According to the USCG requirements, any ship calling at any U.S port shall install USCG Type Approved BWMS by a given time. For example, a ship constructed before 1 December 2013 with ballast water capacity of more than 5,000 m^3 shall install USCG type-approved BWMS by its first scheduled dry docking after 1 January 2016 and a ship constructed on or after 1 December 2013 shall install USCG Type Approved BWMS at the time of delivery (USCG, 2012).

The problem is that any Type Approved BWMS may need an additional Type Approval by the USCG and in the future the USCG requirement may become more stringent than IMO D-2 performance standard.

The non-acceptance of BWMS Type Approval Certificates by other states requires shipowners, BWMS manufacturers and flag States to undertake additional preparations for receiving Type Approval by other states.

3.3 Economic challenges

3.3.1 Shipowners aspect

Compliance with the BWM Convention for all ships (i.e. existing and new ships) requires shipowners to invest huge amounts of money. A Ballast Water Management System can cost from half a million to four million dollars and there will be additional costs including development of Ballast Water Management Plans, dry docking and installation (World Maritime News, 2013).

The secretary-general of the International Chamber of Shipping (ICS) insisted that there should be no more stringent environmental regulations targeting shipping without an appropriate cost benefit analysis and study of the available technology (Lloyd list, 2013). Under the current economic recession, the difficulty experienced by many shipowners in making new investments to meet new environmental regulations could be understandable. Further, the BWM Convention requires all existing ships to install BWMS by a given time regardless of ships' age. Therefore, there is a possibility that shipowners will try to operate their ships longer after installing BWMS on old ships in order to recover their investment.

The steady and proper recycling of old ships and their substitution by new ships promotes more environmentally friendly and safer ships' design, better operating performance and a decrease in maritime accidents (ICS, 2001). In this regard, the extended operation of many older ships might cause other environmental problems such as producing more CO_2, NO_X and sulphur emissions.

3.3.2 Flag States aspect

Although invasive species cause significantly negative socio-economic impacts, the implementation of the BWM Convention also has costs for the flag States (GEF *et al.*, 2010).

In this regard, there could be mainly two types of cost. One is preparatory phase costs and the other is compliance-related costs. With regard to preparatory phase costs, flag Administrations need to assess their institutional needs and develop national strategies. In addition, it may be necessary to improve inter-agency coordination which contributes to improved communication between different parties in order to manage BWM strategies. With regard to compliance-related costs, flag States need to establish their national legislation concerning the implementation of the BWM Convention such as the issuance of certificates, Type Approval of BWMS, survey procedures, approval of BWMP and training of crew (GEF *et al.*, 2010). Further, since the ballast water issue is complex, implementing the BWM Convention by flag States at their national level may involve reforms of institutions, legislation and policies (GEF *et al.*, 2009).

However, for most developing countries, their major concern is focused on more basic issues than investing money to build national systems to implement the BWM Convention. This might an obstacle for them to ratify the BWM Convention. Therefore, continuous support for those countries through capacity building in international or regional levels is required to the effective implementation of the BWM Convention.

3.4 Conclusion

Tackling several technical, legal and economic challenges will promote an increase in number of Contracting States to the BWM Convention and it also contributes to the smooth implementation of the Convention. The IMO and the international maritime industry have been making a lot of efforts to tackle several unresolved issues. For example, a technical Guidance was issued by the IMO after fruitful discussion to deal with issues related to BW sampling and the IMO will keep this issue under consideration. With regard to the adjustment to the installation schedule for BWMS which is related to the availability of BWMS on the market and shipowners' difficulty due to technical and economic challenges, IMO's Assembly 28 will consider this issue in December, 2013. Accordingly, flag States need to be actively involved in ongoing discussions at the IMO which may affect the implications of the BWM Convention and they need to take appropriate actions promptly for their flagged ships.

CHAPTER 4
IMPLICATIONS OF THE BWM CONVENTION FOR FLAG STATES

There are many significant implications for flag States to properly prepare for the forthcoming entry into force of the BWM Convention since effective BW management is very complex and technical in various aspects. Flag States need to appreciate the provisions of the BWM Convention and related guidelines which are intricate and contain various technical requirements. They also need to understand the general obligations stipulated in the UNCLOS in order to implement the BWM Convention effectively.

This Chapter discusses establishing national legislation, survey and certification of ships, approval and certification of BWMS, approval of BWMP and delegating works to recognized organizations which are the main implications of the BWM Convention for flag States.

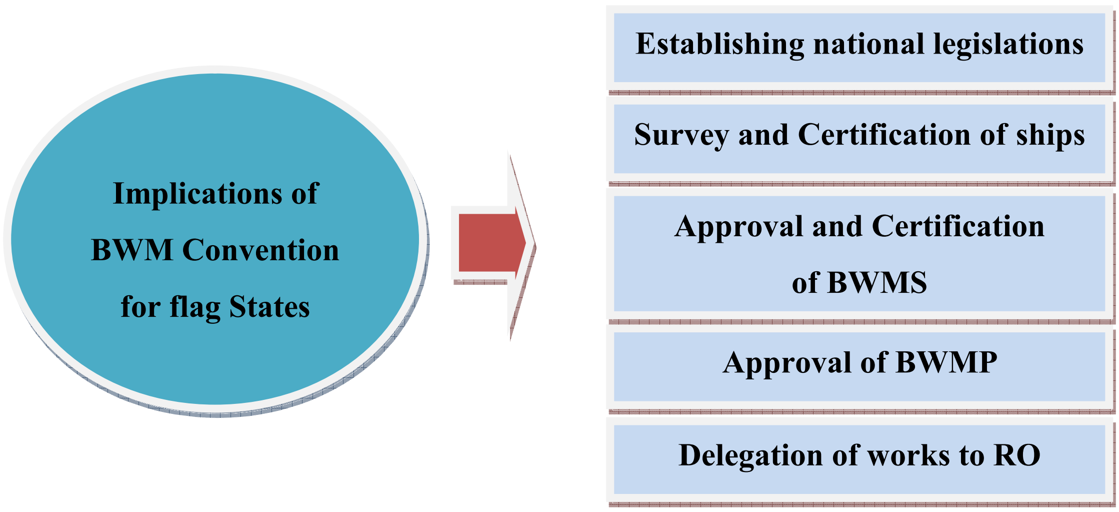


Figure 10 Implications of the BWM Convention for flag States

(Source: Author)

4.1 Establishing national legislation

In accordance with article 94 of the United Nations Convention on the Law of the Sea (UNCLOS), a State shall appropriately "exercise its jurisdiction and control in administrative, technical and social matters over ships flying its flag" (UN, 1982). That is to say that flag States have obligations to take proper actions to ensure the safety of a ship flying its flag in connection with, inter alia, construction, equipment and seaworthiness of the ship and surveys conducted by qualified surveyors (Franson, 2009). Although shipowners are primarily responsible for their ships' safety and protection of the environment because they are the first entity, the legislation regulating shipping by flag States is a significant element to ensure ships' safety and pollution prevention (Mansell, 2009).

