

KOREA MARITIME INSTITUTE

KMI International Journal of Maritime Affairs and Fisheries

KMI International Journal of Maritime Affairs and Fisheries is a comprehensive journal of ocean policy studies. It offers researchers, analysts and policy makers a unique combination of legal, political, social and economic analyses. The journal covers international, regional and national marine policies; management and regulation of marine activities, including fisheries, ports and logistics; marine affairs, including marine pollution and conservation and use of marine resources. This journal is published in June and December by the Korea Maritime Institute.

Published by
Dr. Chang Ho Yang
President of Korea Maritime Institute

26, Haeyang-ro 301beon-gil, Yeongdo-gu, Busan, 49111, Korea
Telephone: +82 51 797 4800 Facsimile: +82 51 797 4810
Website: www.kmi.re.kr

All rights reserved. ©2014 Korea Maritime Institute. All materials contained in this journal are protected by the copyright of the Korea Maritime Institute and may not be translated, reproduced, distributed, stored in a retrieval system or transmitted in any form or by any other means, whether electronic or mechanical, including photocopying, recording or otherwise, without prior permission in writing from the publisher.

The publisher, the institute and the editor cannot be held responsible for errors or any consequences arising from the use of information contained in this journal.

Printed and bound by Design World

CONTENTS

Innocent Passage in the Territorial Sea
within the Framework of the Law of the Sea Convention

Pierandrea Leucci 1

A Study on the Selection of Core Technology in Maritime Safety Field for Fourth
Industrial Revolution Era - Focusing on Ship Inspection Agency -

Tae-Han Song Joo-Hwan Kim Hwayoung Kim 17

The Prospects of Investment in the Maritime Industry of Russian Far East
- Prospects for Maritime Industry Investment -

Iurii V. Vedernikov Sergei M. Smirnov, PhD 39

Implications of Sea-Level Rise for the Law of the Sea

Ekrem Korkut Lara B. Fowler 49

Innocent Passage in the Territorial Sea within the Framework of the Law of the Sea Convention

Pierandrea Leucci*

ABSTRACT

From its early stage of development, the 'right of navigation' was recognised as one of the key components of the principle of freedom on the high seas, which for centuries dominated the international law of the sea. However, because of the progressive seaward expansion of the coastal States authority, a reconciliation between such a right and the sovereignty of States in their territorial waters soon became necessary. Innocent passage of foreign vessels in the territorial sea is, therefore, an outstanding example of compromise between the territorial sovereignty of coastal States and the right of any vessel to freely navigate across the oceans. Indeed, all ships enjoy the right to traverse the territorial sea of another State as long as they comply with a number of legal and technical conditions, most of which are set out in the framework of the United Nations Law of the Sea Convention (LOSC). This article aims at offering an overarching examination of the body of rules governing innocent passage in the territorial sea in order to identify strengths and shortcomings of the existing legal framework.

Keywords: International Navigation; Innocent Passage; Territorial Sea; International Law of the Sea; United Nations Convention on the Law of the Sea.

* President & Legal Adviser at ASCOMARE. Master's degree in Law at the University of Florence, LL.P. Statement for the study of Public International Law at the University of Uppsala and LL.M. in Law of the Sea at the University of Tromsø. Email: pierandrealeucci@hotmail.com

1. Introduction

For millennia, nations and communities have been using oceans for a multitude of different purposes, including navigation. According to Thucydides¹⁾, the Minoans were the first civilization to exercise a supremacy at sea (*Θαλασσοκρατία*) already in the 15th century BC, although Phoenicians, Romans, Vikings and several indigenous populations were also known to be expert navigators. Nevertheless, it was only after the expeditions of Christopher Columbus and Vasco da Gama, respectively in 1492 and 1498, that the history of navigation significantly changed. Following the colonization of the Americas and India, States started competing for the supremacy over the new maritime routes opened to commerce and navigation. That gave rise to a doctrinal debate on the legal status of the oceans while contributing to reinforce the existing dichotomy between the principle of freedom on the high seas and the principle of sovereignty. In this regard, in 1609, Grotius noticed that, since the seas were common to all by their first condition of nature, vessels should be able to traverse them freely²⁾. Thus, the ‘right of navigation’ emerged as one of the key components of the principle of freedom on the high seas, which dominated the development of the international law of the sea until the early 20th century. However, with the introduction of the ‘cannon shot rule’ by Cornelius van Bynkershoek, in 1702, States started embracing the idea that a projection of their jurisdiction over a belt of water (the territorial sea) adjoining the mainland was possible. Thence, because of the progressive seaward expansion of coastal states authority, a reconciliation between the right of navigation and the sovereignty of States in their territorial waters soon became necessary. In this regard, it was in 1758 that Vattel observed that the existence of property over a territory could not deprive nations of the ‘general right of traversing the earth for the purposes of mutual intercourse, of carrying on commerce with each other, and for other just reasons’³⁾. A concept which could easily transposed to any areas covered by property or territorial sovereignty, including the territorial sea. The same jurist referred to that general right with the name ‘innocent passage’. From that moment on, the right of innocent passage consolidated into the practice of States until its first codification, which occurred in 1958 with the adoption of the Convention on the Territorial Sea and Contiguous Zone (TSC). Indeed, Part I, Section III of the TSC Convention consisted of ten articles (from 14 to 23) focusing on the ‘Right of Innocent Passage’. Most of those provisions codified concepts, rules and definitions that were afterward transposed in the text of the ‘Constitution for the oceans’⁴⁾, adopted in 1982, in Montego Bay, at the 11th session of the third United Nations

-
- 1) S. Hornblower (1996), *A Commentary on Thucydides: Volume II: Books IV-V. 24*, Clarendon Press, Oxford, p. 125.
 - 2) H. Grotius (1609), *Mare Liberum (The Free Sea)*, Natural Law and Enlightenment Classics, Liberty Fund, Indianapolis, p. 80.
 - 3) E. de Vattel (1758), *Le droit des gens ou Principes de la loi naturelle appliqués à la conduite et aux affaires des nations et des souverains* (published in English in 1797), Natural Law and Enlightenment Classics, Liberty Fund, Indianapolis, p. 183.
 - 4) T. B. Koh (1983), “A Constitution for the Oceans” in *the Law of the Sea: United Nations Convention on the Law of the Sea*, St Martin’s Press, New York, p. xxxiii.

Conference on the Law of the Sea (UNCLOS III).

The purpose of this article is to offer an overarching examination of the body of rules governing innocent passage in the territorial sea within the framework of the United Nations Law of the Sea Convention (LOSC). Indeed, to date, the LOSC is the most comprehensive and interdisciplinary source of international law of the sea. Moreover, most of its provisions reflect well-consolidated rules of customary international law, which therefore also bind States who are not contracting parties to the same Convention.

This article develops through six chapters (including this introductory part), that follow as far as possible the systematic structure of Part II, Section 3 of the LOSC. Notably, the following chapters will focus on: the way in which the passage needs to be conducted (chapter 2); the meaning of innocent passage, including activities which are prejudicial to the peace, security and good order of the coastal State (chapter 3); the right of coastal States to adopt and enforce laws and regulation relating to innocent passage (chapter 4); the obligations of coastal States concerning foreign vessels that navigate in their territorial waters (chapter 5), concluding remark (chapter 6).

2. Meaning of Passage

Under article 2(1) of the United Nations Law of the Sea Convention (LOSC)⁵, coastal States enjoy sovereignty over their territorial waters - including the seabed, subsoil thereof, water column and air space above those waters – up to a limit of 12 nautical miles from the baselines of their territorial sea⁶). This sovereignty is without limitation *ratione materiae*. Therefore, coastal State is entitled to exercise full and exclusive jurisdiction, within the limits of its territorial waters, in all matters, except where otherwise provided for under international law⁷). It follows that no one can enter or undertake any activity in the territorial sea of another State, unless the same State so agreed: tacitly; on a case-by-case basis; or by becoming party to international instruments which restrict its sovereignty.

Ships of all States, whether landlocked or coastal, enjoy the right of innocent passage in the territorial sea of another State⁸). That means coastal States must allow foreign vessels to traverse their territorial waters for the purpose of entering or leaving internal waters and ports (vertical passage) or in order to proceed to other maritime areas, especially to the high seas (lateral passage)⁶. Nonetheless, innocent passage is to be exercised in conformity with the other provisions of the LOSC and in accordance with rules and principle of international law. Whilst the 1982 Convention does not provide any definition for ‘ship’, no doubts exist that the right also extends to vehicles other than vessels *stricto sensu*, such as floating platforms, installations and submarines. However, underwater vehicles have the right

5) United Nations Convention on the Law of the Sea (LOSC), Montego Bay, 10 December 1982. In force 16 November 1994; 1833 UNTS 31363.

6) LOSC, art 3.

7) Y. Tanaka, *The International Law of the Sea*, Cambridge University Press, Cambridge, 2012, pp. 5-7.

8) LOSC, art 17.

to traverse the territorial sea of another State only on the condition they navigate on the surface of water and show their flag⁹⁾. Furthermore, since the only beneficiaries of the right of innocent passage are ships, aircrafts do not enjoy any corresponding right of overflight in the air space above the territorial sea. And for the same reason, vessels are not allowed to launch, land or take on board aircraft during the passage¹⁰⁾.

The passage is to be continuous and expeditious¹¹⁾. That means vessels have to maintain a regular speed during the navigation and avoid any unnecessary delay in the passage, for instance by navigating in a zigzag¹²⁾. Accordingly, ships are prohibited to stop or anchor during the passage, except:

- when this is incidental;
when this is necessary to render assistance to vessels, aircraft or people in danger at sea;
- in the event of distress or force majeure.

As for the latter point, some clarification on the legal status of vessels in distress and force majeure is hereunder necessary. Although, to date, there is not any universally agreed definition of 'distress' and 'force majeure', the International Law Commission (ILC) examined the two terms in its Commentaries to the 2001 Draft Articles on 'Responsibility of States for Internationally Wrongful Acts'¹³⁾. The examination showed how a distinctive element between the condition of distress¹⁴⁾ and that one of force majeure¹⁵⁾ is the component of 'voluntariness' at the basis of the conduct of the author. Indeed, only in a situation of force majeure there is a supervening impossibility to comply with a specific obligation, as the author is materially dominated by the unfolding of events (e.g. because of a lightning that destroyed the engine of the ship). On the other hand, in event of distress the author is still in the material possibility to act otherwise, which means - as it was mentioned above - the conduct of the author is on a certain extent voluntary. However, the same ILC Commentaries also make clear that in event of distress the 'voluntariness' is actually nullified by the threat that the event poses to the author's life or to the lives of other persons entrusted to the author's care¹⁵⁾. Thus, in event of distress, such a threat is so irresistible that the impossibility to comply with the obligation results not from a material limitation, but from a psychological constraint. It follows that, except when the event is predictable

9) *Id.*, art 20.

10) LOSC., art 19(2)(e).

11) *Id.*, art 18(2).

12) D. R. Rothwell and Sam Bateman (2000), *Navigational Rights and Freedoms and the New Law of the Sea*, Martinus Nijhoff Publishers, The Hague/London/Boston, p. 5.

13) International Law Commission (ILC), *Draft articles on Responsibility of States for Internationally Wrongful Acts*, with commentaries, 2001, Yearbook of the International Law Commission, 2001, vol. II, Part Two; supplement No. 10 (A/56/10).

14) The occurrence of an event that threat the author's life or the lives of other persons entrusted to the author's care and that thus precludes the author from performing the obligation; *Id.*, art 23. 13 The occurrence of an irresistible force or of an unforeseen event that makes materially impossible to perform the obligation; *Id.*, art 24.

15) *See* 13, pp. 79-80.

or self-inflicted, a vessel in distress or force majeure is always acting beyond any real human control: in event of force majeure, because of a material constraint; in event of distress, due to a psychological constraint. And it is the lack (material or psychological) of human control over the vessel that would ‘excuse’, under article 18(2) LOSC, a passage which is not continuous or expeditious. This clarification is primarily important to understand when the conditions to apply article 18(2) occur in practice.

3. Meaning of Innocent Passage

We discussed how passage needs to be conducted and who is entitled to conduct it. Now it is time to understand what makes passage ‘innocent’. Article 19(1) LOSC underlines that passage is innocent ‘so long as it is not prejudicial to the peace, good order or security of the coastal State’. Moreover, to be innocent, passage shall take place in conformity with the LOSC and with other rules of international law. Article 19(2) LOSC lies down a list of activities which have the effect of prejudicing the innocence of passage, such as any threat or use of force against the sovereignty, territorial integrity or political independence of the coastal State; any act of wilful and serious pollution¹⁶⁾; any fishing activities¹⁷⁾; the carrying out of research or survey activities¹⁸⁾. That list covers most of the activities that would be technically or legally in contrast with the sovereignty of coastal States over their territorial waters. However, the same list is not an exhaustive one at least for two reasons:

- (i) according to the language of article 19(1) the passage must be in conformity with the Convention and other rules of international law. Therefore, the same provision does not exclude that other grounds exist, beyond those listed into the LOSC, for prejudicing the innocence of the passage;
- (ii) in article 19(2), letter (l) refers to ‘any other activity not having a direct bearing on passage’, thus also extending the scope of the provision to other activities than those specifically mentioned in the list.

Nonetheless, the author takes the view that the material scope of article 19(2)(l) LOSC should sometimes be interpreted in a restrictive way. This is something that reconnects with what discussed in chapter 2 about the definition of distress or force majeure. More in details, we already observed how article 19(2) LOSC refers to a number of activities which prejudice the innocence of the passage, i.e. they can turn the passage from innocent to non-innocent. For instance, so long as the passage is continuous and expeditious, a fishing vessel is certainly allowed to traverse the

16) LOSC., art 19(2)(h).

17) *Id.*, art 19(2)(i).

18) *Id.*, art 19(2)(j).

territorial sea of another State. However, if the same vessel engages in fishing activities during the passage, it prejudices the peace, good order or security of the coastal State and then, according to article 19(2)(i) LOSC, it loses the presumption of innocence, which is precondition for the passage. It can therefore be argued that to prejudice the innocence of passage an 'active' participation of the vessel is necessary. That might consist, *inter alia*, in the act of fishing, in the act of collecting information or in the act of causing a wilful and serious pollution. And this is also in line with the wording of article 19(2)(l) LOSC, which expressly refers to 'any other activity not having a direct bearing on passage (emphasis added)'. Thus, we can agree that when the 'active' participation is lacking, for instance due to an event of distress or force majeure, the vessel does not lose the right of innocent passage, since the psychological or material impossibility to comply with an obligation results in a 'passive' (instead of an 'active') conduct, which is therefore beyond the scope of article 19 LOSC. And this is something very important to bear in mind, especially when it comes to determine whether the coastal State is entitled to exercise enforcement jurisdiction against vessels traversing its territorial sea. Indeed, as it will be discussed later, it is the non-innocence of the passage that justifies in general the right of coastal States to take actions against foreign vessels.

4. Rights of the Coastal States

As mentioned at the beginning of this article, coastal States enjoy full and exclusive jurisdiction in their territorial waters. Jurisdiction is a key element of State sovereignty under international law, as it recognises States, *inter alia*, the power to adopt, amend or repeal rules of law (prescriptive jurisdiction) and take actions to ensure their compliance (enforcement jurisdiction)¹⁹.

4.1 Prescriptive Jurisdiction

Coastal States are entitled to exercise prescriptive jurisdiction in a number of matters relating to innocent passage²⁰) including, the conservation of the living resources²¹), the preservation of the marine environment²²), the prevention of any violation of their customs, fiscal, immigration and sanitary laws and regulations²³) or the safety of navigation²⁴). Once laws and regulations are publicised, they are immediately compulsory to foreign vessels which intend to navigate through the territorial waters of the coastal State²⁵). However, according to article 21(2) LOSC,

19) M. N. Shaw (2003), *International Law*, Cambridge University Press, Cambridge, p. 572.

20) LOSC, art 21(1).

21) *Id.*, art 21(1)(d).

22) *Id.*, art 21(1)(f).

23) *Id.*, art 21(1)(h).

24) *Id.*, art 21(1)(a).

25) *Id.*, arts 21(3); 22(4).

prescriptive jurisdiction cannot be exercised for the adoption of laws and regulations regarding the construction, design, equipment and manning (CDEM) of ships, unless they have the effect of giving efficacy to general accepted international rules and standards (GAIRS). The rationale behind this limitation is to avoid foreign vessels from being in fact precluded from enjoying the rights of innocent passage due to the difficulty to comply with different - and potentially conflicting - technical standards adopted by coastal States for their territorial waters. Although, some scholars argued that the real reason for the inclusion of the limitation on CDEM standards into the LOSC was to accommodate the interests of the shipping industry, because of the high costs that would involve complying with a multitude of different national standards²⁶⁾. Given that, the fact that article 21(2) LOSC refers to GAIRS instead of mentioning some specific instrument is pivotal, as it allows the LOSC to automatically assimilate the most updated international rules and standards without amending from time to time the text of the convention. On the other hand, as Jakobsen outlined, neither the LOSC nor the jurisprudence of international courts and tribunals 'define or provide any guidance as to how the concept of GAIRS should be understood'²⁷⁾. In this regard, it is largely agreed that to be 'generally accepted' rules and standards at least require a widespread and consistent implementation by the majority of members of the international community, regardless of whether States who implement them also are contracting parties to the agreements which set out such rules and standards²⁸⁾. An example of a CDEM rule that gives efficacy to GAIRS standards is Regulation 13G(6) of Annex I to the International Convention for the Prevention of Pollution from Ships (MARPOL)²⁹⁾, which obligates oil tankers of 5,000 tons or above and older than 15 years to comply with the 'double-hulls' requirement.