Similarly, the concept of the flag States' obligations can be found in the BWM Convention. Article 4 of the BWM Convention stipulates that each Party shall oblige ships flying its flag or operating under its authority to comply with the requirements stipulated in the BWM Convention as well as the relevant standards and shall take appropriate measures to ensure that their flagged ships comply with the applicable requirements. In addition, Article 7 of the BWM Convention stipulates that each flag State shall require ships flying its flag or operating under its authority to be surveyed and certified (IMO, 2004).

Therefore, it is the duty of Parties to the BWM Convention to establish their national legislation and to properly conduct their duty. The national legislation should at least contain appropriate measures such as surveys of ships by qualified surveyors, approval of BWMP, Type Approval of BWMS and delegation of flag States' tasks to recognized organizations.

Flag States must understand clearly their existing national regulatory framework and the aspects concerning ballast water management. Such an understanding would help flag States to know how and what they should prepare to achieve effective Ballast water management (GEF *et al.*, 2009).

In addition, it might be necessary for flag States to reform their legislations and policies, strategies and institutional arrangements for Ballast water management through a consistent review process to achieve the ultimate purpose of establishing a national BWM framework (GEF *et al.*, 2009). Figure 11 shows an example of the review and reform process.

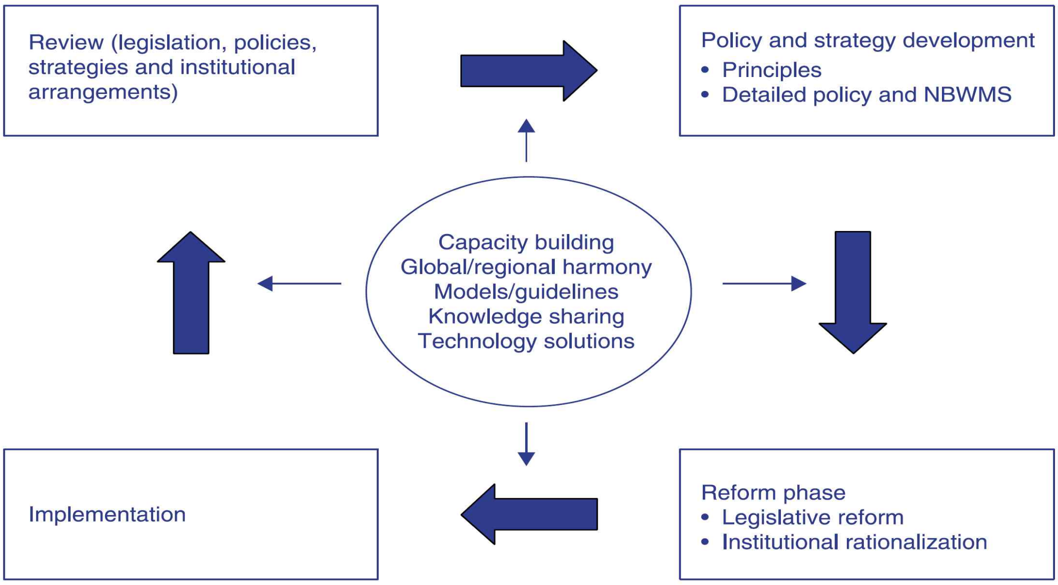


Figure 11 The review cycle for policy, strategy, legal and institutional reforms

(Source: GEF et al., 2009)

According to the BWM Convention, there are two Certificates to be issued by flag States. In this regard, an International BWM Certificate is to be issued for a ship that complies with the requirements of the BWM Convention and a Type Approval Certificate is to be issued for BWMS which complies with Regulation D-2 of the BWM Convention in accordance with Guidelines 8 adopted by resolution MEPC.174(58).

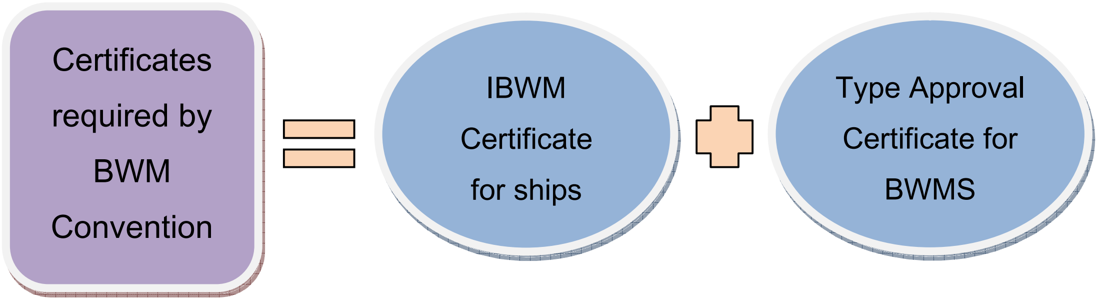


Figure 12 Certificates required by the BWM Convention

(Source: Author)

Those two certificates including the relevant surveys of ships and type-approval of BWMS will be discussed in the following two subsections, 4.2 and 4.3.

4.2 Surveys and certification for ships

Regulation E-1 of the BWM Convention requires that a ship engaged in international voyages with 400 gross tonnage and above, excluding floating platforms, FSUs and FPSOs, shall be surveyed in accordance with Regulation E-1 of the BWM Convention and Regulation E-2 requires that a ship is issued an International BWM Certificate after completion of a survey (2004, IMO). Therefore, ships are to be surveyed by the flag State Administration and the International BWM Certificate shall be always carried on board when a ship is engaged in international voyages.

4.2.1 Ship surveys

There are several different ship surveys depending on when the surveys are carried out. In accordance with Regulation E-1 of the BWM Convention, the following surveys are carried out regularly (IMO, 2004) except the last survey listed below:

- "an initial survey (In) before a ship is put in service" or before first issuance of IBWM Certificate;
- a renewal survey (R) not exceeding five years

- “an intermediate survey (I) within three months before or after the second anniversary date or within three months before or after the third anniversary date” of the IBWM Certificate
- “an annual survey (A) within three months before or after each anniversary date”
- additional surveys if any change occurs affecting BW systems

Figure 13 shows a regular survey cycle to be conducted to comply with the BWM Convention.