In addition to what stressed above, coastal States enjoy special prescriptive jurisdiction:

- To ensure the safety of navigation - Coastal States are entitled to designate sea lanes and traffic separation schemes³⁰⁾ as long as they are duly publicised and take into account: (a) the recommendations of the competent international organizations, namely the International Maritime Organization (IMO); (b) any channels customarily used for international navigation³¹⁾; (c) the special characteristics of particular ships and channels; (d) the density of traffic³²⁾.

26) A. Khee-Jin Tan (2006), *Vessel-Source Marine Pollution: the Law and Politics of International Regulation*, Cambridge University Press, Cambridge, p. 205.

27) I. U. Jakobsen (2016), *Marine Protected Areas in International Law: An Arctic Perspective*, Brill Nijhoff, Leiden/Boston, pp. 349-350.

28) T. Dux (2011), *Specially Protected Marine Areas in the Exclusive Economic Zone (EEZ). The Regime for the Protection of Specific Areas of the EEZ for Environmental Reasons under International Law*, Lit Verlag, Berlin, p. 190.

29) International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), 11 February 1973. In force 10 October 1983; 1340 UNTS 184.

30) LOSC, art 22(1).

31) This is to be read in accordance with article 37 LOSC, which sets the criteria (functional and the geographical) to identify a strait used for international navigation.

32) LOSC, art 22(3).

- When it is essential for security reasons - Coastal States have the power to suspend innocent passage in specified areas of its territorial sea as long as the closure is temporary, duly publicised and non-discriminatory (in form or in fact)³³). The suspension is not per se discriminatory if it only addresses certain categories of vessels (e.g. ships transporting noxious substances). However, coastal States are not allowed to suspend innocent passage to single vessels or groups of vessels belonging to any of those categories.
- To regulate the passage of foreign nuclear-powered ships and ships carrying nuclear or other inherently dangerous or noxious substances - Coastal States are entitled to adopt more stringent precautionary measures, as well as to ask for supplementary documents to be carried by those vessels during the passage³⁴). Any measures adopted for this purpose needs to be duly publicised and shall not jeopardise in form or in fact navigation³⁵).

As for this last point, ever since the LOSC was adopted, a number of States, including Algeria, China, Bangladesh, Egypt, Malaysia³⁶), subjected the right of innocent passage of certain categories of foreign vessels (e.g. warships, nuclear-powered vessels or vessels carrying hazardous, noxious or other dangerous substances) to a compulsory prior authorisation. Those same States argued that, under international law, they would have the right to prevent foreign vessels from innocently traversing their territorial waters when passage may pose a risk to a number of national interests, including security, safety or environmental conservation. However, that practice does not seem to be in conformity with the international law of the sea³⁷). That that was also underlined by Germany, Italy, the Netherlands and United Kingdom in declarations and statements made pursuant to article 310 of the LOSC. Notably, those Countries pointed out that none of the provisions of the LOSC, which on this matter reflects customary international law, would entitle coastal States 'to make innocent passage of particular categories of foreign ships dependent on prior consent [or authorization]'³⁸), and this mainly because according to Subsection A of Part II, Section 3 of the LOSC the rules laid down therein indiscriminately apply to all ships⁴⁵. Nonetheless, the same cannot be argued when innocent passage is subjected to a prior notification, rather than an authorisation. Indeed, the prior notification is consistent with the provisions of the LOSC so long as it does not preclude foreign vessels from exercising their right of innocent passage. For instance, the notification may be necessary to redirect certain categories of vessels to sea lanes and traffic separation schemes³⁹)

33) *Id.*, art 25(3).

34) *Id.*, art 23.

35) *Id.*, art 24(1).

36) D. R. Rothwell and T. Stephens (2010), *The International Law of the Sea*, Hart Publishing, Oxford/Portland, p. 76.

37) Y. Tanaka in J. E. Noyes in D. R. Rothwell, A. G. Elferink, K. N. Scott and T. Stephens (2015), *The Oxford Handbook of the Law of the Sea*, Oxford University Press, Oxford, pp. 547-549.

38) United Nations Division for Ocean Affairs and the Law of the Sea (DOALOS), Declarations and Statements to the Law of the Sea Convention; http://www.un.org/depts/los/convention_agreements/convention_declarations.htm

39) LOSC, art 22(2).

or inform them of special precautionary measures adopted pursuant to article 23 LOSC. And this is also the approach pursued by several regional instruments, such as the Izmir Protocol on the Prevention of the Mediterranean Sea by Transboundary Movements of Hazardous Wastes and their Disposal, which at article 6(4) underlines that, for technical reasons <<[t]he transboundary movement of hazardous wastes through the territorial sea of a State of transit only takes place with the prior notification by the State of export to the State of transit [...]>>⁴⁰⁾.

4.2 Enforcement Jurisdiction

According to article 25(1) LOSC, when passage is not innocent coastal States can take ‘the necessary steps’ to prevent it. The 1982 Convention does not lay down any exhaustive list of actions that coastal States would be entitled to take for the purpose of preventing the passage which is not innocent. Nevertheless, an accurate examination of the provisions spread down into the LOSC can help to identify some of the measures that coastal States would be entitled to take.

In this regard, by virtue of a combination of articles 27, 28, 30 and 220 LOSC, coastal States would at least have the right to: request information; visit, board and inspect the vessel; tow the vessel into port or force it to leave the territorial sea; arrest people on board and institute proceedings, including the detention of the ship. Furthermore, although the LOSC, unlike other international instruments, such as the 1995 Fish Stocks Agreement (FSA)⁴¹⁾, does not make any reference to the possibility to use the force, according to international jurisprudence, coastal States would be entitled to use the force to prevent the passage that is not innocent, on the condition that the use of force is *necessary and reasonable*⁴²⁾.

However, no action, except the formal request to leave the territorial sea immediately⁴³⁾, can be taken against warships⁴⁴⁾ or other government ships operated for non-commercial purposes, since those ships are covered by immunity⁴⁵⁾. Moreover, pursuant to article 236 of the LOSC, laws and regulations adopted by coastal States for the purpose of protecting and preserving the marine environment do not apply to warships and government ships operated for non-commercial purposes⁴⁶⁾. Despite

40) K. Hakapaa and E. J. Molenaar (1999), *Innocent Passage – Past and Present*, Pergamon, Marine Policy, Vol. 23, No. 2, p. 142.

41) Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (1995), art 22(1)(f); 2167 UNTS 3.

42) <<[...] Although the [LOS] Convention does not contain express provisions on the use of force in the arrest of ships, international law, which is applicable by virtue of article 293 of the Convention, requires States to avoid as far as possible the use of force and, where force is unavoidable, it must not go beyond what is reasonable and necessary in the circumstances>>; The M/V Saiga (No.2), Saint Vincent and the Grenadines v Guinea, Merits, Judgment, ITLOS Case No.2, ICGJ 336 (ITLOS 1999), para 155.

43) LOSC, art 30.

44) *Id.*, art 29.

45) *Id.*, art 32.

46) A. M. Lewis (2017), *Navigational Restrictions within the New LOS Context: Geographical Implications for the United States*, Brill Nijhoff, Leiden/Boston, p. 23.

that, flag States are responsible for any loss or damage caused by their vessels during the passage⁴⁷⁾. As well as, coastal State would be in any case entitled to use the force against any vessel, including a vessel covered with immunity, within the limits of the right of self-defence as recognised under international law⁴⁸⁾.

As for the right of coastal States to exercise criminal and civil jurisdiction on merchant ships and government ships operated for commercial purposes while they are in the territorial sea⁴⁹⁾, the LOSC dedicates the whole Subsection B of Part II, Section 3 to that topic⁵⁰⁾. More in details:

(*Criminal jurisdiction*) According to article 27(1) LOSC, the coastal State should not arrest any person or undertake any investigation over a foreign ship during the passage for crimes committed on board the ship (internal affairs), except when the vessel enters or leaves internal waters⁵¹⁾ and save in the following cases:

- when the consequences of the crime extend to the coastal State;
- when the crime is of a kind to disturb the peace of the country or the good order of the territorial sea;
- when the master of the ship or the flag State requested the assistance of the local authorities;
- when it is necessary for the suppression of illicit traffic in narcotic drugs or psychotropic substances⁵²⁾.

The language of article 27(1) of the LOSC is not compulsory ([...] should not). That means coastal States would keep a certain degree of discretion in deciding whether or not to exercise criminal jurisdiction over foreign ships traversing their territorial sea. On the other hand, according to article 27(4) LOSC, coastal States *shall* have due regard to the interests of navigation in exercising an arrest⁵³⁾. Moreover, they *shall not* exercise (save where otherwise provided for by the LOSC)⁵⁴⁾ criminal jurisdiction for crimes committed before the vessel entered the territorial sea, except for those crimes committed in internal waters⁵⁵⁾.

47) LOSC, art 31.

48) T. Treves (2009), *Piracy, Law of the Sea, and Use of Force: Developments off the Coast of Somalia*, EJIL vol. 20 No.2, pp. 412-413.

49) Y. Tanaka, op. cit., pp. 94-95.

50) According to Papanicolopulu, since the provisions dealing with criminal and civil jurisdiction are included into an autonomous Subsection (B), they would apply only to ships in innocent passage and not to all ships navigating in the territorial sea of the coastal State. I. Papanicolopulu (2018), *International Law and the Protection of People at Sea*, Oxford University Press, Oxford, note 196.

51) LOSC, art 27(2).

52) LOSC, art 27(1).

53) Noyes refers to the obligation at article 27(4) LOSC as the expression of 'a general test of reasonableness for the exercise of enforcement jurisdiction'. Which means local authorities, in deciding whether or not arrest should be made, must have 'due regard' to the impact of that on navigation. J. E. Noyes in D. R. Rothwell, A. G. Elferink, K. N. Scott and T. Stephens, op. cit., p. 100.

54) Article 27(5) LOSC excludes from the scope of the prohibition those violations of laws and regulations adopted in accordance with Part V and Part XII (e.g., art 211(4) LOSC).

(*Civil jurisdiction*) Under article 28(2) LOSC, coastal States may not levy execution or arrest the ship for the purpose of any civil proceedings except:

- for obligations or liabilities assumed or incurred by the ship in the course or for the purpose of its voyage⁵⁵). In this regard, Aquilina noticed that the scope of the provision would also extend to any obligations or liabilities assumed or incurred by the ship when it was in the coastal State's port⁵⁷;
- for vessels entering or leaving internal waters⁵⁸).

Furthermore, article 28(1) LOSC underlines that coastal States *should not* stop or divert a foreign ship during the passage for the purpose of exercising civil jurisdiction on people on board of the vessel. In a way similar to what observed for article 27(1) LOSC, also this provision makes use of a non-compulsory wording ([...] *should not*). However, it is worth noticing that article 28(1) LOSC transposes almost verbatim the text of article 21 of the 1958 Territorial Sea and Contiguous Zone Convention (TSC)⁵⁹ for which, therefore, the 1956 Commentaries of the International Law Commission (ILC)⁶⁰ play a fundamental role as travaux préparatoires⁶¹). In this regard, the ILC Commentaries notice that <<[a] ship which is only passing through the territorial sea without entering internal waters may *in no circumstances* be stopped for the purpose of exercising civil jurisdiction in relation to any person on board (emphasis added)>>. Therefore, even though *prima facie* the language of article 28(1) LOSC seems to recognise the power of coastal States to decide whether or not to stop or divert a foreign ship during the passage for the purpose of exercising civil jurisdiction, article 28(1) LOSC should instead be considered as a concrete prohibition.

5. Duties of the Coastal State

Part II, Section 3 of the LOSC formally reserves only one provision (article 24) to duties of the coastal State in the context of foreign ships' innocent passage. In this regard, article 24 requires States not to hamper the passage that is innocent (except where the LOSC provides otherwise, such as in the event of a temporary closure)⁶² and warn vessels of any danger to navigation of which it has knowledge.

55) LOSC, art 27(5).

56) *Id.*, art 28(2).

57) K. Aquilina in D. J. Attard, M. Fitzmaurice and N. A. Martínéz Gutiérrez (2014), *The IMLI Manual on International Maritime Law, Volume I, Law of the Sea*, Oxford University Press, Oxford, p. 54.

58) LOSC, art 28(3).

59) United Nations Convention on the Territorial Sea and the Contiguous Zone (TSC), Geneva, 29 April 1958. In force 10 September 1964; 516 UNTS 205.

60) Yearbook of the International Law Commission 1956, Vol. II, p. 275.

61) J. Harrison (2011), *Making the Law of the Sea: A Study in the Development of International Law*, Cambridge University Press, Cambridge, pp. 31-37.

See p. 9.

Notably, the duty to warn was discussed by the International Court of Justice (ICJ) in the *Corfu Channel* case⁶³), where the ICJ noticed that the duty to notify ships of the danger to which they are exposed during the passage is something required by international law⁶⁴). In the merits of the same case, the Court examined an important precondition of such a duty, which is also clearly stressed at article 24(2) of the LOSC, namely the fact that the coastal State is obliged to inform the vessel or its flag State of any danger to navigation so long as it has *knowledge* of the danger. In this regard, the ICJ noticed that:

<<It is true, as international practice shows, that a State on whose territory or in whose waters an act contrary to international law has occurred, may be called upon to give an explanation. It is also true that that State cannot evade such a request by limiting itself to a reply that it is ignorant of the circumstances of the act and of its authors [...] But it cannot be concluded from the mere fact of the control exercised by a State over its territory and waters that that State necessarily knew, or ought to have known, of any unlawful act perpetrated therein, nor yet that it necessarily knew, or should have known, the authors.>>⁶⁵)

Therefore, even though the duty to warn undeniably reflects customary international law, what we observed above shows how the real challenge in its concrete implementation is to prove, in practice, that the coastal State had knowledge of the danger, especially considering that the burden of proof would be in any case on the claimant.

Beyond that, article 24 LOSC needs to be read in accordance with other rules of international law. Indeed, beside the duty not to hamper the passage and the duty to warn, coastal States must comply with a number of international obligations, most of which are laid down within the framework of the 1982 Convention. Hereunder a general list of those obligations is offered. In particular, coastal States shall not:

- impose any requirements on foreign ships, which have the practical effect of denying or impairing the right of innocent passage⁶⁶);
- discriminate in form or in fact against the ships of any State or against ships carrying cargoes to, from or on behalf of any State⁶⁷);
- deliberately avert to inform foreign vessels about any danger to navigation, of which it has knowledge, within its territorial sea⁶⁸);
- levy discriminatory charges upon foreign ships passing through the territorial sea⁶⁹);

63) *Corfu Channel* (United Kingdom v. Albania) case, I.C.J. Reports 1949, p. 4; General List No. 1.

64) T. Phimolsathien (2015), *Customary International Law and General Principles of Law and the Protection of the Environment*, International Journal of Social Science and Humanity, Vol. 5, No. 9, September 2015, p. 820.

65) *Corfu Channel* (United Kingdom v. Albania) case, I.C.J. Reports 1949, p. 4; General List No. 1, p. 18.

66) LOSC, art 24(1)(a).

67) LOSC, art 24(1)(b).

68) *Id.*, art 24(2).

69) *Id.*, art 26(2).

- suspend the passage beyond the scope of article 25(3) LOSC;
- adopt CDEM measures that are more stringent than those giving efficacy to GAIRS⁷⁰⁾;
- violate the immunity of warships and other government ships operated for non-commercial purposes⁷¹⁾;
- exercise criminal and/or civil jurisdiction beyond the scope of articles 27 and 28 LOSC⁷²⁾;
- exercise their powers of enforcement as to endanger the safety of navigation or otherwise create any hazard to a vessel, including bringing it to an unsafe port or anchorage, or expose the marine environment to an unreasonable risk⁷³⁾.

Furthermore, coastal States must promptly notify the flag State of any actions taken against a vessel flying its flags when the same vessel has committed violations concerning the prevention, reduction and control of pollution from vessels during the passage across the territorial sea⁷⁴⁾. The duty to promptly notify the flag State also applies, by request of the master of the ship, for actions taken in accordance with article 27(1) and (2) of the LOSC⁷⁵⁾. As well as, in addition to what mentioned above, the coastal State must duly publicize any laws and regulations adopted in conformity with the LOSC⁷⁶⁾, including laws and regulations adopted for the designation of sea lanes and traffic separation schemes⁷⁷⁾ or those suspending temporarily the passage in specified areas of the territorial sea⁷⁸⁾.

6. Concluding Remarks

Ships of all States enjoy the right to traverse the territorial sea of a foreign Country as long as their passage complies with a number of legal and technical conditions and is not prejudicial to the peace, good order or security of the coastal State. Innocent passage in the territorial sea is probably the greatest example of compromise between the freedom of navigation on the high seas and the sovereignty of the coastal State over its territorial waters. Although the first appearance of the right of innocent passage date back hundreds of years ago, the establishment of an organic body of rules to regulate such a right is a relative young achievement. In this regard, Part II, Section 3 of the United Nations Law of the Sea Convention (LOSC) represents the main legal framework in place to govern innocent passage

70) *Id.*, art 21(2).

71) *Id.*, art 32.

72) E.g., LOSC arts 27(5); 28(1).

73) LOSC, art 225.

74) *Id.*, arts 220(2); 231.

75) *Id.*, art 27(3).

76) *Id.*, art 21(3).

77) LOSC., art 22(4).

78) *Id.*, art 25(3).

globally. Most of the provisions included therein reflect well-consolidated rules of customary international law and, therefore, they bind all States, including those who are not contracting parties to the 1982 Convention. Such provisions cover various aspects of the right of innocent passage, such as the beneficiary of the right, the way the passage is to be conducted, the factors which influence the innocence of the passage, rights and obligations of coastal States. However, the current system is far from being flawless. Indeed, as it resulted from the examination of the previous chapters of this article, there still are many controversial issues that would need to be addresses more clearly by legislators. Most of them are matters of interpretation, as for the definitions of ships, GAIRS, distress or force majeure, but others are issues of more substantive nature which can affect the stability of the whole legal framework, such as in the case of passage subject to a prior authorisation or the material scope of article 19 LOSC from which the use of enforcement jurisdiction depends. It follows that a revision of the body of rules in force or, in alternative, the adoption of a new multilateral legal instrument to deal with innocent passage in the territorial sea would be desirable. After all, considering that many of the provisions of the LOSC referring to innocent passage have been transposed almost verbatim from the text of the 1958 TSC Convention, the current system includes elements and definitions formulated more than sixty years ago. Many things have changed during that lapse of time, including the amount of traffic at sea and the size and threat posed by vessels navigating worldwide. It is time to recognise that innocent passage, as other areas of the law of the sea, needs to be 'refreshed' to take into account those changes. That is the only way to ensure a peaceful use of the seas and oceans for the benefit of the present and future generations.

References

- Attard D. J., Fitzmaurice M. and Martínéz Gutiérrez N. A. (2014), *The IMLI Manual on International Maritime Law, Volume I, Law of the Sea*, Oxford University Press, Oxford.
- Dupuy R. J. and Vignes D. (1982), *A Handbook on the New Law of the Sea*, vol. 1, Clarendon Press, Oxford.
- Dux T. (2011), *Specially Protected Marine Areas in the Exclusive Economic Zone (EEZ). The Regime for the Protection of Specific Areas of the EEZ for Environmental Reasons under International Law*, Lit Verlag, Berlin.
- Grotius H. (1609), *Mare Liberum (The Free Sea)*, Natural Law and Enlightenment Classics, Liberty Fund, Indianapolis.
- Hakapaa K. and Molenaar E. J. (1999), *Innocent Passage – Past and Present*, Pergamon, Marine Policy, Vol. 23, No. 2.
- Harrison J. (2011), *Making the Law of the Sea: A Study in the Development of International Law*, Cambridge University Press, Cambridge.
- Hornblower S. (1996), *A Commentary on Thucydides: Volume II: Books IV-V. 24*, Clarendon Press, Oxford.
- Jakobsen I. U. (2016), *Marine Protected Areas in International Law: An Arctic Perspective*, Brill Nijhoff, Leiden/Boston.
- Khee-Jin Tan A. (2006), *Vessel-Source Marine Pollution: the Law and Politics of International Regulation*, Cambridge University Press, Cambridge.
- Koh T. B. (1983), “A Constitution for the Oceans” in *the Law of the Sea: United Nations Convention on the Law of the Sea*, St Martin’s Press, New York.
- Lewis A. M. (2017), *Navigational Restrictions within the New LOS Context: Geographical Implications for the United States*, Brill Nijhoff, Leiden/Boston.
- Papanicopolulu I. (2018), *International Law and the Protection of People at Sea*, Oxford University Press, Oxford.
- Phimolsathien T. (2015), *Customary International Law and General Principles of Law and the Protection of the Environment*, International Journal of Social Science and Humanity, Vol. 5, No. 9, September 2015.
- Rothwell D. R. and Bateman S. (2000), *Navigational Rights and Freedoms and the New Law of the Sea*, Martinus Nijhoff Publishers, The Hague/London/Boston.
- Rothwell D. R. and Stephens T. (2010), *The International Law of the Sea*, Hart Publishing, Oxford/Portland.
- Rothwell D. R., Elferink A. G., Scott K. N. and Stephens T. (2015), *The Oxford Handbook of the Law of the Sea*, Oxford University Press, Oxford.
- Shaw M. N. (2003), *International Law*, Cambridge University Press, Cambridge.
- Tanaka Y. (2012), *The International Law of the Sea*, Cambridge Press, Cambridge.
- Treves T. (2009), *Piracy, Law of the Sea, and Use of Force: Developments off the Coast of Somalia*, EJIL vol. 20 No.2.

Vattel E. (1758), *Le droit des gens ou Principes de la loi naturelle appliqués à la conduite et aux affaires des nations et des souverains*, Natural Law and Enlightenment Classics, Liberty Fund, Indianapolis.

A Study on the Selection of Core Technology in Maritime Safety Field for Fourth Industrial Revolution Era

- Focusing on Ship Inspection Agency -

Tae-Han Song* · Joo-Hwan Kim** · Hwayoung Kim***

ABSTRACT

The ‘fourth industrial evolution’ brings lots of changes to industries. Digital technologies based on ICT and convergences are changing in society and economy. Even in maritime industry, fourth industrial revolution is bringing many changes, such as ICT technology application to shipbuilding, navigation and maritime transport. Especially, a maritime safety technology is the key technology for keeping and developing of current maritime industry. Thus, Ship inspection authority which has main role in maritime safety field should react promptly to these changes comes from fourth industrial revolution.

So, a series of interview and an AHP questionnaire survey, the importance of evaluation criteria are ranked and 30 selected core maritime safety technologies which have high relevance with ‘Ship Inspection Authority’ and these are ranked by Multi Criteria Analysis. Also selected core maritime safety technologies were analyzed by BCG Matrix with core competencies of Ship inspection authority (Ship inspection, Ship safety management, Environment-Friendly).

Keywords: Fourth industrial revolution; Ship inspection authority; Maritime safety technology; BCG Matrix; AHP analysis

* Researcher at Maritime Safety Research Center, Korea Ship Safety Technology Authority, first author, thsong@kst.or.kr

** Senior Researcher at Maritime Safety Research Center, Korea Ship Safety Technology Authority, kjh710@kst.or.kr

*** Corresponding author, Assistant professor of Mokpo Maritime University, hwayoung@mmu.ac.kr

1. Introduction

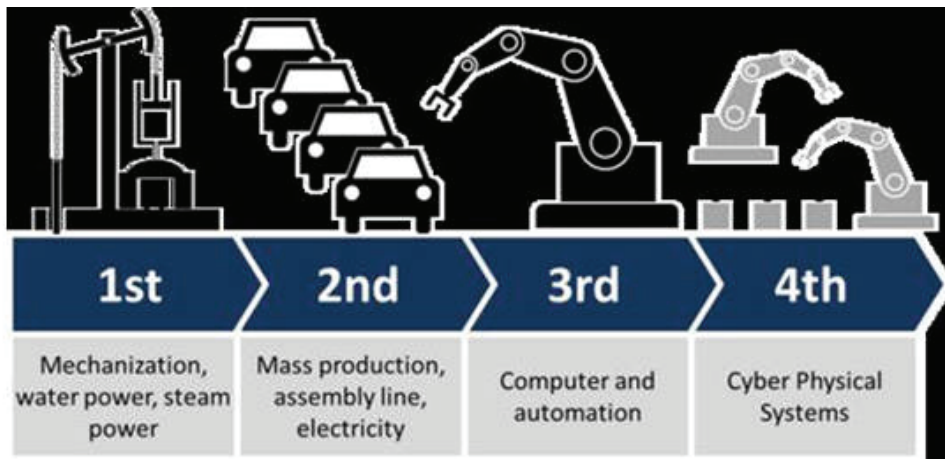
1.1 Background

Since the concept of the 'fourth industrial revolution' was laid out at the World Economic Forum 2016, an interest about this concept is growing on the whole society and it is expected to transform the entire human race with its rapid development. The fourth industrial revolution is a revolution that combines offline and online unlike the conventional industrial revolution, and it is a completely different mix of virtual and physical systems, rather than a particular technology shift in the conventional industrial revolution. (Kagermann, 2013)

Major technologies in the fourth industrial revolution include innovative ICT, cyber-physical systems, network communications, simulation, big data analytics, cloud computing, robots, augmented reality and intelligent devices(EPRS, 2015)

Especially, the fourth industrial revolution, especially based on the digital revolution, takes place at the beginning of the 21st century. It represents the ubiquitous mobile internet, information center, artificial intelligence and machine learning.

Figure 1. Four stages of the industrial revolution



Source: Internet of Things(www.heat-processing.com)

Fourth industrial revolution in Figure 1 was initialized at the Hanover Exhibition in 2011. To explain how technology fundamentally changes the structure of the global value chain, the fourth industrial revolution has made virtual machines available worldwide by introducing the 'Smart Factory'. Through this, it became possible to produce products fully customized and a new operating model was created.

The fourth industrial revolution predicted that ICT technologies accumulated in the third industrial revolution will have a significant impact on the progress and innovation of mankind by the process of 'increasing usage' and 'condensed adaptation

periods'.(Paul Krugman, 1998)

Although the definition of the fourth industrial revolution is unclear, it is possible to conciliate the various points discussed so far in three dimensions: technology, industry and systems

In the aftermath of the fourth industrial revolution, the concept of 'Smart Automation' which interacts with machines-machines-humans is spreading. Also these major technologies from fourth industrial revolutions will likely play a role in the maritime safety field and contribute to the development of related technologies.

In the field of ship inspection and ship management, lots of technologies related to fourth industrial revolution will be developed in the near future. But, the overall response to these developments is costly and time consuming and the rationalization through selection and focus is necessary.

1.2 Literature Review

Some previous studies related to maritime safety technology have been made. Oh et al. (2010) carried out evaluation maritime technologies that require international cooperation. They selected high-priority technologies in maritime safety and developing countries and evaluated their priorities by deriving evaluation factors. The evaluation factors were divided into three groups as the maturity of maritime safety technology, the promotion probability of projects and the degree of importance of technology, and the detailed factors of each group were drawn. Significantly evaluated maritime safety technologies included electronic chart technology, ship monitoring technology, and oil spill diffusion prediction and countermeasures. Cho(2011) studied about the present status and future direction of Maritime Safety Audit(MSA). He evaluated the achievements and implementation problems of MSA through define the fundamental problems of MSA by conceptualizing and analyzing MSA limits. Kang(2018) applied this method to the entire process of smart disaster safety management based on the fourth industrial revolution to minimize human, social, economic and environment damage from accidents and disasters of general industry part. And he also proposed virtual reality and augmented reality disaster safety management decision support system intelligent robot for recovery, disaster, discovery, reconnaissance relief and so on.

In the previous study, some studies on maritime safety technology were conducted. However, few studies have examined the importance and priority of maritime safety technology based on the fourth industrial revolution technology. In some studies, there are only cases that apply to the field of safety management in general industry. Therefore, this study can be said that it is different from the fourth industrial revolution Technology as an important research to identify what important technology is required in maritime safety field and what technology should be developed first.

1.3 Scope of Research

In Korea, a ship inspection is carried out under related law (Ship Safety Law)

to check competency of ship's structure and equipment for securing sea-worthiness of ship and human life. This inspection for the government has been carried out by two authorities, one is a classification society in Korea and the other is a quasi-government authority. In this study, the core technologies in maritime safety for the authority. Because it was difficult to collect data for analysis from classification society.

1.4 Research methodology

There are two methodologies for this study. Firstly, the concept and trends of fourth industrial revolution and technologies related to fourth industrial revolution are examined by desk research. Secondly, the maritime safety technologies which have highly related with core competency of ship inspection authority using quantitative techniques.

The final objectives of this study are the screening of maritime safety technology which has a close correlation with fourth industrial revolution and also the selection of maritime safety technology for ship inspection authority as a future growth engine for the authority

To achieve the objective of this study, the trends and kinds of technologies related to fourth industrial revolution in the maritime safety field are figured out. A number of technologies which have close relationship with Ship Inspection Agency A are identified by using desk research and interview with experts.

Especially, a questionnaire survey is carried out to the group of maritime safety experts (Ship inspector, Research institute, Shipbuilder, Shipping Company and etc.) to enhance the objectivity of survey result and analyze the survey result with AHP (Analytic Hierarchy Process) and MCA (Multi Criteria Analysis).

Also, the BCG Matrix method is using to decide the prior maritime safety technologies which are related with the core competency of Ship Inspection Agency A.

2. Ship Inspection Agency “A”

2.1 Overview of Ship Inspection Agency “A”

Ship Inspection Agency A established under the law of Ship Safety Act (Article 45) in 1979, as a semi-government body is supposed to be a safeguard of people's life and property at sea through excellent ship inspection, passenger ship, safety operations and develop & research the technologies in the areas of ship and its equipment, as well as maritime sectors.

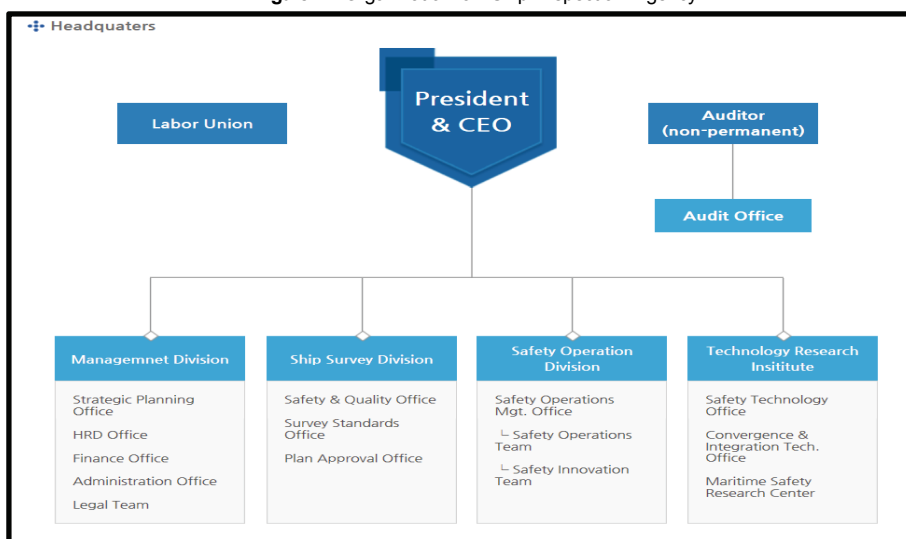
The Main services of Ship Inspection Agency A are ‘Ship inspection for securing ship’s safety’, ‘ R&D and distribution of technologies for ship and ship’s facilities’ and ‘Passenger ship Safe Operation Management’, the details of services are as below;

- Approval of plan for ship construction and ship borne materials

- Inspection of ship & ship borne materials
- Confirmation for ship borne materials or small ship made or altered by accredited manufactures
- Status survey for container
- Approval for cargo stowage, lashing and other related activities
- R&D for securing of seaworthiness of ship and human life at sea
- Research and analysis of international standards for ship safety
- Consigned tasks for supervision throughout whole process of ship construction
- Research, education and public relations for preventing maritime accidents
- Consigned tasks from government and municipality by law
- Passenger ship safety operation management
- Other services declared by CEO for achievement of the goal

Ship Inspection Agency A has three (3) divisions and one (1) research institute and 15 branch office. One of the core competencies of authority, ‘Ship Inspection’ is charged in the ‘Ship Survey Division’, ‘Ship Safety Management’ is charged in ‘Safety Operation Division’ and ‘Maritime Safety Technology and Environment-Friendly Technology Development’ is charged in ‘Technology Research Institute’ in the Figure 3.

Figure 2. Organization of ‘Ship Inspection Agency A’



Source: Korea ship safety authority(www.kst.or.kr)

2.2. Technologies in Ship Inspection Agency A

The majority of technology development has been carried out by the ‘Technology Research Institute’ in the Ship Inspection Agency A. The Vision of ‘Technology Research Institute’ is that realization of “Leading authority for ship safety” and market creation through “HIGH-SAFETY-TRUST” and “Year- Round” Technologies and objectives

are dealt with fourth industrial revolution related technology development.

For the realization of authority's VISION, the institute sets 6 objectives as below;

- 1) Standardization of maritime safety assessment technology: Pursuing international standardization of maritime traffic safety assessment technology and best marine industry technologies.
- 2) Development of the equipment to prevent human accident: Localization of life saving appliance and navigation safety facilities
- 3) ICT based marine convergence technology: Development the marine convergence technologies through the analysis of marine safety information
- 4) Climate change response technology: Operation of comprehensive information center for GHG mitigation and development of GHG Mitigation technologies
- 5) Environment-friendly technology certification: Development of certifying technology of electronic propulsion system and navigational performance for the NON-SOLAS Coastal passenger ship
- 6) Development of ship safety technology: Self-Dependency on core engineering technology for securing ship's sea-worthiness and structure performance

Meanwhile, 'Technology Research Institute' sets 6 Core strategies for development of technology as below;

- (Strategy 1) Build the 'Integrated assessment system for ship's safety': Development of navigation loads detection & analysis and DB system, Development of status monitoring and operation system for car-ferry vessel. Development of program for assessment of aged ship's hull fatigue strength
- (Strategy 2) Development of Safety device for prevention of human loss in marine accident; Development of performance evaluation technology for life saving appliance with high-end material, Development of core technology for prevention of fire safety on ship, Development of evacuation facilities suitable for maritime environment condition.
- (Strategy 3) Development of environment-friendly ship technology and its adoption to international standard: Verification technology for electronic propulsion system, Development of environment-friendly propulsion system satisfied with international standard, Development of environment-friendly navigation system for coastal ship.
- (Strategy 4) Development of technology for response to climate change: Build a comprehensive information center for GHG mitigation, Development of GHG Mitigation Technology, Development of Policy for GHG reduction.
- (Strategy 5) Development of marine convergence technology based on ICT: Development of SMART e-Navigation system, Development of high value-added technology for creation of new growth engine in the maritime industry, Development of marine convergence technology for securing maritime traffic safety.