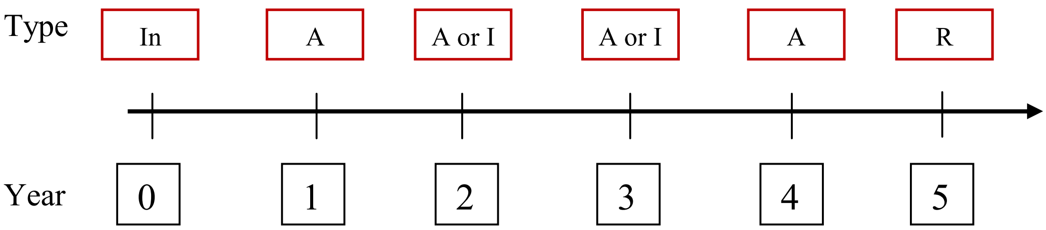


Figure 13 Survey cycle required by the BWM Convention
(Source: Drawn by Author based on IMO, 2011b)

Interim Survey Guidelines containing detailed survey items for each different survey were prepared by the FSI Sub-Committee in 2006 and were disseminated through BWM.2/Circ.7 in order to assist the surveys of ships requested by flag States or shipowners to verify compliance with the requirements of the BWM Convention (IMO, 2006a). Until the BWM Convention enters into force, the Guidelines will be used on a voluntary basis for the survey of ships if shipowners request to certify compliance with the requirements of the BWM Convention. Once the BWM Convention enters into force, the aforementioned Guidelines will be integrated into Survey Guidelines under the Harmonized System of Survey and Certification (HSSC) adopted by Assembly resolution (i.e. currently resolution A.1053(27)) since only survey requirements of IMO mandatory instruments that are in force can be integrated into the Survey Guidelines under HSSC (IMO, 2006a).

4.2.2 Ship certification

The BWM Convention does not allow a phase-in period for existing ships. Therefore, when the BWM Convention enters into force, all ships engaged in international voyages of 400 gross tonnage and above shall carry on board an International BWM Certificate and an approved Ballast Water Management Plan (BWMP) by the date of entry into force of the Convention. This means that when the BWM Convention meets the requirements of entry into force, which is 35 contracting States and 35 % of world gross tonnage, the aforementioned ships shall be surveyed, and carry an International BWM Certificate and an approved BWMP within a 12 month period.

In this aspect, at the 65th session of MEPC it was agreed that preparing, approving and issuing certificates after initial surveys for all the applicable ships was not practicable during the 12 month period from the date of meeting entry into force requirements and the actual entry into force of the BWM Convention. To address the impracticality above, as a solution, IBWM Certificates may be issued before entry into force of the Convention with a statement allowing the vessel to trade for a maximum of three months with an unapproved BWM Plan. In this regard, BWM.2/Circ.40 was issued in 8 October 2012 to ensure that the above solution is properly implemented from a practical point of view (IMO, 2012d).

Therefore, flag States should be ready to issue IBWM Certificates and to approve BWM Plans although the BWM Convention has not entered into force. If flag States intend to delegate the works for issuance of IBWM Certificates and approval of BWM Plans prior to entry into force of the BWM Convention, it is required for flag States to instruct their recognized organizations accordingly for the effective implementation of the BWM Convention.

<u>Certificates and installation schedule of BWMS</u>

When a flag State issues an International BWM Certificate, normally the expired date of the Certificate is five years from the date of first issue of the Certificate and the date of the renewal survey of the ship is the same as the expire date unless the shipowner applies for a renewal survey before that date. The date of renewal survey is very important because it influences the date of installation of BWMS in accordance with Regulation B-3.2 of the BWM Convention.

A draft Assembly resolution shown in Appendix A of this dissertation which was prepared by MEPC 65th session to be submitted to IMO Assembly's 28th session stipulates that the date for enforcing the Ballast Water Performance Standard in Regulation D-2, is "based on the renewal survey associated with the International Oil Pollution Prevention (IOPP) Certificate under MARPOL Annex I" (IMO, 2013b).

If the Assembly resolution is adopted at the Assembly 28th session in December 2013, flag States should decide whether they will apply the Assembly resolution to their flagged ships since the Assembly resolution is recommendatory in nature. The flag States' decision will be very important because the installation schedule of BWMS for the applicable ships will be significantly delayed.

4.3 Approval and certification of BWMS

4.3.1 General

A Type Approval of BWMS is to be conducted by flag States in accordance with procedures stipulated in the Guidelines for Approval of BWMS (G8). The approval consists of both shore based testing in order to verify that the D-2 performance standards are complied with and ship board testing to verify that the system works properly onboard the vessel. This process takes approximately six months (Greensmith, 2010).

Although a considerable amount of information is available on the efficacy of existing BWMS, these systems have been tested under particular conditions such as water salinity, scale and temperature. Flag States wishing to conduct Type Approval for new BWMS may need to develop their own testing procedures corresponding to their own testing conditions. Additionally, carrying out the approval process of BWMS involves a highly technical matter. Flag States may face difficulties to assess the required technologies.

Therefore, flag States may need to improve their capacity for establishing procedures for Type Approval of BWMS and its proper application. Before Type Approval Certificates are issued there may also be costs incurred in order to be able to provide a detailed review of the test results and technical documents (GEF *et al.*, 2010).

In general, the BWMS manufacturers will select the country where they are based to achieve Type Approval. And some companies may choose flag States where appropriate testing facilities are located. In this regard, flag States may delegate the approval works to Recognised Organisations such as classification societies to verify and assure the quality of the tests (Greensmith, 2010).

After issuing Type Approval Certificates, flag States should provide the relevant information to the IMO in accordance with the Guidelines for approval of BWMS (G8).

4.3.2 Type Approval Certificate

Flag States issue a Type Approval Certificate for a BWMS which complies with the requirements stipulated in the Guidelines for Approval of BWMS (G8). The Type Approval Certificate form is found in appendix 1 of G8. The form stipulates the main particulars of the system and any limiting conditions which affect the efficacy of the system (IMO, 2008a).

In accordance with paragraph 6 of Guidelines for Approval of BWMS (G8), the Type Approval Certificate should include information of "ballast water capacities, flow rates, salinity, temperature regimes and any limiting conditions or circumstances as appropriate" (IMO, 2008a).

There have been continuous discussions to ensure more reliable Type Approval of BWMS. In this regard, "Guidance for administrations on the Type Approval process for ballast water management systems in accordance Guidelines (G8)" was disseminated by BWM.2/Circ.28 in October 2010 in order to provide additional guidance for flag States.