- (Strategy 6) Research on maritime safety policy and internationalization of maritime industry technology : Build a system for applying local best maritime technology to the international standards, Development of optimal navigation route for passenger ship, Development of New Concept Technology for assessment of Maritime Traffic status and Port safety.

3. Selection of Core Maritime Safety Technologies for the ‘Ship Inspection Agency A’

3.1 Selection of Core Maritime Safety Technologies

In the process of core maritime safety technologies selection for the Ship inspection agency A to accommodate with fourth industrial revolution, the importance of evaluation indices was identified by ‘Hierarchy method’ to enhance the objectivity.

The maritime safety technologies are categorized with consideration of the correspondence the technology with authority’s core competencies and evaluated the importance of each technology by multi criteria analysis method then picked the core technologies out

The selected core maritime safety technologies were analyzed by BCG Matrix in a view of Growth rate and market possession after development of technologies.

Total 108 maritime safety technologies were identified in a relation with the core technologies of the fourth industrial revolution and 30 technologies were classified as shown in the Table 1 by experts in a view of correlation with the core competency of ship inspection agency A

Table 1. Pool of the ‘Core Maritime Safety Technology’

Rank	fourth Industrial revolution Core Tech.	Maritime Safety Tech.	Details of Tech.	Score (10 point)
1	BIG Data	Ship Safety Management	Optimal navigation route proposal for vulnerable ship	9.0
2	BIG Data	Ship Safety Management	Enhancing the Safety management for mid/small cargo ship and passenger ship	9.0
3	Internet of Things, BIG Data	Ship Safety Management	Comprehensive managing and monitoring system for ship’s safe and environment-friendly navigation	9.0
4	Internet of Things, BIG Data	Ship Safety Management	Pre-alarming and accident prevention system for the risky situation (Fire, Flooding)	8.8
5	Augmented Reality	Ship Safety Management	Simulator for workers’ safety education	8.8
6	BIG Data	Ship Safety Management	Detecting and response system for maritime accidents	8.5
7	BIG Data	Ship Safety Management	Safe route for Passenger ship	8.3
8	BIG Data	Ship Safety Management	New Concept Technology for assessment of Maritime Traffic status and Port safety	8.3

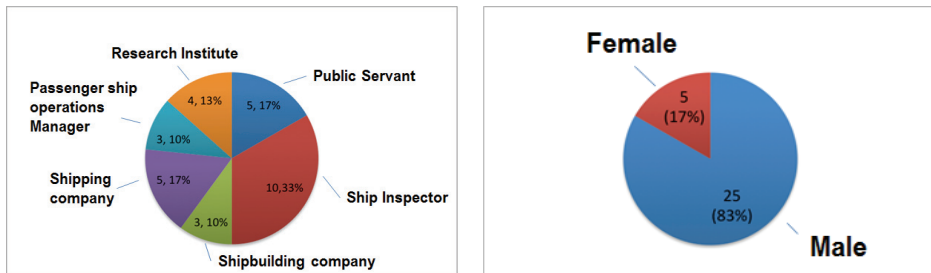
Rank	fourth Industrial revolution Core Tech.	Maritime Safety Tech.	Details of Tech.	Score (10 point)
9	High-Tech Manufacturing	Ship Inspection	Performance evaluation of Life saving device made with High-Tech Material	8.3
10	Clean Energy	Ship Inspection	Electric Propulsion system Tech.	8.3
11	High-Tech Manufacturing	Ship Inspection	Integrated Control system for ship's equipment	8.1
12	High-Tech Manufacturing	Ship Inspection	Customized Safety device for small/mid ship	8.1
13	Clean Energy	Ship Inspection	Environment-Friendly propulsion system in accordance with international standard	8.1
14	Clean Energy	Environment Friendly	Comprehensive management system(DB) of GHG from ship	8.1
15	BIG Data	Ship Inspection	Ship's life cycle management Tech,	7.8
16	BIG Data	Ship Inspection	Tech. for enhancement of ship's maneuverability and stability	7.8
17	Internet of Things, BIG Data	Ship Inspection	Ship status monitoring and managing system for Car-Ferry	7.8
18	Internet of Things, BIG Data	Ship Inspection	Monitoring Tech. for ship's equipment	7.8
19	Clean Energy	Environment Friendly	GHG Mitigation Technology	7.8
20	Augmented Reality	Ship Inspection	Ship Inspection and Monitoring Tech. with VR/AR	7.6
21	High-Tech Manufacturing	Ship Inspection	Development of standard hull shape for fishing boat	7.6
22	High-Tech Manufacturing	Ship Inspection	Development of standard hull shape of Deep-sea fishing vessel for enhancing the catching efficiency and declining of fuel	7.6
23	BIG Data	Ship Safety Management	Optimized Navigation system based on Big Data	7.4
24	Internet of Things, BIG Data	Ship Inspection	Automatic response system for engine failure with diagnostic result	7.4
25	Augmented Reality, BIG Data	Ship Safety Management	Optimal Nav. Information process and management technology based on Augmented Reality	7.4
26	High-Tech Manufacturing	Environment Friendly	Ballast Water Management Tech.	7.4
27	Clean Energy	Ship Inspection	Environment-Friendly navigation system for coastal ships	7.4
28	Clean Energy	Environment Friendly	Safe navigation of LNG-Fueled ship	7.4
29	Internet of Things	Ship Inspection	Water Ingression detecting sensor for small ship	7.4
30	Internet of Things, BIG Data, Cloud	Ship Safety Management	SMART e-Navigation System Tech.	7.1

The classification of marine safety technologies, priority of assessment items, and assessment by technology were performed by organizing a group of experts.

The expert group consists of people who engage the maritime safety area or who has knowledge and a questionnaire survey was carried out to ship's inspector(10 person), Public servants in maritime safety field(5 person), shipbuilding company(5

person), Passenger ship operation manager(3 person) and Research institute(4 person) in the Figure 4.

Figure 3.. Composition of Respondents

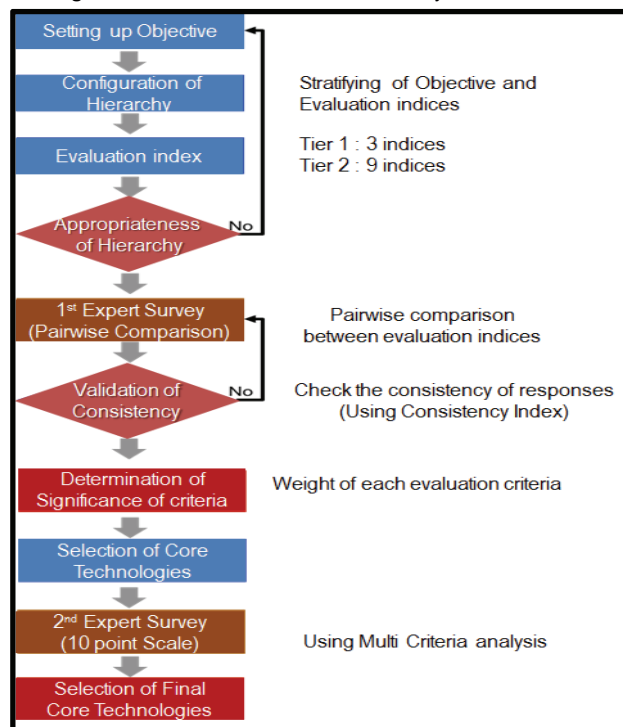


The detailed method to get the rank of core maritime safety technologies for ship inspection agency A' through the survey is as a Figure 5.

Especially, the objective for evaluation is setting up clearly and each evaluation indices is stratified with AHP method and a pair-wise comparison between the 'Evaluation Indices' is using for getting its importance between indices.

After calculation of each evaluation index's importance, classified top 30 technologies are ranked with using 'Multi Criteria Analysis' method.

Figure 4. Process for 'Core Maritime Safety Tech.' selection



In this study, evaluation indices which are using in national R&D budget review process are applied to evaluate the importance of each index and it is classified the 'Tier 1' & 'Tier 2' evaluation index in the Table 2.

It is classified three 'Tier 1' indices and nine 'Tier 2' indices as the evaluation index. The indices of 'Tier 1' are 'Validity', 'Necessity' and 'Economic feasibility'.

The index of 'Validity' consists of 3 'Tier 2' indices; 'Clarity of Technology', 'Appropriateness of Technology', 'Possibility of Technology'.

The next index of 'Necessity' also consists of 3 'Tier 2' indices; 'Urgency of Technology', 'Consistency of Technology', 'Potential of Technology' and the last 'Tier 1' index 'Economic Feasibility' has 3 'Tier 2' indices; effect of technology to the Science, Economy and Society.

Table 2. Evaluation Indices to rank 'Core Maritime Safety Technology' for fourth Industrial Revolution

Tier 1	Tier 2	Details
Validity	Clarity of Technology	Concreteness of Core technology's objective, Measurability of Objective, Attainability of Objective
	Appropriateness of Technology	Development of Core technology's appropriateness with the fourth industrial revolution technologies
	Possibility of Technology	Possibility for success of Core technology
Necessity	Urgency of Technology	Necessity of Core technology development and its urgency
	Consistency of Technology	Match for Government's existing policy for R&D and fourth Industrial revolution technology
	Potential of Technology	Growth potential after development of core technology
Economic feasibility	Scientific effect of Technology	Creation of Scientific output(Research paper, Patent), Ripple effect to other R&D Project
	Economical effect of Technology	Creation of added value through core technology development and increasing of export volume
	Social impact of Technology	Enhancement of Public Safety and job creation through core technology development

With result of questionnaire survey, the importance of evaluation indices in Tier 1 is 'Necessity', 'Economic feasibility', 'Validity' in a row. In 'Tier 2', 'Possibility of Technology', 'Urgency of Technology' and 'Social impact of technology' are ranked in a row.

The final result of analysis showed 'Urgency of Technology (0.1672)', 'Potential of Technology (0.1557)' and 'Consistency of Technology (1.448)' are ranked as the most important index for selection.

Table 3. Result of importance between the Evaluation Indices

Tier.1	Weight	Tier.2	Importance	Total	Rank
Validity	0.2615	Clarity of Technology	0.2847	0.0745	9
		Appropriateness of Technology	0.3566	0.0932	6
		Possibility of Technology	0.3587	0.0938	5
Necessity	0.4678	Urgency of Technology	0.3575	0.1672	1
		Consistency of Technology	0.3096	0.1448	3
		Potential of Technology	0.3329	0.1557	2
Economic feasibility	0.2707	Scientific effect of Technology	0.2963	0.0802	7
		Economical effect of Technology	0.2903	0.0786	8
		Social impact of Technology	0.4135	0.1119	4

The 2nd questionnaire survey is carried out for 30 technologies which have high relevance with ‘Ship Inspection Agency A’ and these are ranked by Multi Criteria Analysis in the Table 4.

The results of the Multi Criteria analysis about each evaluation index are as below table. Such as ‘Safe navigation of LNG-Fueled ship’, ‘Detecting and response system for maritime accidents’, ‘Pre-alarming and accident prevention system for the risky situation (Fire, Flooding)’ are preferred by that result.

Table 4. Evaluation result for core maritime safety technologies

Rank	fourth Industrial revolution Core Tech.	Maritime Safety Tech.	Details of Tech.
1	Clean Energy	Environment Friendly	Safe navigation of LNG-Fueled ship
2	BIG Data	Ship Safety Management	Detecting and response system for maritime accidents
3	Internet of Things, BIG Data	Ship Safety Management	Pre-alarming and accident prevention system for the risky situation (Fire, Flooding)
4	Augmented Reality	Ship Inspection	Ship Inspection and Monitoring Tech. with VR/AR
5	BIG Data	Ship Inspection	Tech. for enhancement of ship's maneuverability and stability
6	Clean Energy	Environment Friendly	GHG mitigation technology
7	BIG Data	Ship Safety Management	Optimized Navigation system based on Big Data
8	Internet of Things, BIG Data, Cloud	Ship Safety Management	SMART e-Navigation System Tech.
9	High-Tech Manufacturing	Ship Inspection	Integrated Control system for ship's equipment
10	High-Tech Manufacturing	Ship Inspection	Development of standard hull shape of Deep-sea fishing vessel for enhancing the catching efficiency and declining of fuel
11	Clean Energy	Ship Inspection	Environment-Friendly navigation system for coastal ships
12	BIG Data	Ship Safety Management	Enhancing the Safety management for mid/small cargo ship and passenger ship
13	High-Tech Manufacturing	Ship Inspection	Development of standard hull shape for fishing boat
14	BIG Data	Ship Safety	Safe route for Passenger ship

Rank	fourth Industrial revolution Core Tech.	Maritime Safety Tech.	Details of Tech.
		Management	
15	Clean Energy	Environment Friendly	Comprehensive management system(DB) of GHG from ship
16	Internet of Things, BIG Data	Ship Inspection	Ship status monitoring and managing system for Car-Ferry
17	High-Tech Manufacturing	Ship Inspection	Customized Safety device for small/mid ship
18	Internet of Things, BIG Data	Ship Inspection	Automatic response system for engine failure with diagnostic result
19	Internet of Things, BIG Data	Ship Safety Management	Comprehensive managing and monitoring system for ship's safe and environment-friendly navigation
20	High-Tech Manufacturing	Ship Inspection	Performance evaluation of Life saving device made with High-Tech Material
21	BIG Data	Ship Safety Management	Optimal navigation route proposal for vulnerable ship
22	Clean Energy	Ship Inspection	Environment-Friendly propulsion system in accordance with international standard
23	BIG Data	Ship Safety Management	New Concept Technology for assessment of Maritime Traffic status and Port safety
24	Clean Energy	Ship Inspection	Electric Propulsion system Tech.
25	High-Tech Manufacturing	Environment Friendly	Ballast Water Management Tech.
26	Internet of Things, BIG Data	Ship Inspection	Monitoring Tech. for ship's equipment
27	Augmented Reality	Ship Safety Management	Simulator for workers' safety education
28	Augmented Reality, BIG Data	Ship Safety Management	Optimal Nav. Information process and management technology based on Augmented Reality
29	BIG Data	Ship Inspection	Ship's life cycle management Tech,
30	Internet of Things	Ship Inspection	Water Ingression detecting sensor for small ship

3.2. Core Maritime Safety Technologies for 'Ship Inspection Agency A'

Considering technology possession and growth rate of technology for future public safety, it is essential for the ship inspection agency A when they will develop the core maritime safety technologies.

The core maritime safety technologies are mostly incomplete. So, it's difficult to predict the development status and possessions of technologies for public safety when the technologies will be developed. However, 'Choice and Concentration strategy' is the best strategy for the ship inspection agency A with enhancement of their own core competencies and preoccupation in maritime safety technology market through the grasp of high potential technologies preferentially.

So, BCG Matrix analysis which was introduced by Boston Consulting Group in USA is applied in this study to find the best strategy for the ship inspection agency A.

In this study, normal terms on BCG Matrix are avoided and redefine the terms with consideration of authority's characteristics as below and in the Figure 6.

- Market Growth Rate → Growth Rate of Public Safety Technology Development

- Relative Market Share→ Public Safety Technology possession
- Emerging Market→ Superb Public Safety Technology
- Profit Creation Market→ Essential Public Safety Technology
- Developing Market→ Required Public Safety Technology
- Declining Market→ Basic Public Safety Technology

The ‘Superb Public Safety Technology’ means that the technology which is must-develop for the public safety. The ‘Essential Public Safety Technology’ means that the technology which is lower growth rate but it is using for public safety. So, this technology is important for keeping public safety.

A term of ‘Required Public Safety Technology’ means that technology which has higher growth rate and lower possession. But, this technology is only developed by strong demand because of its high degree of dependence upon foreign technology. The ‘Basic Public Safety Technology’ has a lower growth rate of public safety technology development and lower public safety technology possession, but it is the required technologies basically to keep the public safety.

Figure 5. Typical BCG Matrix

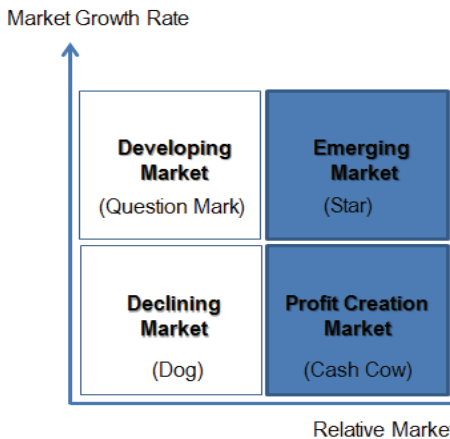
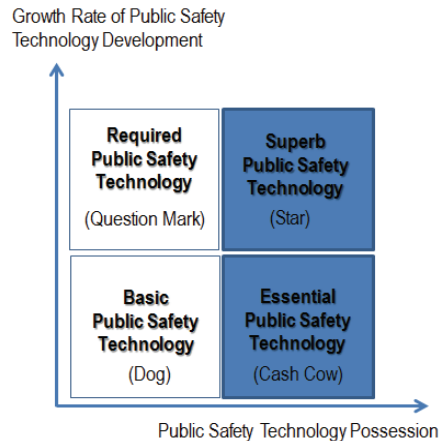


Figure 6. Redefinition of BCG Matrix



However, the core maritime safety technologies are still in developing and the market for these technologies didn't exist yet. So, the opinion about ‘Public Safety Technology Possession’ and ‘Growth rate of Public Safety Technology Development’ after completion of development of technology are analyzed through the survey from maritime safety experts.