However, at the 65th session of MEPC meeting held in May 2013 some IMO members and shipowners representatives argued that Type Approval Certificate and its enclosures are not enough to provide data based on actual tests, and limiting conditions of BWM operations. They recommended that Type Approval Certificate should be revised and standardized (IMO, 2012a).

In this regard, an amendment to BWM.2/Circ.28 was disseminated by BWM.2/Circ.43 in May 2013 to enhance the Type Approval process carried out by flag States and, in this aspect, BWM.2/Circ.43 also requires inscribing reliable test results and specific limiting conditions as follows (IMO, 2013d):

BWMS test results to be contained in BWM Type Approval Certificate:

> *Type Approval Certificate should contain the test results of each land-based and shipboard test run. Such test results shall include at least the numerical salinity, temperature, flow rates, and where appropriate UV transmittance. In addition, these test results shall include all other relevant variables.*

BWMS Limiting conditions to be inscribed in BWM Type Approval Certificate:

Type Approval Certificate should include details on all imposed limiting conditions on the operation of the BWMS. Such limiting conditions to include any applicable environmental conditions (e.g. salinity, UV transmittance, temperature, etc.) and/or system operational parameters (e.g. min/max pressure, pressure differentials, min/max Total Residual Oxidants (TRO), etc.).

Therefore, when flag States proceed Type Approval of a BWMS, BWM.2/Circ.43 ("Amendments to the Guidance for administrations on the type approval process for ballast water management systems in accordance with Guidelines (G8)") should be carefully considered and applied to get the credibility for their Type Approval work in international society.

A flag State may also issue a Type Approval Certificate for BWMS which was already tested under supervision by another flag State. If a BWMS approved by one flag State fails Type Approval by another flag State, then the two flag States concerned should consult each other to reach a mutual agreement (IMO, 2008a).

4.3.3 Approval and oversight of prototype BWMS

Regulation D-4.3 of the BWM Convention stipulates that, "in establishing and carrying out any programme to test and evaluate promising Ballast Water technologies, Parties shall take into account Guidelines developed by the Organization". In this regard, "Guidelines for approval and oversight of prototype ballast water treatment technology programmes (G10)" was adopted by Res.MEPC.140(54) on 24 March 2006 (IMO, 2004)

The intention of Regulation D-4 of the BWM Convention is to encourage the development of BWMS technologies. In cases where approval is granted, a

Statement of Compliance (SOC) is to be issued for a maximum of five years and the standard format of the SOC is shown in Appendix of G10 (IMO, 2006b).

4.4 Approval of BWMP

Ships are obliged to carry a ship specific Ballast Water Management Plan (BWMP) containing ballast water management methods (BW exchange or BW performance standards) and to appropriately implement the plan during the ships' operation. Further, the BWMP shall be approved by the flag States.

Regulation B-1 of the BWM Convention stipulates that the BWMP shall be developed taking into account guidelines developed by the IMO. In this aspect, there are two guidelines adopted by the IMO. The first guidelines were adopted by resolution A.868(20) in 1997 and the latest one was adopted by resolution MEPC.127(53) in 2005. Therefore, there was some confusion as to whether BWMP developed taking into account resolution A.868(20) was also valid since it was adopted before the adoption of the BWM Convention.

In this regard, BWM.2/Circ.40 was issued to clarify the confusion. Although the Guidelines adopted by resolution A.868(20) were superseded by the Guidelines adopted by resolution MEPC.127(53), BWM Plans approved in accordance with resolution A.868(20) remain valid unless the plan is needed to be revised due to installation of a BWMS. The reasons for the above interpretation are based on the fact that Regulation B-1 of the BWM Convention does not specifically identify a resolution and the latest resolution MEPC.127(53) does not revoke the earlier resolution A.868(20) (IMO, 2012d).

Although the BWM Convention is not effective yet and thus the carrying requirement of a BWM Plan is at present not mandatory, currently many ships carry and implement a BWM Plan because many countries such as Australia, Brazil, Canada and USA have required ships calling their ports to carry BWM Plans and conduct

Ballast water exchange in open ocean. Therefore, many BWM Plans were developed taking into account resolution A.868(20) before the adoption of resolution MEPC.127(53).

The interpretation stipulated in BWM.2/Circ.40 seems to be an appropriate and practical decision for the smooth implementation of the BWM Convention. Accordingly, flag States should be aware that an existing BWMP developed by resolution A.868(20) is still valid until it is required to be amended due to installation of BWMS. However, from now on BWMP should be developed based on resolution MEPC.127(53).

Accordingly, the Administration shall approve BWMP for their flagged ships or may delegate its approval work to their recognized organizations. In addition, the Plan shall "be written in the working language of the ship, if the text is not in English, French or Spanish, the plan shall include a translation into one of these languages" (IMO, 2004).

4.5 Delegation to recognized organizations

A flag State may delegate its obligations such as ship surveys and Type Approval of BWMS including issuing relevant certificates to a recognized organization (RO). In this regard, Regulation E-1.3 of the BWM Convention contains delegation provision as follows (IMO, 2004):

> *Surveys of ships for the purpose of enforcement of the provisions of this Convention shall be carried out by officers of the Administration. The Administration may, however, entrust the surveys either to surveyors nominated for the purpose or to organizations recognized by it.*

Similarly, the delegation requirements can be found in other IMO mandatory instruments such as Regulation I/6(a) of SOLAS 74, Regulation 6 of MARPOL Annex I and Regulation 8 of MARPOL Annex II, Article 6 and 7 of Tonnage 69 and Article 13 of Load Lines 66. However, flag States should be aware that the Administration cannot delegate its full responsibility to the recognized organization and the Administration still has their responsibility for their flagged ships although they delegates their works to recognized organizations (Mukherjee, 2000; Seo, 2010). Therefore, proper monitoring of RO's works is required by flag States to ensure the proper implementation of the BWM Convention.

When the Administration delegates its works to a recognized organization, a flag State is required to report the scope of authority to the IMO through the Global Integrated Shipping Information System (GISIS) which is an information data base system established by the IMO in 2005 (Park, 2012). In this regard, Regulation E-1.5 of the BWM Convention stipulates as follows (IMO, 2004):

> *The Administration shall notify the Organization of the specific responsibilities and conditions of the authority delegated to the nominated surveyors or recognized organizations, for circulation to Parties for the information of their officers.*

4.6 Conclusion

Flag states need to understand main implications of the BWM Convention. The obligations of a flag State starts from establishing their national legislation in order to exercise regulatory control over ships which are registered under its flag. The national legislation should at least contain appropriate provisions such as surveys of ships by qualified surveyors, approval of BWMP, Type Approval of BWMS and delegation of flag States' works to recognized organizations in order to perform flag States' duties under the BWM Convention as well as the UNCLOS.

CHAPTER 5
IMPLEMENTATION OF THE BWM CONVENTION : A CASE STUDY OF THE REPUBLIC OF KOREA

The various implications of the BWM Convention for flag States are further discussed in this Chapter through examining the case study of the Republic of Korea (ROK) which is a Contracting State of the BWM Convention and has established its national requirements and has experience in the approval of BWMS. This Chapter also discusses how the ROK deals with several challenges to the implementation of the BWM Convention.

This Chapter, as shown in Figure 14, discusses national legislation of the Republic of Korea (ROK) and introduces the ROK Government and relevant organizations concerning BW management. Towards the end of this Chapter, the approval and certification of BWMS by the ROK Government and relevant organizations are discussed.

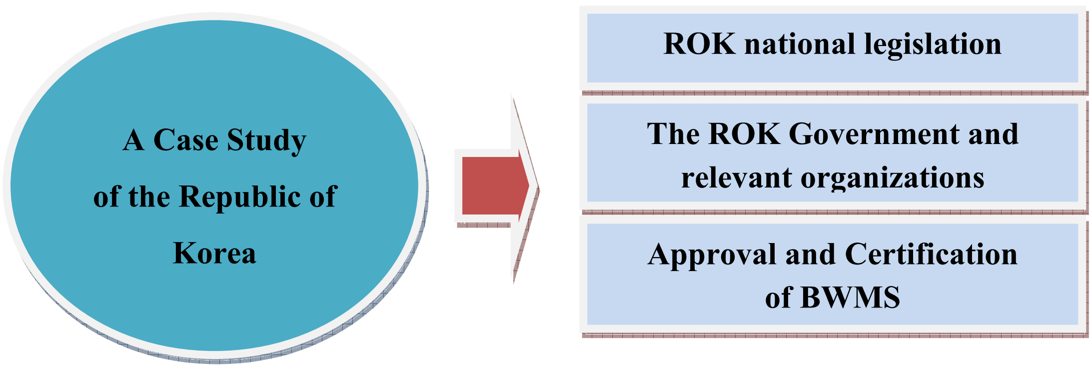


Figure 14 A case study of the Republic of Korea

(Source: Author)

As shown in Table 6, about 56 million DWT is owned by ROK shipowners. Among those ships, although about 39 million DWT is registered in open registry countries, **about 17 million DWT** is registered in the ROK flag administration as of 1 January 2012.

As of 1 January 2012

Country or territory of ownership [b]	Number of vessels			Deadweight tonnage				
	National flag [c]	Foreign flag	Total	National flag [c]	Foreign flag	Total	Foreign flag as a percentage of total	Estimated market share 1 January 2012
Greece	738	2 583	3 321	64 921 486	159 130 395	224 051 881	71.02	16.10
Japan	717	3 243	3 960	20 452 832	197 210 070	217 662 902	90.60	15.64
Germany	422	3 567	3 989	17 296 198	108 330 510	125 626 708	86.23	9.03
China	2 060	1 569	3 629	51 716 318	72 285 422	124 001 740	58.29	8.91
Korea, Republic of	740	496	1 236	17 102 300	39 083 270	56 185 570	69.56	4.04
United States	741	1 314	2 055	7 162 685	47 460 048	54 622 733	86.89	3.92
China, Taiwan Province of	470	383	853	28 884 470	16 601 518	45 485 988	36.50	3.27
Norway	851	1 141	1 992	15 772 288	27 327 579	43 099 867	63.41	3.10
Denmark	394	649	1 043	13 463 727	26 527 607	39 991 334	66.33	2.87
Chinese Taipei	102	601	703	4 076 815	34 968 474	39 045 289	89.56	2.81

Table 6 The top 10 countries with the largest owned fleets

(Source: UNCTAD, 2012)

Further, Table 7 shows that **2,916 ships with total about 19 million DWT** are registered under the ROK flag, including ships owned by foreign shipowners, amounting to a 1.25% share of the world total.

As of 1 January 2012

Number of ships	DWT	Share of world total (percent)	Percent of DWT owned by foreign shipowners
2,916	19,157,000	1.25 %	7.62 %

Table 7 Statistics of ROK flagged ships

(Source: Tabulated by Author based on UNCTAD, 2012)

Chapter 3.3.1 discussed shipowners' economic burden in implementation of the BWM Convention because they are required to install costly BWMS for all their ships regardless of ships' age. The shipping industry in the ROK is also facing a difficult situation due to the current economic recession. However, delaying installation of BWMS on board would not be a permanent solution and it might cause irreversible marine environmental damage. Therefore, considering the number and tonnage of ROK flag ships shown in Table 6 and Table 7, the role of the ROK flag Administration to ensure protection of the marine environment is significant for the effective implementation of the BWM Convention.

5.1 ROK national legislation

When a new or amended IMO mandatory instrument becomes effective, a flag State is required to implement and enforce it through a proper national legislative process as stipulated in paragraph 7 in the IMO Code for the Implementation of Mandatory IMO Instruments, 2011 adopted by Res.A.1054(27) (IMO, 2011c).

The ROK is a Party to most of IMO's mandatory instruments and protocols such as the SOLAS, MARPOL and STCW Convention. Table 8 shows representative IMO mandatory instruments and concerned ROK national legislation.

IMO Conventions	ROK national legislation
SOLAS 74 and its Protocol 78 & 88	Ship Safety Act
MARPOL 73/78 and its Protocol 97	Marine Environment Management Act
STCW 78	Ship Crew Act
COLREG 72	Maritime Traffic Safety Act
TONNAGE 69	Ship Tonnage Measurement Act

Table 8 IMO Conventions and ROK legislation

(Source: Author)

The Parties to the BWM Convention are required to establish national legislation with regard to BW management in order to properly implement the BWM Convention and it is one of most significant implications for flag States. In this regard, the Republic of Korea acceded to the BWM Convention on 10 December 2009 and established national legislation with regard to ballast water management in order to pursue the aim of the BWM Convention which is “Minimizing and ultimately eliminating the risks to the environment, human health, property and resources caused by unwanted harmful organisms by means of ballast water management”.

In conformity with ballast water management, Table 9 shows legislation which has been prepared by the ROK and which will come into force at the same time the BWM Convention enters into force worldwide. The legislation will be applicable to all ships that carry out ballast water discharge in ROK jurisdictional waters or ROK flagged ships (MOF, 2013a). As shown in Figure 15, ROK national legislation was developed based on the provisions of the BWM Convention, related Guidelines and Circulars adopted by the IMO. ROK’s special features such as geographical location, involved organizations, enforcing regimes and opinions of people were also considered during the development of the legislation.