It is defined that the x-axis is as a ‘Public Safety Technology possession’ and the y-axis is as a ‘Growth Rate of Public Safety Technology Development’ and also set the mean value of each survey as a median. Using this median, divide 4 quadrants with x-axis and y-axis and define each quadrant as ‘Superb Public Safety Technology (Star)’, ‘Essential Public Safety Technology (Cash Cow)’, ‘Required Public Safety Technology (Question Mark)’, ‘Basic Public Safety Technology (Dog)’

The technologies in Quadrant 1(Star) have over-average value in both ‘Public Safety Technology possession’ and ‘Growth Rate of Public Safety Technology

Development'. So, it is also expected that these technologies will bring the profit to market in near future.

The technologies in Quadrant 2(Question Mark) have below-average value in 'Public Safety Technology possession' and over-average value in 'Growth Rate of Public Safety Technology Development'. So, it is expected that market will be grown if these technologies will be developed in near future.

The technologies in Quadrant 3(Dog) have below-average value in both 'Public Safety Technology possession' and 'Growth Rate of Public Safety Technology Development'. So, the technologies in here are essential for securing the public safety.

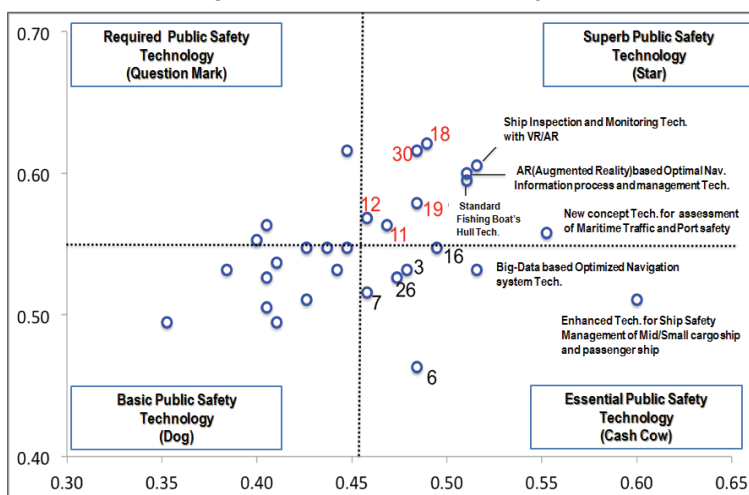
The technologies in Quadrant 4(Cash Cow) have above-average value in 'Public Safety Technology possession' and below-average value in 'Growth Rate of Public Safety Technology Development'. So, the technologies in here will be expected to have large percentage of possession in the market, but the possession will be paused or decreased due to the declining growth rate

With above circumstances, the technologies which are settled in Quadrant 1(STAR) and Quadrant 4(Cash Cow) could be the core technologies for the Ship Inspection Agency A to have strong point with development of these technologies.

The result of BCG Matrix analysis for 30 core maritime safety technologies are Figure 8, the superb public safety technologies in quadrant 1 are 'Ship Inspection and Monitoring Tech. with VR/AR', 'Optimal Nav. Information process and management technology based on Augmented Reality', 'New Concept Technology for assessment of Maritime Traffic status and Port safety' and 'Development of standard hull shape for fishing boat'.

The essential public safety technologies in quadrant 4 are 'Optimized Navigation system based on Big Data', 'Enhancing the Safety management for mid/small cargo ship and passenger ship', 'Comprehensive managing and monitoring system for ship's safe and environment-friendly navigation' and Ballast Water Management Tech.'.

Figure 7. BCG Matrix (Total Technologies)



With the result of BCG Matrix analysis, 9 technologies are ‘Superb Public Safety Technology (Star)’ and 7 technologies are ‘Essential Public Safety Technology (Cash Cow)’ in the Table 5.

The estimated development years for these technologies are expected minimum 7.63 years and maximum 9.47 years according to the survey result from maritime experts. For ‘Superb Public Safety Technology’ will take minimum 6.84years to 9.47 years as maximum and for ‘Essential Public Safety Technology will take minimum 5.79 years to 9.21 years as maximum.

Table 5. Result of BCG matrix analysis(Total Technologies)

Market	No.	Core Technologies	Est. Development Years(Yr)
Superb Public Safety Tech. (Star)	8	New Concept Technology for assessment of Maritime Traffic status and Port safety	8.42
	11	Integrated Control system for ship's equipment	8.68
	12	Customized Safety device for small/mid ship	7.63
	18	Monitoring Tech. for ship's equipment	8.42
	19	GHG Mitigation Technology	8.42
	20	Ship Inspection and Monitoring Tech. with VR/AR	8.16
	21	Development of standard hull shape for fishing boat	6.84
	25	Optimal Nav. Information process and management technology based on Augmented Reality	8.95
	30	SMART e-Navigation System Tech.	9.47
Essential Public Safety Tech. (Cash Cow)	2	Enhancing the Safety management for mid/small cargo ship and passenger ship	5.79
	3	Comprehensive managing and monitoring system for ship's safe and environment-friendly navigation	9.21
	6	Detecting and response system for maritime accidents	8.16
	7	Safe route for Passenger ship	6.32
	16	Tech. for enhancement of ship's maneuverability and stability	8.42
	23	Optimized Navigation system based on Big Data	9.21
	26	Ballast Water Management Tech.	7.63
Required Public Safety Tech. (Question Mark)	13	Environment-Friendly propulsion system in accordance with international standard	7.89
	14	Comprehensive management system(DB) of GHG from ship	8.42
	22	Development of standard hull shape of Deep-sea fishing vessel for enhancing the catching efficiency and declining of fuel	8.68
Basic Public Safety Tech. (Dog)	1	Optimal navigation route proposal for vulnerable ship	7.37
	4	Pre-alarming and accident prevention system for the risky situation (Fire, Flooding)	6.84
	5	Simulator for workers' safety education	7.89
	9	Performance evaluation of Life saving device made with High-Tech Material	7.37
	10	Electric Propulsion system Tech.	9.21
	15	Ship's life cycle management Tech,	8.95
	17	Ship status monitoring and managing system for Car-Ferry	7.37
	24	Automatic response system for engine failure with diagnostic result	8.95
	29	Water Ingression detecting sensor for small ship	7.11

3.3 BCG Matrix Result for Ship inspection related Technologies

The BCG Matrix result of technologies for ship inspection, one of the core competencies, is a Figure 9 and Table 6. The technologies which are settled in Superb Public Safety Technology (STAR) are 5 technologies such as ‘Integrated Control system for ship’s equipment’, ‘Customized Safety device for small/mid ship’, ‘Monitoring Tech. for ship’s equipment’. The technology which is settled in Essential Public Safety Technology (Cash Cow) is ‘Tech. for enhancement of ship’s maneuverability and stability’

Figure 8. BCG Matrix(Ship Inspection related Technologies)

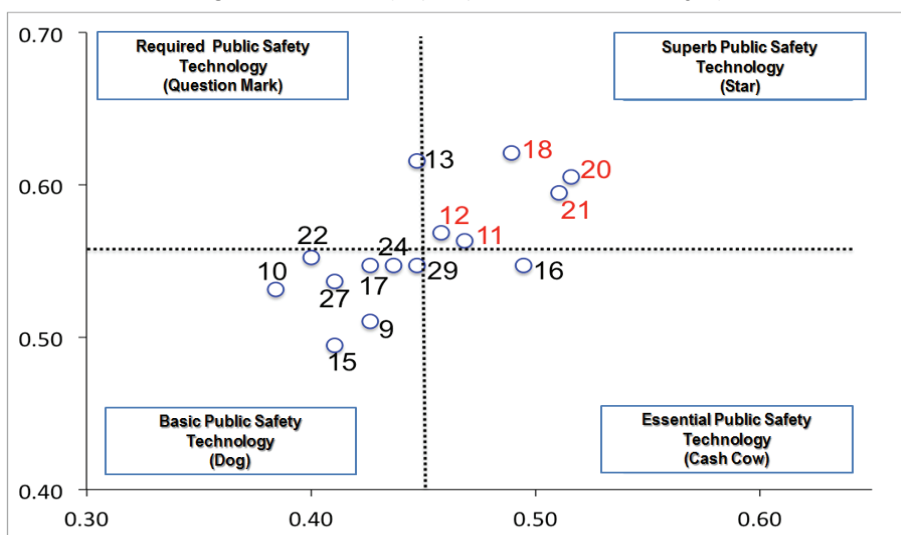


Table 6. Result of BCG matrix analysis(Ship Inspection related Technologies)

Market	No.	Core Technologies	Est. Development Years(Yr)
Superb Public Safety Tech. (Star)	11	Integrated Control system for ship's equipment	8.68
	12	Customized Safety device for small/mid ship	7.63
	18	Monitoring Tech. for ship's equipment	8.42
	20	Ship Inspection and Monitoring Tech. with VR/AR	8.16
	21	Development of standard hull shape for fishing boat	6.84
Essential Public Safety Tech. (Cash Cow)	16	Tech. for enhancement of ship's maneuverability and stability	8.42
Required Public Safety Tech. (Question Mark)	13	Environment-Friendly propulsion system in accordance with international standard	7.89
Basic Public Safety Tech. (Dog)	9	Performance evaluation of Life saving device made with High-Tech Material	7.37
	10	Electric Propulsion system Tech.	9.21
	15	Ship's life cycle management Tech,	8.95

Market	No.	Core Technologies	Est. Development Years(Yr)
	17	Ship status monitoring and managing system for Car-Ferry	7.37
	22	Development of standard hull shape of Deep-sea fishing vessel for enhancing the catching efficiency and declining of fuel	8.68
	24	Automatic response system for engine failure with diagnostic result	8.95
	27	Environment-Friendly navigation system for coastal ships	8.16
	29	Water Ingression detecting sensor for small ship	7.11

3.4 BCG Matrix Result for Ship Safety Management related Technologies

The BCG Matrix result of technologies for Ship Safety Management, one of the core competencies, is a Figure 10. & Table 7. The technologies which are settled in Superb Public Safety Technology (STAR) are 5 technologies such as ‘Comprehensive managing and monitoring system for ship’s safe and environment-friendly navigation’, ‘New Concept Technology for assessment of Maritime Traffic status and Port safety’, ‘Optimized Navigation system based on Big Data’, ‘Optimal Nav. Information process and management technology based on Augmented Reality’ and ‘SMART e-Navigation System Tech.’.

The technologies which are settled in Essential Public Safety Technology (Cash Cow) are ‘Enhancing the Safety management for mid/small cargo ship and passenger ship’ and ‘Detecting and response system for maritime accidents’

Figure 9. BCG Matrix (Ship Safety Management Technologies)

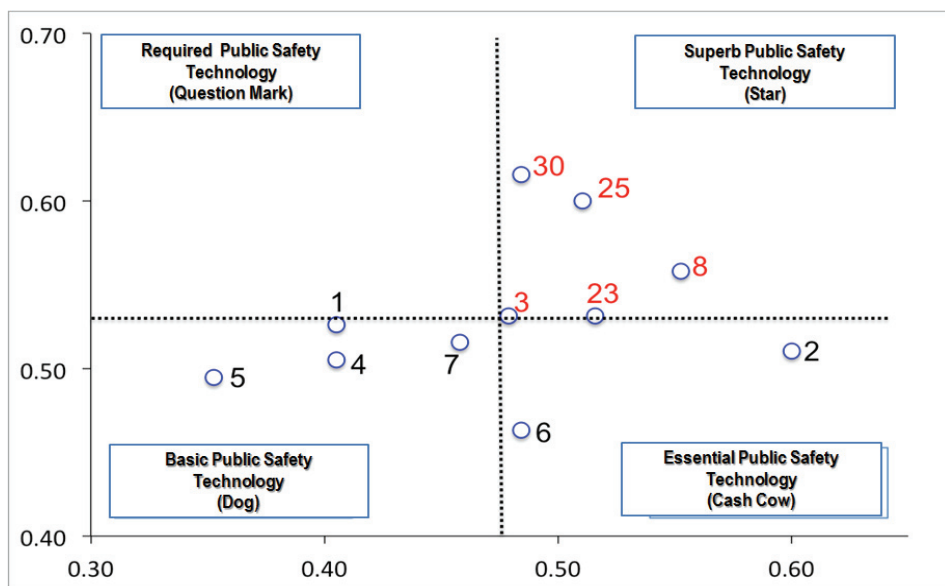


Table 7. Result of BCG matrix analysis(Ship Safety Management Technologies)

Market	No.	Core Technologies	Est. Development Years(Yr)
Superb Public Safety Tech. (Star)	3	Comprehensive managing and monitoring system for ship's safe and environment-friendly navigation	9.21
	8	New Concept Technology for assessment of Maritime Traffic status and Port safety	8.42
	23	Optimized Navigation system based on Big Data	9.21
	25	Optimal Nav. Information process and management technology based on Augmented Reality	8.95
	30	SMART e-Navigation System Tech.	9.47
Essential Public Safety Tech. (Cash Cow)	2	Enhancing the Safety management for mid/small cargo ship and passenger ship	5.79
	6	Detecting and response system for maritime accidents	8.16
Basic Public Safety Tech. (Dog)	1	Optimal navigation route proposal for vulnerable ship	7.37
	4	Pre-alarming and accident prevention system for the risky situation (Fire, Flooding)	6.84
	5	Simulator for workers' safety education	7.89
	7	Safe route for Passenger ship	6.32

3.5 BCG Matrix Result for Environment-friendly related Technologies

The BCG Matrix result of technologies for Environment-friendly, one of the core competencies is a Figure 11. & Table. 8. The technology which is settled in Superb Public Safety Technology (STAR) is 'GHG Mitigation Technology' and the technology which is settled in Essential Public Safety Technology (Cash Cow) is 'Ballast Water Management Tech.'

On the other hands, the technology which is settled in Required Public Safety Technology (Question Mark) is 'Comprehensive management system (DB) of GHG from ship' and the technology which is settled in Basic Public Safety Technology (Dog) is 'Safe navigation of LNG-Fueled ship.'

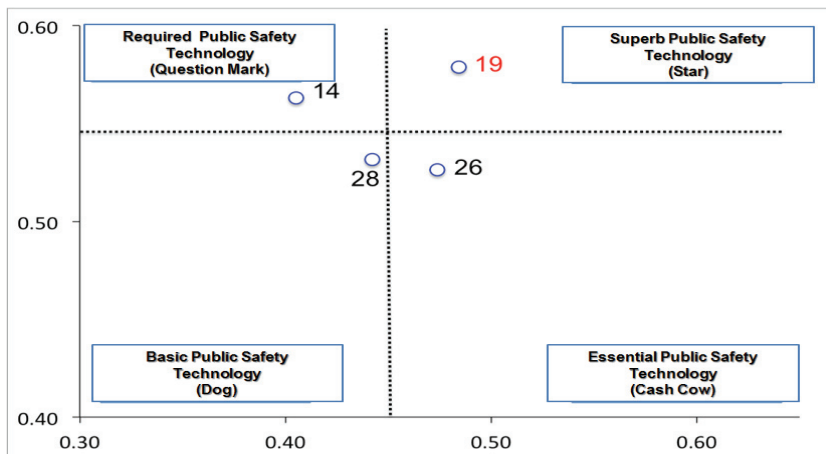
Figure 10. BCG Matrix (Environment-Friendly related Technologies)

Table 8. Result of BCG matrix analysis (Environment-Friendly Technologies)

Market	No.	Core Technologies	Est. Development Years(Yr)
Superb Public Safety Tech. (Star)	19	GHG Mitigation Technology	8.42
Essential Public Safety Tech. (Cash Cow)	26	Ballast Water Management Tech.	7.63
Required Public Safety Tech. (Question Mark)	14	Comprehensive management system(DB) of GHG from ship	8.42
Basic Public Safety Tech. (Dog)	28	Safe navigation of LNG-Fueled ship	8.16

4. Conclusion

The fourth industrial revolution is expected to spread rapidly across all areas of human life and is expected to bring about many changes. Major technologies that will lead this fourth industrial revolution are artificial intelligence, robotics, Internet of Things, self-driving cars, 3D printing, nanotechnology, biotechnology and energy storage technologies and etc.

The changes in the fourth industrial revolution will also affect marine safety and will play a major role in the development of related technologies. So, the authority who has a role in maritime safety field, especially in ship inspection, ship safety management and other. So, it is the essential to identify the core technologies to prepare for fourth industrial revolution and its effects to Ship Inspection Authority which has a main role on the ship inspection and ship safety management.

For preparation for the fourth industrial revolution, many countries and industries are responding to it. It is found that the demand for eco-friendly ships, high value-added ships, and marine leisure ships is high and as strengthening of the regulations for marine environment protection, the technologies for that are strengthened.

Each country shows great interest in maritime safety technologies in advanced maritime countries, and has established practical national strategies to secure global standards for maritime safety technologies and to gain market dominance.

Korean government also set the implementation plan for development of maritime safety, selection of core technology and conduct many researches such as ‘e-navigation technology’, ‘High-end(IT Convergence) navigation aids’, ‘Navigation system technology’, ‘Safe navigation technology for arctic route and polar area’, ‘Maritime salvage technology’, ‘Mitigation technology for maritime accidents’.

This study discusses the selection of core maritime technologies for ship inspection Agency A with its core competencies (Ship inspection, Ship safety management, Environment-friendly).

As a result of the selection process with BCG Matrix, the Superb Public Safety technologies (Star) in ship inspection are ‘Integrated Control system for ship’s equipment’ and others, the Essential Public Safety technologies (Cash Cow) in ship inspection are ‘Tech. for enhancement of ship’s maneuverability and stability’.

The 'Star' technologies in Ship safety management are 'Integrated Control system for ship's equipment' and other 4 technologies, the 'Cash Cow' technologies in Ship safety management 'Enhancing the Safety management for mid/small cargo ship and passenger ship' and 'Detecting and response system for maritime accidents'.

Lastly, the 'Star' technology in Environment-friendly is 'GHG Mitigation Technology' and the 'Cash Cow' technology in Environment-friendly is 'Ballast Water Management Tech.'.

In preparation for the fourth Industrial Revolution era, the core maritime safety technologies for the Ship Inspection Agency A that should be implemented first and prioritize them and it also analyzed the classification of maritime safety technologies, importance of items in technology development, and priority of development of public safety technologies using quantitative techniques.

4.1 Acknowledgement

This study is a part of the results of the planning study on maritime safety for the fourth industrial revolution, which supported by Korea Ship Safety Authority.

References

- Cho, I.S.(2011), “A Study on the Present Status and Future Directions of Maritime Safety Audit”, *Journal of the Korean Society of Marine Environment & Safety*, 17(4), pp.399-405.
- EPRS, Industry 4.0: Digitalization for Productivity and Growth, 2015, pp.2-3
- Heo, J.J.(2017), “The Fourth Industrial Revolution Changes and Responds to Job, Labor Review, pp.62-71.
- Hyundai Economic Institute (2017), “Characteristics and implications of ICT industry in Korea.
- Jang, S.I.(2017), “Trends and Policy Tasks of the industrial Structure in the Fourth Industrial Revolution”, *Planning and Policy*, 424, pp.22-30.
- Kagermann, P., Wahlster, P., & Helbig, D.(2013), “Recommendations for implementing the strategic initiative INDUSTRIE 4.0”, *National Academy of Science and Engineering*, pp.13-15
- Kang, H.J.(2018), “Established Smart Disaster Safety Management Response System based on the 4th Industrial Revolution”, *Journal of Digital Contents Society*, 19(3), pp.561-567.
- KIET (2014), “Changes in Global Value Chain Structure and Challenges for Development of ICT Industry.
- Ministry of Oceans and Fisheries (2014), “Maritime Safety Future Industrial Technology Mid/Long Term Planning Research.
- Oh S.W, Jeon, T.B, Lee, M.J, Seo, S.H, Jo, D.O.(2010), “Evaluation of Maritime Safety Technology for Official Development Assistance(ODA)”, *Journal of the Korean Society of Marine Environment & Safety*, 16(1), pp.81-91.
- Park,J.I., Kwon,H.S., Kim, S.C.(2016), “Telco Strategies for the Fourth Industrial Revolution, *Journal of Broadcasting and Telecommunications Research*, 97, pp.37-59.
- Pual.K.(1998), “What’s new about the new economic geography?”, *Oxford Review of Economic Policy*, 14(2), pp.7-17.
- Schwab. K.(2016), “The Fourth Industrial Revolution, Portfolio Penguin.
- WEF(2016), “The Future of Jobs”
- Woo, J.Y.(2016), “The Fourth Industrial Revolution : Preparing for Data Economy”, *The Korea Contents Association Review*, 15(1), pp.14-20.
- Yun, C, Lee, D.N, Lee, S.I.(2011), “A study on the Legal Responsibility of Ship survey”, *Maritime law review*, vol.23, no.2, pp. 25-54

The Prospects of Investment in the Maritime Industry of Russian Far East

(Prospects for Maritime Industry Investment)

Iurii V. Vedernikov* • Sergei M. Smirnov, PhD**

ABSTRACT

The article considers the current state of the merchant and fishing fleet of the Russian Federation carrying out domestic cargo transportation and fishery operations in the Eastern sector of the Arctic and the adjacent seas of the Far East. Taking into account the high degree of physical and moral wear of the greater part of vessels under Russian flag as well as the necessity to accomplish the goals set by Maritime Strategy of Russia, a mechanism for radical fleet modernization has been proposed. The leasing of merchant and fishing vessels from the Republic of Korea and the introduction of cooperative arrangements between shipbuilding enterprises of the two countries represent two possible options for this modernization program. Regional authorities in the Far East of Russia may act as the guarantees for the foreign investments utilizing recent changes in domestic legislation.

Keywords: merchant fleet, fishing vessels, investment, leasing of merchant and fishing ships.

* Senior Research Fellow, Naval Museum (St. Petersburg), +7-904-605-7408, v2381010@yandex.ru

** Director, International Department, Admiral Nevelskoy Maritime State University, +7-924-239-4924, Ssmirnov@msun.ru

1. Introduction and Overview

Accelerated social and economic development of the Far Eastern regions is a priority for the Russian Federation. Strategic planning in this area is complicated by the huge spatial dimensions of the territories and the uneven economic, infrastructural and demographic level of development of its administrative units¹⁾. Insufficient scientific support is complicating the feedback mechanism creation for taking into account the priorities of the Center and the Periphery, the state and business interests [6]. At the same time, there is an understanding in the Russian Federation that the integration of the Far Eastern territories with the economies of the neighboring states of Northeast Asia is certainly a necessary condition for their development. However, there is no clear understanding exactly how such integration should be implemented, what measures of a regulatory nature should be applied to attract foreign investors to projects in the Far East of Russia. Accordingly, potential foreign partners are in no hurry to join the economic projects in the Far East, rightly fearing investment risks and uncertainties.

Maritime industry is an important element of Russia's economic system in the Far East, acting as a principal interconnecting transport artery (merchant fleet) and as one the main productive factor of regional economic (marine fishing fleet). It is likely that the development of international cooperation in this area may have the best prospects in terms of minimizing investment risks and the relatively fast commercial profitability achievement. Therefore, one of the possible mechanisms for mutually beneficial practical cooperation in the field of maritime activities between the Far East of Russia and the Republic of Korea is proposed in this article.

The North - Eastern provinces of the Russian Federation, namely Magadan *Oblast'*, Kamchatsky *Krai*, Chukotka Autonomous District, the coastal and Arctic regions of Sakha - Yakutia Republic and the coastal regions of Khabarovskiy *Krai*, are located in extreme climatic and geographic conditions and lack land transport connectivity with the 'mainland'. There are practically no opportunities to produce vital food and energy resources in the required volumes necessary for the physical survival of the population and economic activities on site. Table 1 shows the data on the dependence of remote and island territories of the Russian Federation on the import of vital commodities and materials. (The data provided in this paper generally refers to 2014, exactly before the Western sanctions have led to a distortion of the normal course of economic processes.)

Historically, the operations for the delivery of cargo and materials to the North-East of Russia have been given the status of a national campaign code - named "Northern Delivery" [3; 8; 10].

1) Official Russian term for administrative territorial units is "Subjects of [Russian] Federation". We use "provinces" instead as the more understandable term in this paper.

Table 1. Import of products and materials to the North - Eastern regions of Russia(sample), 2014

Region	Commodities, % of total consumption									
	Food					Energy resources				Clothes, footwear
	Potatoes	Milk products	Meat products	Vegetables & Melons	Eggs	Coal	Diesel fuel	Gasoline	Heavy fuel oil	
Kamchatsky <i>Krai</i>	5,4	68,2	80,0	39,5	29,1	81,0	100,0	100,0	100,0	90,3
Magadan <i>Oblast'</i>	22,4	80,0	91,9	68,7	28,3	56,3	100,0	100,0	100,0	89,9
Sakhalin <i>Oblast'</i>	2,8	68,1	92,2	26,6	3,7	0,3	-	-	-	87,5
Chukotka Autonomous District	93,5	86,1	29,4	78,6	74,3	27,2	100,0	100,0	100,0	94,8

Source: [14; 15]

The absolute majority of these commodities are delivered by water transport. Inland transport (along the rivers Lena, Kolyma, Yana, Indigirka) play an important role in the distribution of flows and the delivery of transit cargo to the end user. However, river navigation is limited in time and complicated by the presence of serious navigation restrictions. The main volumes of cargo and materials are delivered by sea. Also, the products of resource-producing enterprises are transported by, both for domestic and export consumers.

The existing transport and logistics infrastructure of Russia in the Far East is attracted to the southern non-freezing ports linked with the Trans-Siberian Railway (TSR) and the international transport corridors 'Primorye-1' and 'Primorye-2'. It is no coincidence that the ports in Southern Primorye are considered to be the "entrance gates" of both the "Northern Delivery" and the Northern Sea Route (NSR). Hence, internal maritime transportation originating from the ports in Primorsky *Krai* ensure the livelihoods of the North - Eastern regions of Russia with food by 65-70 %, coal - from 30 to 85 %, liquid fuel (gasoline, fuel oil, diesel fuel, etc.) - almost 100 % of total consumption [4; 7].

Thus, the peculiarity of maritime transportation in the Far East of Russia and in the Eastern sector of the Arctic is its huge spatial extent (for example, the distance between Vladivostok and Tiksi ports is 4,133 nautical miles) and complicated navigational conditions (heavy ice, insufficient hydrographic support and emergency rescue capacity, communication problems in high latitudes). This dictates the serious requirements for the qualitative parameters of the freight and auxiliary vessels used.

The maritime fishing fleet in the Far East annually catches about 3 million tons of marine biological resources, which is more than 2/3 of the total Russian catch [5; 14].

Meanwhile, the maritime industry in the Far East of Russia is facing serious infrastructural challenges from an engineering standpoint. Let us illustrate this with examples, analyzing the current ship composition of both merchant and fishing fleet assets.

The structural and quantitative indicators for the merchant ships under the Russian flag in the Far East are shown in Figure 1 and Table 2 (based on the data provided by Russian Maritime Register of Shipping).

Figure 1. Merchant fleet assets structure

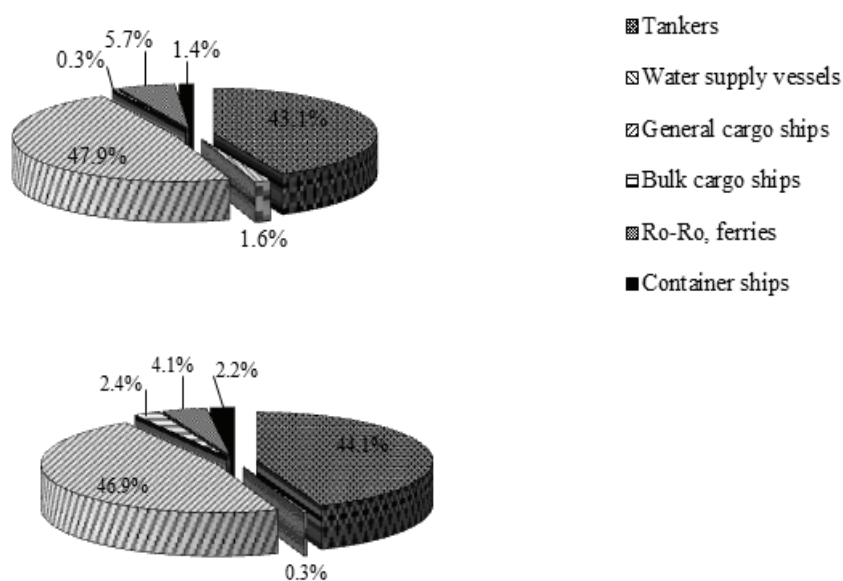
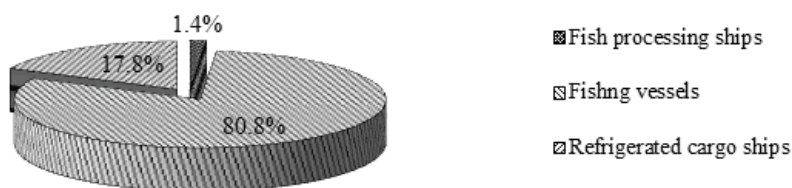


Table 2. Merchant fleet assets: quantitative indicators [13]

Ship type	Number of ships	Combined deadweight, thousand tons	Average deadweight, thousand tons	Average age of ships, years
Tankers	143	555,1	3,9	28,5
Water supply vessels	6	3,8	0,6	32,7
General cargo ships	159	590,2	3,7	28,1
Bulk cargo ships	1	30,0	30,0	27,0
Ro-Ro, ferries	19	52,0	2,7	25,6
Container ships	4	26,4	6,6	32,2
Total:	332	1257,5	3,8	29,0
For reference: 173 companies including 23 registered abroad have been accounted as shipowners.				

The indicators for the fishing fleet assets are generally similar.

Fishing fleet assets structure



Fishing fleet assets deadweight composition

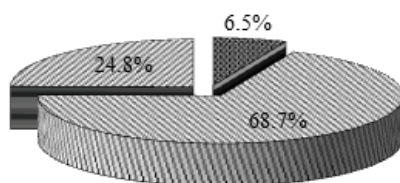


Table 3. Fishing fleet assets: quantitative indicators [13, 14]

Ship type	Number of ships	Combined displacement, thousand tons	Average displacement, thousand tons	Average age of ships, years
1	2	3	4	5
Fishing fleet vessels total:				
Including:	699	1483,5	2,12	26,5
- Fish processing ships	10	96,0	9,6	24,4
- Fishing vessels	565	1018,8	1,8	27,8
- Refrigerated cargo ships	124	368,7	2,97	27,4
For reference:	254 companies have been accounted as shipowners.			

Note: deadweight is indicated in columns "Combined displacement, thousand tons" and "Average displacement, thousand tons" for refrigerated cargo ships.

As a result, it is obvious that an absolutely largest part of merchant and fishing vessels have been operated beyond the normative period. This creates threats:

- Disruption of internal maritime traffic, which entails interruptions in ensuring the livelihoods of the North - Eastern regions of Russia and forms prerequisites for a humanitarian catastrophe in these territories;
- Reduction in marine biological resources extraction which entails a decrease in export earnings to the budget of the Russian Federation, and may adversely affect the economy of the East Asian countries which are the main consumers of these products.

We must admit that these problems have not yet been fully recognized by the federal government of Russia as well as the leadership of the Far Eastern provinces,

which is confirmed by the absence of any policy documents whose content is aimed at preventing these challenges. It should be noted that the long-term plans for the development of the Russian Federation maritime fleet as a whole are more oriented toward ensuring the export of Russian raw materials and do not specifically consider the development of the internal shipping and fishing fleet in the Far East [10].

The low level of financial self-sufficiency and heavy dependence on federal budget subsidies predetermines a practical inability of the Far Eastern provinces to solve the problem of fleet modernization independently. According to authors' estimations, the budgets of these entities are formed at the expense of their own incomes by 36.7% - 58.5% only, and the periodically arising budget deficit is covered by subsidies and subventions from the budget of the Russian Federation [4; 15].

Table 4. Indicators of the budget system of North – Eastern provinces of Russia

(sample, 2014).

Territory	Consolidated budget revenues, billions Rubles:		Budget self-sufficiency, %	Consolidated budget expenditures, billions Rubles.	Deficit (-) / Surplus (+) of the consolidated budget, in percent of income
	Total	- including at the expense of the federal budget and other third-party sources			
Kamchatsky Krai	62 399,8	39 466,2	36,7	63 527,1	- 1,8
Magadan Oblast'	26 831,5	11 172,1	58,4	31 189,4	- 16,2
Sakhalin Oblast'	155 477,8	8 431,9	94,5	132 371,5	+ 14,8
Chukotka Autonomous District	21 385,4	10 557,6	50,6	22 339,8	- 4,4
Sakha – Yakutia Republic	172 332,9	71 407,0	58,5	177 367,4	- 2,9
Khabarovsk Krai	98 449,4	24 614,0	75,0	113 628,5	- 15,4
For reference: Far Eastern Federal District	704 640,3	210 592,8	70,1	725 174,8	-2,9

Note: budget self-sufficiency is the proportion of the budget's own revenues in its consolidated revenues. Source: [14]

Note that the current economic development of the Russian Federation is based on the principles of public - private partnership and program - targeted development.

Public - private partnership implies cooperation of the state and business in solving any large-scale social and economic tasks. The state is responsible for the creation of various conditions and favorable environment for the implementation of the projects and awarding of benefits to project participants, while the business entities accomplish the commercial activities for implementation of the project goals.

The program - targeted development presupposes that the solution of the tasks of social and economic development of regions and industries is carried out on the basis of program planning of activities adequate in its composition to business planning process.

These principles reinforce the essential role of private initiative, the participation of private investors in the implementation of social and economic development of the regions, at least theoretically. Russian legislation allows foreign investors to partic-

ipate in solving social and economic problems on the territory of the Russian Federation in the manner and under the conditions provided for by the federal law No. 160-FZ "On Foreign Investments in the Russian Federation" dated July 9. 1999 [1]. This law has introduced a set of guarantees to foreign investors, including a guarantee of legal protection for the activities of a foreign investor, free transfer of profits and revenues obtained here to the outside financial institutions, property rights, etc.

Now about the authors' view on the ways of solving the problems with fleet modernization, utilizing the available legislative preferences and potential interests of investors from the Republic of Korea.

Logically following the above mentioned situation analysis and projecting its results in the perspective of 10-15 years, Russia will have to update the structure and composition of both internal merchant and fishing fleet assets in the Far East, building dozens of freight ships and at least about a hundred large and medium fishing vessels. Taking into account that domestic shipbuilding industry in the region is not ready to solve this task, it is proposed to acquire these assets from Korea.