	ROK national legislation	**Promulgation in the ROK**
The BWM Convention	Ballast Water Management Act	21 Dec. 2007
	Ballast Water Management Act Enforcement Ordinance	09 Feb. 2011
	Ballast Water Management Act Enforcement Regulation	23 Nov. 2012

Table 9 The BWM Convention and ROK legislation

(Source: Author)

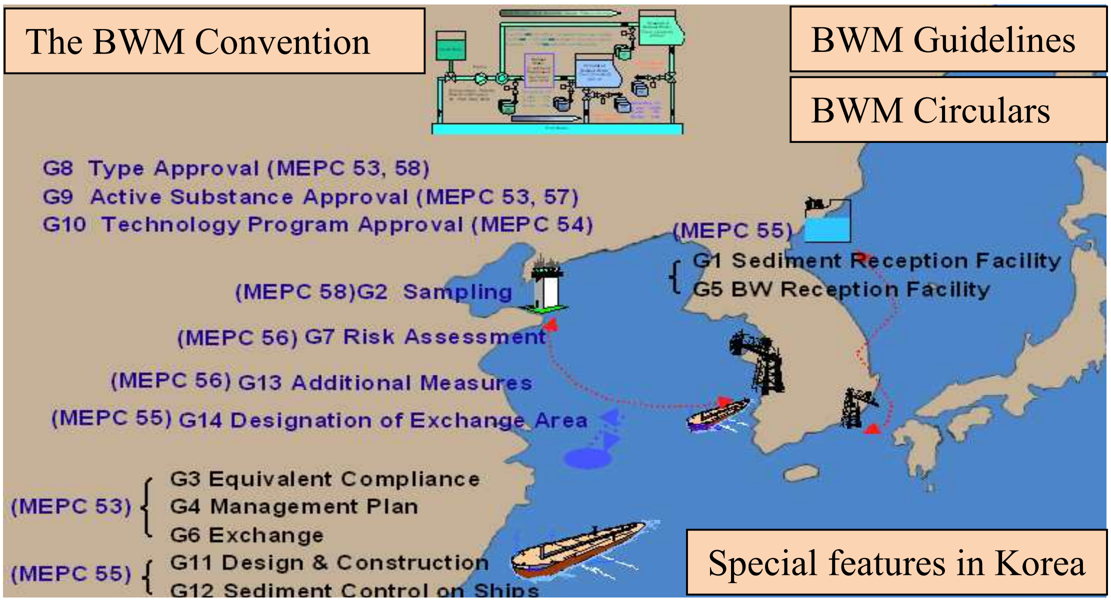


Figure 15 Considerations during establishing ROK legislation

(Source: Drawn by Author based on KR, 2010)

In addition to the national legislation outlined above, for effective Type Approval of Ballast Water Management Systems (BWMS), "Provisional Regulation for Type Approval of Ballast Water Management System" (promulgated on 08 Nov. 2006) was developed and the current Type Approval for BWMS is carried out in accordance with this legislation. The text was revised once in December 2012 to specify detailed procedures and requirements for Type Approval and individual certification schemes (MOF, 2013d).

There are several special requirements concerning BW management which were decided by the ROK after considering special features in the country and they are stipulated in ROK legislation as follows:

<u>Ballast water exchange and reporting</u>

The ROK legislation stipulates, as mandatory requirements, that until BWMS is required to be installed on board, all ships intending to discharge ballast water in ROK jurisdictional waters shall conduct Ballast water exchange at least 200 nautical miles from the base line and in water at least 200 metres in depth and shall send a copy of the Ballast Water Reporting Form to the relevant agency twenty-four hours prior to the estimated time of arrival (MOF, 2013a).

The BWM Convention does not require ships to report a Ballast Water Reporting Form for conducting Ballast water exchange, but the ROK will require such a report to be submitted once the BWM Convention enters into force.

<u>Inspection, Violation and Fine</u>

Monitoring of ROK legislation will be done through the inspection of the BWMP and the Ballast Water Reporting Form. In addition, the collection and analysis of a ballast water samples also may be included for monitoring purposes. Violations of provisions of national legislation will be sanctioned according to the national law, which may include detention, fine or denial of the ship's entry into ROK ports or terminals (MOF, 2013b). Table 10 shows some examples of violations and fines stipulated in ROK national legislation.

No.	Violation	Fine *
1	In case where a ship does not report the port of call	2,000,000
2	Violation of carrying BWMP onboard or denying showing it	300,000
3	Violation of carrying, recording or showing BW Record book	300,000
4	Violation of carrying Certificates	300,000
5	In case where a ROK flagged ship is detained in a foreign port due to violation of the BWM Convention (only for ROK flagged ships)	2,000,000

** Unit: ROK Won (1 US $ = 1,085 won, on 10 September 2013)*

Table 10 Violation and fine in ROK legislation
(*Source: Tabulated by Author based on MOF, 2013b)*

Equivalent Compliance for small ships

In accordance with Regulation A-5 (equivalent compliance) of the BWM Convention, the Administration decides the applicability of the BWM Convention to pleasure craft with less than 50 metres in length overall and maximum BW capacity of 8 cubic metres taking into account Guidelines for ballast water management equivalent compliance (G3) adopted by Res.MEPC.123(53). In this regard, ROK national legislation stipulates that if those ships use fresh water supplied by the shore as their ballast water, the ships are allowed to discharge the ballast water in ROK jurisdictional waters (MOF, 2013c).

5.2 The ROK Government and relevant organizations

5.2.1 The ROK Government

In the case of the ROK, Ministry of Oceans and Fisheries (MOF) is in charge of all maritime affairs such as maritime safety, security, legislation, PSC, RO auditing and seafarers training. Four departments, namely *Maritime Industry Technology Division, Maritime Safety Policy Division, Port Management Division, and Seafarer and Labour Policy Division* are the actors dealing with the obligations of the flag State.

Among those divisions in the ROK Government, *the Maritime Industry Technology Division* is in charge of BW management including monitoring Type Approval process, issuance of Type Approval Certificates and delegation of its duty to relevant organizations. Type Approval certificates of BWMS are issued only by the ROK Government. A copy of a Type Approval Certificate shall be carried on board a vessel fitted with BWMS at all times (MOF, 2013c).

A ship carrying ballast water shall have an approved BWM plan. With regard to approval of BWMP, according to ROK legislation, the ROK Government has not delegated its work to any recognized organizations for the approval of BWM plans. Instead, 11 Regional Maritime Affairs and Port Administrations approve the plan for

ROK flagged ships (MOF, 2013c).

The ROK supports the prompt implementation of the BWM Convention since further delay of implementation would cause irreversible damage to the marine environment from the damage by harmful aquatic organisms. With regard to the adjustment of the installation schedule of BWMS onboard discussed in Chapter 3.2.1, since it is recommendatory in nature, if the adjustment is decided by Assembly 28, its application to ROK flag ships needs to be considered further. For the prompt amendment and implementation of ROK national legislation, detailed and frequently changeable requirements are inserted in “Provisional regulation” which does not require approval of Parliament.

5.2.2 Recognized organizations

Ship surveys and approval of drawing required by the BWM Convention are conducted by two recognized organizations (i.e. KR or KST) on behalf of the ROK flag Administration (MOF, 2013c).

Korean Register of Shipping (KR) “was established in 1960 as a not-for-profit ship classification society and became a member of the International Association of Classification Societies (IACS) in 1988” (KR, 2013). KR is presently authorized by more than 65 Administrations to carry out statutory services on their behalf including the ROK Government (KR, 2013).

Korea Ship Safety Technology Authority (KST) was established under Article 45 of the Ships Safety Act on 1 January 1979 and it performs Statutory Surveys on behalf of the ROK Government (KST, 2013).

5.2.3 Test organizations

The following test organizations conduct Land based tests and Shipboard tests for Type Approval of BWMS on behalf of the ROK Government.

Korea Institute of Ocean Science & Technology (KIOST)

"KIOST was established on 30 October 1973 and it performs basic and applied research to promote the efficient use of coastal and ocean resources, undertakes comprehensive surveys and studies of ROK's seas and open oceans and conducts scientific research in polar and tropical regions" (KIOST, 2013a).

Figure 16 shows KIOST Land-based test facility subsidized by the ROK Government.

 Test Water Tank (500m^3)	 Treated Water Tank (250 m^3)	 Control Water Tank (250 m^3)
 Ballast Water Test System Module	 Storage Tank	 Main Control Room

Figure 16 KIOST Land-based testing facility of BWMS
(*Source: Compiled by Author based on KIOST, 2013b)*

Korea Marine Equipment Research Institute (KOMERI)

KOMERI was established in 2001 as an institute for marine and shipbuilding equipment dedicated to providing wide-ranging and systematic support for the ROK industry (KOMERI, 2013).

Busan Technopark

Busan Technopark was established in 1999 and it has been fostering local industries by creating a support system covering all stages of R&D, fostering human resources, utilizing equipment, testing and verification, and marketing (Busan Technopark, 2013).

With regard to BW sampling issue discussed in Chapter 3.1.1 as one of challenges to the implementation of the BWM Convention, the ROK test organizations and research institutes have been trying to develop reliable simple test kits to promptly and effectively check compliance with the D-2 requirements on board. In case of detailed samplings conducted by ROK PSCO, the sample will be sent to one of the test organizations and the detailed analysis will be done promptly.

5.3 Approval and certification of BWMS

The concerned ROK national law, namely "Provisional Regulation for Type Approval of Ballast Water Management System" was developed based on the IMO "Guidelines for approval of ballast water management systems (G8)", "Guidance for Administrations on the Type Approval process for ballast water management systems in accordance with Guidelines (G8)" disseminated in BWM.2/Circ.28 and its Amendment disseminated in BWM.2/Circ.43. As discussed in Chapter 3.1.2, there is a concern that Type Approved BWMS may not comply with the D-2 (BW Performance Standard) in some operational conditions and the operation of BWMS onboard may affect negatively on ballast tank coating of ships. In order to tackle the issue related to the uncertainty of BWMS performance, ROK BWMS are verified by various expert organizations in their fields and detailed operational limitations are inscribed in Type Approval Certificates to avoid unnecessary mistakes by ship owners. Table 11 shows involved organizations, type of tests and representative test items carried out by each organization. The Type Approval Certificate is finally issued by the ROK Government to a BWMS which complies with all the relevant national requirements.

Registered Organizations	Type of Test	Test Items
KR (Korean Register of Shipping) or **KST** (Korea Ship Safety Technology Authority)	Conformity Test	- Conformity of ship's operation - Performance of alarm devices and recording equipment - Control and monitoring system
KIOST (Korea Institute of Ocean Science and Technology) or **KOMERI** (Korea Marine Equipment Research Institute) or **Busan Techno Park**	Land-based Test	- Test cycle : more than 5 times per each cycle (PSU), minimum 2 cycles (total 10 times) - Capacity of control tank and ballast tank should be greater than 200 m^3 - Time of sampling : 3 times shortly before/after ballast water treatment
	Shipboard Test	- Compliance with D-2 after repeating ballast water circulation suction → storage → discharge process 3 times - Organisms test - Sampling test
KTL (Korea Testing Laboratory) or **KOMERI** (Korea Marine Equipment Research Institute) or **SGS Tesco**	Environmental Test	- Vibration test - Temperature test - Moisture test - IP Test - Power variation test - Incline test - EMC test

Table 11 Type Approval practices for BWMS in the ROK
(*Source: Tabulated by Author based on* MOF, *2013d)*

So far, the ROK Government has issued eight type-approval certificates. According to the IMO, at present there are 33 Type Approved BWMS by various Administrations. Among those systems, eight BWMS are ROK manufacturers, accounting for 24% of the total. Table 12 below shows the list of ROK manufacturers and BWMS Type Approved by the ROK Government (KG) after IMO Basic and Final approval.

No.	Name	Company	IMO Approval	Treatment method	Type Approval date by KG
1	Electro-Cleen	Techross Co., Ltd	Basic & Final	Electrolysis	December 2008
2	NK-03 Blue Ballast	NK Co., Ltd	Basic & Final	Ozonation	November 2009
3	GloEn-Patrol	Panasia Co., Ltd	Basic & Final	Filter + UV	December 2009
4	Eco Ballast	Hyundai Heavy Industry	Basic & Final	Filter + UV	March 2011
5	Purimar System	Samsung Heavy Industry	Basic & Final	Filter + Electrolysis	October 2011
6	HiBallast	Hyundai Heavy Industry	Basic & Final	Filter + Electrolysis	November 2011
7	AquaStar BWMS	AQUA Eng. Co., Ltd	Basic & Final	Filter + Electrolysis	June 2012
8	ARA Plasma BWMS	Samkun Centrury	Basic & Final	Filter + UV + Plasma	July 2012

Table 12 List of Type Approved BWMSs in the ROK (As of May 2013)

(*Source: Author)*

In addition, Table 13 shows ROK manufacturing capacity for BWMS prepared by ROK BWMS manufacturers. According to this table, it is expected that the ROK alone can produce 63,353 units of BWMS in the period of the year 2012 to 2020. Accordingly, it is construed that worldwide demand for BWMS for existing and new ships can be satisfied and the availability of BWMS will be enough to comply with Regulation B-3 of the BWM Convention.