The implementation of this project may be carried out according to the leasing scheme within the framework of the UNIDROIT Convention "On International Financial Leasing". Wherein:

- The Korean side builds and delivers maritime freight and fishing vessels, acting as a lessor;
- Russian shipping and fishing companies act as customers of sea vessels, being a lessee;
- State bodies of Far Eastern provinces act as guarantors of fulfillment of obligations on the part of Russian lessees - shipping and fishing companies.

As mentioned earlier, the Russian Federation officially welcomes foreign investments, providing foreign investors with various benefits. In particular, a system of tax and customs privileges is provided for leasing operations, the Far Eastern provincial authorities are empowered to grant individual preferences to foreign investors, for example, permitting payments for the leasing of fishing vessels by targeted supply of fish products.

It is also feasible to propose the creation of medium-tonnage shipbuilding production enterprises for constructing sea-going freight and fishing vessels on the Pacific coast of Russia, on the basis of production cooperation with clear distribution of functions. Similar production scheme has long been successfully used on the Baltic Sea between Russian and Finnish shipyards. Implementation of this scheme in the Far East with Korean partnership based on the 'Free Port of Vladivostok' residents' mechanism [2] will guarantee a substantial package of benefits for both sides.

The organization and coordination of the proposed forms of cooperation can be carried out at the regional level. Though power control mechanisms in modern Russia tend to be hyper - centralized to a large degree, the Far Eastern provinces still have the appropriate power capacity fixed by law. This allows trimming and adjusting of the implementation investment processes in relation to the needs of a specific region, as well as testing the mechanism of investment on relatively small projects, which significantly reduces risks and raises reliability.

The economic results of investments in the above-mentioned projects seem quite promising to us. Thus, the renewal of the sea freight and fishing fleet provides for the supply of several dozen cargo ships and hundreds of fishing vessels (preliminary assessment). This provides long-term workload for South Korean shipbuilding companies. Another income aspect for Korean investors is the maintenance (warranty repair) of the constructed ships, its technical modernization. Other forms of income generation by South Korean investors are possible too, for example, training of service personnel for ships' equipment. The substantive content of other forms of income sources may be determined by interviewing representatives of the Russian maritime industry.

Minimization of risks for Korean investors is achieved through the use of a leasing scheme, in which payment for ships supplied by Korean factories is carried out (according to an agreed plan) by Russian leasing organizations. The risk of untimely payments by Russian shipping and fishing companies operating vessels in leasing will be assigned to Russian leasing organizations.

A possibly important role in implementing these tasks may belong to the Korea - Russia Research Center jointly created by the Korean Maritime Institute and the Admiral Nevelskoy Maritime State University (Vladivostok, Russia). This is explained by the large scale of preliminary on-site research and coordination activities between Korean investors and regional Russian actors (federal and regional authorities, business, environment protection NGOs, public opinion makers) needed for successful cooperation projects.

As indicated above, there are 173 shipping and 254 fishing companies in the Far East of Russia, whose activities are supervised by the administrative bodies of seven provinces. To organize and maintain successful cooperation between the Russian and Korean sides it is obviously necessary first to establish direct contacts with:

- shipping and fishing enterprises of the Far East of Russia, to analyze their financial and economic situation, identify their needs in new vessels and technical equipment;
- provincial administrative bodies in the Far East supervising maritime related activities, to evaluate their interests, priorities, competence and readiness for cooperation.

We should also take into account the existing and possible restrictions on the part of national and international legislation concerning the import of Hi-Tech products, including vessels and sophisticated ship equipment.

References

1. Federal law No. 160-FZ “On Foreign Investments in the Russian Federation” dated July 9. 1999. Available at http://www.consultant.ru/document/cons_doc_LAW_16283/
2. Federal law No. 212-FZ “On the Free Port Vladivostok” dated July 13, 2015. Available at http://www.consultant.ru/document/cons_doc_LAW_182596/
3. Smirnov S.M.(2016). The Transport and Logistics System of Russia in the Far East and the Problems of Its Integration with North – East Asian Economies. *Russia and the Asia-Pacific: Role, Interests and Priorities of Regional Security and Accelerated Economic Development. (Monograph)*. Vladivostok: FEFU, 240 pp.
4. Vedernikov I.V. (2016). 375 Years of Russian Navigation in the Pacific. The Chronicles of Shipping and Shipwrecks. Vladivostok, 247 pp.
5. Vedernikov I.V. (2017). Substantiation of the Main Parameters of the Far Eastern Merchant Fleet Development Program on the Example of Internal Maritime Transportation. *PhD Thesis (Manuscript)*
6. Smirnova O.O. (2012). Fundamentals of Strategic Planning in the Russian Federation. M.: ‘Nauka’, 302 pp.
7. Vedernikov I.V., Vedernikov D.I. (2017). The Present Cargo Base for Internal Maritime Transportation in the Far East and Its Influence on Merchant Shipping. // *The Herald of the Volga State Academy of Inland Transport*. Issue 51. PP. 163-171.
8. Vedernikov I.V., Vedernikov D.I. (2016). The Current State of the Merchant Fleet Under the Flag of Russia in the Far East. // *The Herald of the Volga State Academy of Inland Transport*. Issue 48. PP. 216-220.
9. Smirnov, Sergei (2015). The Northern Sea Route: Strategic, Political and Economic Dimensions. // *The KMI International Journal of Maritime Affairs and Fisheries*, Vol. I June 2015.
10. Vedernikov I.V., Vedernikov D.I. (2017). State and Corporate Views on the Development of Maritime Transport in Russia Today. // *The Herald of the Volga State Academy of Inland Transport*. Issue 53. PP. 157-164.
11. Yuri G. Zhuravel, Sergey M. Smirnov. The Northern Sea Route and its Impact on Asia-Pacific. // *Asia-Pacific Journal of Marine Science & Education*, Vol.5 #2, 2015, PP.1-6.
12. Strategy for the Development of Maritime Activities of the Russian Federation until 2030 [Electronic resource]. Available at <http://docs.cntd.ru/document/902250877>
13. Register book / Russian Maritime Register of Shipping [Electronic resource]. Available at <http://www.rs-class.org/>
14. Russian Federal Fishery Agency. [Electronic resource]. Available at <http://fish.gov.ru/>
15. Federal Statistical Service of Russian Federation. [Electronic resource]. Available at: <http://www.gks.ru/>

Implications of Sea-Level Rise for the Law of the Sea

Ekrem Korkut* • Lara B. Fowler

ABSTRACT

Increasing global temperature due to climate change is causing the sea level to rise, which will have an increasingly greater effect on coastlines and baselines of maritime states, creating the potential for economic and political uncertainty. International law and the United Nations Convention on the Law of the Sea [hereinafter: LOSC] do not offer a solution to the effects of sea-level rise, except in Article 7(2), which fixes straight baselines in highly unstable coastlines in a delta or similar area, and Article 76(9), which permanently fixes the outer limits of continental shelf. Most scholars have proposed a freeze of the existing baselines or outer limits of maritime spaces and have urged the international community to adopt a rule on this issue. We would argue an exception to the above solution in the case of islands and rocks. Although most scholars argue that an island or a rock must retain its continental shelf in case of submersion, such interpretation does not seem to be consistent with the purpose of Article 121(3) of the LOSC, which was adopted to deny tiny rocks from having an exclusive economic zone (EEZ) and continental shelf. Such entitlements from disappeared islands do not comply with the principle of “the land dominates the sea,” and therefore should be exempted from the freeze.

Keywords: Sea-level rise, baselines, maritime entitlements, disappeared islands. Thanks for informing me.

* Dr. Ekrem Korkut is a research specialist at Penn State Law. He received his LL.M. and S.J.D. degrees at Pennsylvania State University, USA. Email: ezk137@psu.edu

** Professor Lara B. Fowler is a senior lecturer at Penn State Law, USA. She focuses on environmental, energy, and natural resource law. Email: lbf10@psu.edu.

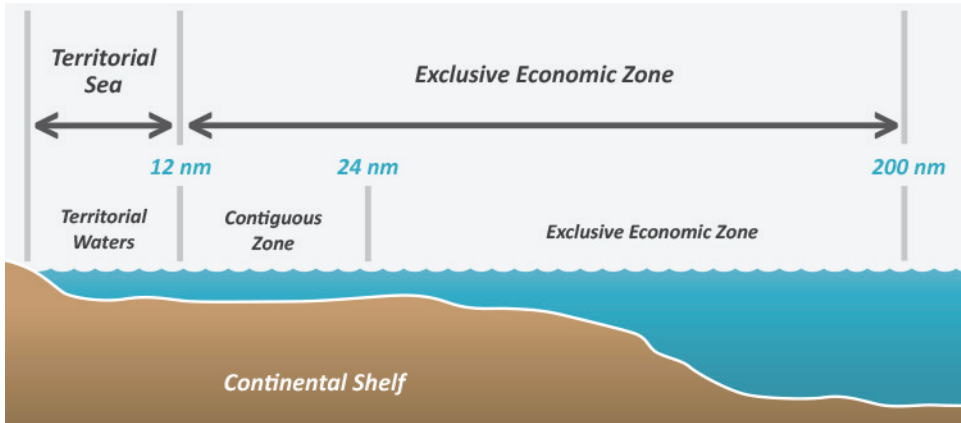
1. Introduction

Increasing global temperature due to climate change is causing the sea level to rise. Such rises can impact countries' boundaries given how the Law of the Sea Convention (LOSC) is configured, which in turn may affect maritime entitlements of insular features. How to deal with the potential difference between changes in geographic boundaries caused by rising seas versus legally demarcated baselines that establish critical elements of sovereignty and sovereign rights, including economic zones, jurisdiction and navigation, and fishing areas is an important question.

Between 1993 and 2010, for example, sea level rose 3.2 mm per year,¹⁾ while by 2100, it is expected that sea level rise will be approximately one meter (3.2 ft).²⁾ As a consequence of this rise in sea level, low-lying areas and some insular features are threatened with submersion.³⁾ If baselines, from which the maritime zones are measured, move landward or seaward, maritime boundaries might also move. The United Nations Convention on the Law of the Sea does not explicitly regulate the baseline shift, nor does it offer a solution for this issue.⁴⁾ Because some 87 percent of the world's sea hydrocarbon reserves are located within the national jurisdiction of States,⁵⁾ and more than 90 percent of fish stocks live within 200 nautical miles of the baselines,⁶⁾ securing maritime boundaries which is contingent upon baseline is very important for maintaining international peace and security.

-
- 1) IPCC, "2013: Summary for Policymakers" in *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, The Physical Science Basis*, ed. T.F. Stocker et al. (Cambridge: Cambridge University Press, 2013), p. 11.
 - 2) J. A. Church et al., "Sea Level Change" in *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, ed. T.F. Stocker et al. (Cambridge: Cambridge University Press, 2013), p.1140.
 - 3) "For example, a one-meter rise in the sea level could result in the loss of 75 percent of certain low-lying islands of Vanuatu, and 80 percent of the Majuro atoll in the Marshall Islands." Charles Di Leva and Sachiko Morita, "Maritime Rights of Coastal States and Climate Change: Should States Adapt to Submerged Boundaries?" *Law and Development Working Series 5* (2008), p. 8.
 - 4) United Nations Convention on the Law of the Sea, adopted 10 December 1982, 1833 UNTS 397.
 - 5) UN Division for Ocean Affairs and the Law of the Sea, "The United Nations Convention on the Law of the Sea (A historical perspective)," accessed June 19, 2017, http://www.un.org/depts/los/convention_agreements/convention_historical_perspective.htm#Historical%20Perspective.
 - 6) Louis B. Sohn et al., *Cases and Materials on the Law of the Sea*, 2nd ed. (Leiden: Brill, 2014), p. 662.

Figure 1. Maritime Zones⁷⁾



2. Background

The LOSC aims to “contribute to the strengthening of peace, security, cooperation and friendly relations...”⁸⁾ This objective hinges upon the stability of maritime space and borders, and an ambulatory baseline system would entirely disturb the stability and continuity of maritime boundaries. Therefore, it seems the best solution to the sea level rise is to fix baselines permanently.

2.1 The Definition of “Baselines”

A coastal State measures its maritime space from baselines, which are generally measured from the low-water line along the coast.⁹⁾ According to LOSC Article 6, in case of islands having fringing reefs, the baseline is the seaward low-water line of the reef. Normal baselines are shown in large-scale charts officially recognized by the coastal State.¹⁰⁾

Straight baselines, on the other hand, may be employed “where the coastline is deeply indented and cut into, or if there is a fringe of islands along the coast in its immediate vicinity.”¹¹⁾ According to LOSC Article 9, the baseline for a river, which directly flows into the sea, is a straight line across the mouth of the river between the points on the low-water line of its banks. Straight baselines may not be employed “to and from low-tide elevations [which is explained below] unless lighthouses or similar installations which are permanently above sea level have been built on them or except in instances where the drawing of baselines to and from

7) Secure Fisheries, <http://securefisheries.org/sites/default/files/pictures/economic-zones-oceans.png> (last visited Apr. 15, 2018).

8) Preamble of the LOSC.

9) Article, 5, LOSC.

10) Article 5, LOSC.

11) Article 7, LOSC.

such elevations has received general international recognition.”¹²⁾ A straight baseline may be employed on the mouth of a bay, where the distance between low-water marks on either side is less than 24 nautical miles (nm).¹³⁾ Finally, an archipelagic State may draw straight baselines “by joining the outermost points of the islands and drying reefs of the archipelago.”¹⁴⁾

Straight baselines or the outer limits of the territorial sea, of the Exclusive Economic Zone (EEZ) and the continental shelf must be shown on charts.¹⁵⁾ Alternatively, the coastal State may utilize a list of geographical coordinates of points, specifying the geodetic datum.¹⁶⁾ Under the LOSC, the coastal State is required to give due publicity to such charts or lists of coordinates and deposit a copy of them with the Secretary-General of the United Nations.¹⁷⁾

2.2 Maritime Zones

Baselines further define other critical aspects of sovereignty, both on the landward and seaward of the defined and registered baseline. The landward side of a baseline constitutes internal waters of a State, and thus subject to the absolute sovereignty of the State. The territorial sea is adjacent to the internal waters and extends up to twelve nautical miles (nm) from the baselines.¹⁸⁾ Beyond the territorial sea, a contiguous zone provides a coastal State to exercise its control necessary to “a) prevent infringement of its customs, fiscal, immigration or sanitary laws and regulations within its territory and territorial sea; and b) punish infringement of the above laws and regulations committed within its territory or territorial sea.”¹⁹⁾ A contiguous zone cannot extend beyond 24 nautical miles from the baselines.

The exclusive economic zone (EEZ) and continental shelf extend up to 200 nm from the baselines. A state may be entitled to a continental shelf beyond 200 nm if its continental margin extends beyond the 200-nm limit. However, such extension may not be longer than 350 nautical miles from the baselines nor longer than 100 nautical miles from the 2,500-meter isobaths.²⁰⁾ Within the EEZ, the coastal State has sovereign rights for the purpose of exploring and exploiting, conserving and managing living and non-living resources of the water column and of the seabed and subsoil, as well as sovereign rights with regard to other economic activities such as production of energy from the water, currents and winds.²¹⁾ On the other hand, the coastal State’s sovereign rights over the continental shelf are limited to the exploration of the continental shelf and exploitation of its natural resources.²²⁾

12) Article 7(4), LOSC.

13) Article 10(4), LOSC.

14) Article 47, LOSC.

15) Articles 16, 47(9), 75 and 84, LOSC.

16) Ibid.

17) Ibid.

18) Article 3, LOSC.

19) Article 33, LOSC.

20) Article 76(6), LOSC.

21) Article 56(1)(a), LOSC.

22) Article 77(1), LOSC.

3. The Effect of Baseline Shift

The LOSC does not explicitly state that a baseline shift would also move maritime boundaries,²³⁾ which has significant implications given existing and predicted sea level rise. This is particularly important given that two provisions in the LOSC permanently fix baselines.²⁴⁾ First, according to LOSC Article 76(9), a coastal State is required to deposit with the Secretary-General of the United Nations charts and information, “permanently describing the outer limits of its continental shelf.” One scholar on the LOSC has indicated that the inclusion of the word “permanent” was intentional.²⁵⁾ Second, according to LOSC Article 7(2),

Where because of the presence of a delta and other natural conditions the coastline is highly unstable, the appropriate points may be selected along the furthest seaward extent of the low-water line and, notwithstanding subsequent regression of the low-water line, the straight baselines shall remain effective until changed by the coastal State in accordance with this Convention.

This provision allows a coastal state to draw straight baselines in areas where the coastline is highly unstable because of a river delta. Furthermore, once the coastal state designates such straight baselines, they will be permanent regardless of any physical change along the coastline. Therefore, if the coastal State does not take action under LOSC Article 7(2), a fixed baseline will not change even if the low-water line moves landward or seaward. However, no State has changed its baseline pursuant to this provision.²⁶⁾ Apart from these two provisions, the LOSC does not say anything to the effect that the LOSC is permanently fixing baselines.

Because there is no explicit provision in the LOSC concerning baseline shift in response to the sea level rise, nor in any other international convention, this issue has been widely discussed by the legal scholars.²⁷⁾ Most scholars accept that a shift in the baseline landward would move the outer limits of each maritime zone landward.²⁸⁾ One scholar noted “as the normal low-water line moves landward and seaward with accretion and erosion, so does the baseline. As the baseline ambulates, so does each maritime space measured from it.”²⁹⁾ For example, area within the

23) Di Leva and Morita, note 3 above, p. 17.