Unit: number of BWMS

Year	Ballast water treatment capacity (m^3/h)				Total
	Less than 200	200 ~ 1,000	1,001~ 5,000	Greater than 5,000	
2012	261	1,015	251	55	1,582
2013	358	1,340	395	117	2,210
2014	772	2,748	685	180	4,385
2015	964	3,570	1,243	447	6,224
2016	1,454	4,050	1,533	460	7,497
2017	1,806	5,114	2,815	1,255	10,990
2018	1,768	5,046	2,583	1,085	10,482
2019	1,758	5,026	2,553	1,085	10,422
2020	1,692	4,850	2,154	865	9,561
Total	**10,833**	**32,759**	**14,212**	**5,549**	**63,353**

Table 13 Estimated ROK manufacturing capacity for BWMS

(*Source: MEPC 64/INF.9 submitted by the ROK)*

5.4 Conclusion

As a Contracting State to the BWM Convention, the ROK has prepared its national legislation with regard to BW Management and has been conducting various Type Approvals of BWMS. For the effective implementation, ROK legislation is to be amended continuously and in a timely fashion following amendments to international standards or recommendations by the IMO. Several expert organizations are involved in Type Approval of BWMS and the Type Approval Certificate is finally issued by ROK Government, thus the co-operation between organizations is essential. The case study of the ROK will benefit other flag States in their preparation of needed national regulations, procedures, policies and schedules for the implementation of the BWM Convention.

CHAPTER 6
OVERALL CONCLUSION

Shipping carries around 80 per cent of global trade in volume and ships' ballast water is indispensable to ensure safe shipping these days. However, shipping is the main vector for movement of species and is responsible for introductions of invasive aquatic species (IAS) around the world. The frequency of the introductions has been increasing rapidly with the increase of maritime trade and globalization. Therefore, IAS is considered as one of the major threats to global biodiversity because it is almost impossible to eradicate the problem caused by IAS once a new species is established.

The most effective way of eradicating the problems caused by IAS is stopping the root causes such as bio fouling on ships' hulls or appendages, and ships' ballast water. However, ship's hulls, appendages such as propellers and rudders and ships' ballast water are essential for ship operation. As a practical solution, with regard to bio fouling, the IMO recently adopted Guidelines for recommendation to minimize the effects.

With regard to controlling the transfer of invasive species by ballast water, an internationally binding instrument which is the BWM Convention was adopted in 2004. The BWM Convention has been in place for nine years since its adoption but it has not yet entered into force due to several significant challenges as discussed in Chapter 3.

As a consequence, the marine environment, human health, property and resources are continuously under threat from unwanted harmful organisms. Some challenges would be obstacles even after entry into force of the BWM Convention unless these are solved before its entry into force. Especially, the uncertainty of BW sampling and

BWMS performance issues should be urgently solved by international efforts at the IMO.

For the effective implementation of the BWM Convention, the role of flag States is vital since ships are primarily under control of their national Administrations. According to the UNCLOS and the BWM Convention, flag States have several important responsibilities to ensure its compliance with these instruments by establishing proper national legislation such as ship surveys, issuance of IBWM Certificate, Type Approval of BWMS, approval of BWMP and if necessary, delegation of flag States duties to recognized organizations.

This dissertation discussed the background of the BWM Convention, several challenges that the maritime community is facing and various implications encountered by flag States. This dissertation was supported by a case study of the Republic of Korea in order to illustrate and discuss how the identified challenges and implications are dealt with by the ROK.

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APPENDIX A

Comparison table of installation schedule of BWMS between regulation B-3 of the BWM Convention and the draft Assembly resolution

Reg. No.	Year of ship constructed	BW Capacity	Reg.B-3 of the BWM Convention	Draft Assembly resolution
B-3.1.1	Before 2009	Between 1,500 and 5,000 cubic metres	Until 2014 : D-1 or D-2 After 2014 : D-2 (D-2 shall be complied not later than the first intermediate or renewal survey after the anniversary date of delivery of the ship in 2014)	Until 2014 : D-1 or D-2 After 2014 : D-2 (D-2 shall be complied not later than the first renewal survey after the anniversary date of delivery of the ship in 2014) (However, if the Convention enters into fore after the year 2014, D-2 shall be complied not later than the first renewal survey after the date of entry into force of the Convention)
B-3.1.2	Before 2009	Less than 1,500 or greater than 5,000 cubic metres	Until 2016 : D-1 or D-2 After 2016 : D-2 (D-2 shall be complied not later than the first intermediate or renewal survey after the anniversary date of delivery of the ship in 2016)	Until 2016 : D-1 or D-2 After 2016 : D-2 (D-2 shall be complied not later than the first renewal survey after the anniversary date of delivery of the ship in 2016) (However, if the Convention enters into fore after the year 2016, D-2 shall be complied not later than the first renewal survey after the date of entry into force of the Convention)

B-3.3	In or after 2009	Less than 5,000 cubic metres	At the time of delivery : D-2	D-2 shall be complied not later than the first renewal survey after the date of entry into force of the Convention
B-3.4	In or after 2009, but before 2012	5,000 cubic metres or more	Until 2016 : D-1 or D-2 After 2016 : D-2 (D-2 shall be complied not later than the first intermediate or renewal survey after the anniversary date of delivery of the ship in 2016)	Until 2016 : D-1 or D-2 After 2016 : D-2 (D-2 shall be complied not later than the first renewal survey after the anniversary date of delivery of the ship in 2016) (However, if the Convention enters into fore after the year 2016, D-2 shall be complied not later than the first renewal survey after the date of entry into force of the Convention)
B-3.5	In or after 2012	5,000 cubic metres or more	At the time of delivery : D-2	D-2 shall be complied not later than the first renewal survey after the date of entry into force of the Convention

(Source: Drawn by Author based on IMO, 2004; IMO, 2013b)

Note: The draft Assembly resolution also provides that the date for enforcing the ballast water performance standard in Regulation D-2, is **based on the renewal survey associated with the International Oil Pollution Prevention (IOPP) Certificate** under MARPOL Annex I.