24) Ibid., p. 17.

25) David D. Caron, “When Law Makes Climate Change Worse: Rethinking the Law of Baselines in Light of a Rising Sea Level,” *Ecology Law Quarterly*, Vol. 17, Issue 4 (1990), p. 635.

26) Di Leva and Morita, note 3 above, p. 18.

27) In 2012, a committee—the Committee on International Law and Sea Level Rise—was established by the International Law Association. The Committee has prepared a report on the law of the sea issues, and migration and human rights issues arising from rising sea levels. Davor Vidas, David Freestone and Jane McAdam, “International Law and Sea Level Rise: The New ILA Committee,” *ILSA Journal of International & Comparative Law*, Vol. 21: 2, Article 9 (2015).

28) Michael W. Reed, *The Development of International Maritime Boundary Principles through United States Practice, Vol. 3, Shore and Sea Boundaries* (Washington, DC: U.S. Department of Commerce, 2000); Caron, note 24 above, p. 634.

29) Reed, note 26 above, p. 185.

territorial sea might become part of the EEZ because of a baseline shift; the new area would be subject to the freedom of navigation rather than the innocent passage.³⁰⁾

Even so, the same authors prefer to preserve baselines on the charts even if the baselines themselves move.³¹⁾ Jose Luis Jesús reasoned this position as follows:

In a world where almost every coastal State shares at least one common maritime border with another State, stability and continuity of maritime boundaries seems to be only possible if baselines are basically permanent and are not regularly redrawn to reflect geographical changes that may occur, especially the drastic changes that may be caused by the appearance of a new-born island or the sea-level rise.³²⁾

While Caron and Jose Luis Jesús proposed to maintain the original baselines,³³⁾ Soons proposed to maintain the original outer limits of maritime spaces in case of a sea-level rise.³⁴⁾ According to these writers, updating charts and moving maritime boundaries would prevent stability in boundaries.³⁵⁾ It would also be an expensive task.³⁶⁾ The difference between the fixing of baselines and the fixing of outer limits of maritime spaces is explained as follows:

The fixing of baselines would mean that the future submerged area becomes internal waters, whereas fixing only the outer limits of maritime zones would result in expanding the breadth of the territorial sea landwards to the extent that baselines shift in the future. According to this latter approach, the newly submerged area would be subject to the regime of innocent passage. Between the two approaches, the former appears to be more justifiable since the newly submerged area was formerly part of the land territory of the coastal State under its full sovereignty, and thus should be turned into internal waters rather than the territorial sea. In addition, the former has the merit of having no

30) Di Leva and Morita, note 3 above, p. 20.

31) Caron, note 25 above; Sarra Sefrioui, "Adapting to Sea Level Rise: A Law of the Sea Perspective" in *The Future of the Law of the Sea: Bridging Gaps Between National, Individual and Common Interests*, ed. Gemma Andreone (Springer: 2017), p. 18; Moritaka Hayashi, "Islands' Sea Areas: Effects of a Rising Sea Level," *Review of International Studies*, June 10, 2013, /islandstudies//research/a00003/, p. 11.

32) Jose Luis Jesús, "Rocks, New-born Islands, Sea Level Rise and Maritime Space," in *Verhandeln für den Frieden* [Negotiating for Peace], ed. Jochen Frowein et al. (Berlin: Springer, 2003), p. 599.

33) Caron, note 25 above, p. 647; Jesús, note 32 above, p. 602. Jesús said "once the baselines have been established and given publicity... such baselines should be seen as permanent baselines, irrespective of changes." Ibid.

34) A. H. Soons, "The Effect of a Rising Sea Level on Maritime Limits and Boundaries," *Netherlands International Law Review*, Vol. 37:2 (1990), p. 231.

35) "In particular, it is argued that the rule that maritime boundaries should be tied to ambulatory baselines, will, as the result of a rising sea level, encourage wasteful spending by states and lead to uncertainty in boundaries and hence conflict." David Caron, "Climate Change, Sea Level Rise and the Coming Uncertainty in Oceanic Boundaries: A Proposal to Avoid Conflict Maritime Boundary Disputes, Settlement Processes, and the Law of the Sea," from *Selected Works of David D. Caron* (2008), p. 17 at http://works.bepress.com/david_caron/39/.

36) Caron, note 24 above, p. 650.

need of changing the rules on the breadth of the territorial sea and the EEZ as contained in Articles 3 and 57 of the LOSC, respectively. Furthermore, the fixing of baselines, especially straight and other non-normal baselines is of particular importance for navigators of non-coastal States as they define the outer limits of internal waters of the coastal State.³⁷⁾

Thus, defining the actual baseline and responding to sea level rise is critical. When to “freeze” a baseline in place is an important issue as well. Hayashi and Jesús suggested the moment when the coastal State shows its normal baselines on charts officially recognized by the coastal State under LOSC Article 5, or when it shows its straight baselines and outer limits of its maritime zones on charts or indicates geographical coordinates of baseline points and gives due publicity to them under LOSC Article 16.³⁸⁾ Some States, such as the United Kingdom and the Netherlands, have treated nautical charts as the only legal document that defines baselines. Sefrioui said, “in fact, by recognizing that coastline change over the time, the nautical chart or the straight baseline geographical coordinates as deposited with the Secretary-General must remain the reference legal document regardless of coastline changes.”³⁹⁾

Scholars vary on what should happen. Soons suggested that States create a customary international law rule, which would allow them to retain outer limits of their maritime zones in case of sea-level rise.⁴⁰⁾ Rayfuse suggested that coastal States threatened by rising sea-levels must adapt their domestic legislation and baselines practice such that it would be consistent with their international ambitions.⁴¹⁾ Another option for the adoption of such a rule could be accomplished by an amendment to the LOSC, which could be enacted through the formal process in the LOSC, or through a decision of the Meeting of the States parties, or through the adoption of a supplementary agreement for LOSC modification.⁴²⁾

37) Moritaka Hayashi, “Sea Level Rise and the Law of the Sea: How can the Affected States be Better Protected?” in *Limits of Maritime Jurisdiction*, ed. Clive H. Schofield, Moon-Sang Kwon, and Seokwoo Lee (Leiden: Brill, 2013), p. 617; Jesús, note 32 above, p. 599.

38) Hayashi, *ibid.*, p. 619. He proposed a rule as follows:

A coastal State may declare the baselines established in accordance with the relevant provisions of the UN Convention on the Law of the Sea as permanent once it has shown them on charts of an adequate scale or described them by a list of geographical coordinates, and given due publicity thereto, notwithstanding subsequent changes in geographical features of coasts or islands due to sea level rise. *Ibid.*

39) Sefrioui, note 31 above, p. 17.

40) Soons, note 34 above, p. 231.

41) Rosemary Rayfuse, “Sea Level Rise and Maritime Zones: Preserving the Maritime Entitlements of ‘Disappearing’ States,” in *Threatened Island Nations: Legal Implications of Rising Seas and a Changing Climate Change*, ed. Michael B. Gerrard and Gregory E. Wannier (Cambridge: Cambridge University Press, 2013), p. 191.

42) *Ibid.*, pp. 189, 190; Hayashi, note 37 above, pp. 620-623.

4. Decisions by International Tribunals

Thus far, international tribunals have had little to say regarding baseline shift. In *Nicaragua v. Honduras*, the International Court of Justice (ICJ) considered a dispute between the Republic of Nicaragua and the Republic of Honduras regarding maritime delimitation in the Caribbean Sea.⁴³⁾ As a rule, the ICJ determines baselines from which maritime zones are measured before beginning delimitation. The ICJ held that Honduras did not have a viable base point (“Point 17” in Honduran Executive Decree No. PCM 007-2000 of 21 March 2000) since “the point is no longer in the mouth of the River Coco and cannot be properly used as a base point” without discussing the effect of this situation on baselines shift.⁴⁴⁾ The Court simply looked at whether the baselines complied with physical reality.

In a second case, *the Bay of Bengal Maritime Boundary Arbitration*, an arbitral tribunal established under Annex VII of the LOSC determined the maritime boundary between Bangladesh and India in the Bay of Bengal. The tribunal’s first task was to determine the baselines in an area where the coast is highly unstable. However, the arbitral tribunal did not take into account future instability of the coastline.⁴⁵⁾ Aside from these decisions, there is no case decided by an international tribunal discussing the effect of a baseline shift on maritime entitlements, in other words, no case in which “one state sought to limit territorial or maritime claims of another because the latter state allegedly lost territory due to rising sea levels.”⁴⁶⁾ Should a case concerning this issue arise, it may be adjudicated before the ICJ or, in the event that concerned States are parties to the LOSC, they can benefit from mandatory jurisdiction system of the LOSC.

5. Decisions by the U.S. Supreme Court

Although international tribunals have not made decisions, the U.S. Supreme Court has dealt with this issue in two decisions. While such decisions do not create precedent for international tribunals, they can offer insights on how the issue might be addressed.

In a 1997 decision, the Supreme Court treated baselines as ambulatory, and said they can be “heretofore or hereafter modified by natural or artificial means,” as opposed to something permanently fixed.⁴⁷⁾ In *United States v. Alaska*, the U.S. Supreme Court dealt with a dispute between the United States and Alaska over the

43) *Territorial and Maritime Dispute between Nicaragua and Honduras in the Caribbean Sea (Nicaragua v. Honduras)*, Judgment, I.C.J. Reports 2007.

44) *Ibid.*, p. 743, para. 278.

45) Naomi Burke, *Annex VII Arbitral Tribunal Delimits Maritime Boundary Between Bangladesh and India in the Bay of Bengal*, 18 ASIL Insights Home (2014), <https://www.asil.org/insights/volume/18/issue/20/annex-vii-arbitral-tribunal-delimits-maritime-boundary-between>.

46) Di Leva and Morita, note 3 above, p. 21.

47) *United States v. California*, 382 U.S. 448, 449 (1966).

ownership of submerged lands along Alaska's Arctic Coast.⁴⁸⁾ Because such entitlements are measured from coastlines, the Supreme Court first had to determine the baselines.⁴⁹⁾ The Court said, "the shifts in a low-water line along the shore ... could lead to a shift in the baselines for measuring a maritime zone."⁵⁰⁾ The Court maintained that because of baseline shifts, "the State's entitlement to submerged lands beneath the territorial sea would change."⁵¹⁾

In 2007, the U.S. Supreme Court dealt with a case by the State of Massachusetts against the Environmental Protection Agency.⁵²⁾ The Court agreed with the Massachusetts that because rising seas have begun to swallow its coastal land, the State was injured as an owner of a substantial portion of the state's coastal property.⁵³⁾ This case then set precedent on the regulation of greenhouse gas emissions to combat global warming and potential impacts from sea level rise, among other impacts.

6. Implications for Maritime Boundary Agreements

The baselines shift might also affect maritime delimitation agreements in those maritime areas where coastal States are less than 400 nautical miles or less than 24 nautical miles from each other. For the delimitation of EEZ and continental shelf, the LOSC has identical provisions. According to the Convention, "the delimitation of the continental shelf [and the EEZ] between States with opposite or adjacent coast shall be effected by agreement on the basis of international law, as referred to in Article 38 of the Statute of the International Court of Justice, in order to achieve an equitable result."⁵⁴⁾ The LOSC does not regulate a standard delimitation method but requires reaching an equitable result. The concerned States may apply a median line or another line based on special circumstances such as the configuration of coastlines or the presence of islands.⁵⁵⁾

Regarding delimitation of territorial sea between States whose coasts are opposite, if those States fail to agree on a delimitation line for the territorial sea, "neither of the two States may extend its territorial sea beyond the median line, every point of which is equidistant from nearest points on the baselines" unless special circumstances or historic title requires a different delimitation boundary.⁵⁶⁾

One scholar noted that if the delimitation agreement explicitly refers to the median line, the boundary may change as a result of sea level rise: "asymmetrical changes of the baselines of both States will lead to changes in the location of the

48) *United States v. Alaska*, 521 U.S. 1 (1997).

49) *Ibid.*, p. 22.

50) *Ibid.*, p. 31.

51) *Ibid.*

52) *Massachusetts v. Environmental Protection Agency*, 549 U.S. 497 (2007), cited in Di Leva and Morita, note 3 above, p. 22.

53) *Ibid.*

54) Article 74 and 83, UNCLOS.

55) Soons, note 34 above, p. 226.

56) Article 15, LOSC.

median line.”⁵⁷⁾ In other cases, where the boundary line has been fixed, the baseline shift because of sea level rise will not affect the maritime boundary.⁵⁸⁾ However, parties to a maritime boundary agreement can explicitly decide that the boundary may shift in case of a baseline shift. On the other hand, if the treaty says the boundary is definite regardless of any shift of the baseline,⁵⁹⁾ one party cannot unilaterally terminate the agreement.⁶⁰⁾ Indeed, Dutch baseline shifts because of coastline projects in 2009 and 2012 did not affect the Netherlands’s outer limits of continental shelf and EEZ because these demarcations had been determined by treaties.⁶¹⁾

Key questions become what happens if an agreement does not indicate the boundary line as definite, and whether the negatively affected State can terminate the agreement. Under the Vienna Convention on the Law of Treaties, a party can terminate an agreement on the ground of a fundamental change of circumstances, which was not foreseen by the parties at the time of conclusion of the treaty.⁶²⁾ Such circumstances must constitute an essential basis of the consent of the parties; the effect of change must transform the extent of obligations still to be performed under the treaty.⁶³⁾ Although not every sea level rise constitutes a fundamental change of circumstances, a very substantial change in the location of the baseline might constitute such a change.⁶⁴⁾ However, the Vienna Convention explicitly excludes boundary agreements from the application of changed circumstances.⁶⁵⁾ Therefore, a State is not entitled to invoke changed circumstances stemming from the sea-level rise in order to unilaterally terminate a maritime delimitation agreement.⁶⁶⁾ However, Soons believed that a rule of customary international law, which would allow a State to terminate a boundary agreement because of sea-level rise as a “changed circumstances,” might develop in the future.⁶⁷⁾

57) Soons, note 34 above, p. 227.

58) Ibid.

59) Ibid.

60) Ibid.

61) Treaty between the Kingdom of the Netherlands and the Federal Republic of Germany concerning the lateral delimitation of the continental shelf in the vicinity of the coast of 1 December 1964; Agreement between the Government of the Kingdom of the Netherlands and the Government of the United Kingdom of Great Britain and Northern Ireland relating to the delimitation of the continental shelf under the North Sea between the two countries of 6 October 1965; Treaty between the Kingdom of the Netherlands and the Federal Republic of Germany concerning the delimitation of the continental shelf under the North Sea of 28 January 1971; Treaty between the Kingdom of the Netherlands and the Kingdom of Belgium on the Delimitation of the Continental Shelf of 18 December 1996 cited in Leendert Dorst, Alex Oude Elferink and Thijs Ligteringen, “Recent Changes in the Dutch Baseline: The Inseparable Connection Human Activities and Natural Processes” (2012), p. 5.

62) Article 62(1), Vienna Convention on the Law of Treaties.

63) Ibid.

64) Soons, note 34 above, p. 228, cf. Sefrioui, note 31 above, p. 19. “Both parties know, at the time of conclusion of their maritime boundary agreement, that change of geography is inherent to this kind of agreements and can initially be expected; thus, stable geography is not the “circumstance” that forms the ground of their consent. Therefore, article 62 of the Vienna Convention cannot be invoked, and coastline changes will not affect the maritime boundary agreement.” Ibid.

65) Article 62(2), *ibid.*

66) Soons, note 34 above, p. 227.

7. Implications for Insular Features

Rising sea levels are of potential consequences for insular features—lands, rocks, or low-tide elevations—and their maritime zones. According to Article 121(1) of UNCLOS, "an island is a naturally formed area of land, surrounded by water, which is above water at high tide."⁶⁸⁾ An island has the capacity to produce its own maritime zones, like the land territory of a State, namely territorial sea, contiguous zone, exclusive economic zone, and continental shelf.⁶⁹⁾ A low-tide elevation is an insular feature that is under water at a high tide but above water at low tide. A low-tide elevation is not entitled to any maritime space. Nevertheless, a low-tide elevation can be used as a baseline for measuring the breadth of the territorial sea if it is situated within the territorial sea of the mainland or an island.⁷⁰⁾

The LOSC provides that "rocks which cannot sustain human habitation or economic life of their own" are not entitled to any economic zone or continental shelf.⁷¹⁾ They do, however, have the capacity to generate a territorial sea and a contiguous zone. It can be understood that an island is capable of sustaining human habitation or economic life of its own.⁷²⁾

Rising sea levels might cause the inundation of insular features that produce maritime zones, or might cause inundation of low-tide elevations, which are taken into consideration for determining baselines. As a result of the disappearance of such features, a State could be deprived of these maritime zones.⁷³⁾ However, a disappeared island could still retain its continental shelf if established in accordance with LOSC Article 76(9), which permanently fixes the outer limit of the continental shelf, and if such State retains its statehood under arrangements with another State.⁷⁴⁾ Hayashi supported the idea that the State must retain the seabed of the submerged insular feature itself:

A State consists physically not only of the land but of its airspace and its subsoil, and the very fact that the seabed area in question was precisely part of its own land and subsoil until inundation, it may be argued that the area constitutes a special kind of seabed area, assimilated to the continental shelf, belonging to that State.⁷⁵⁾

He further argued that the seabed of the territorial sea of a disappeared island

Ibid., p. 228.

68) Article 121(1), LOSC.

69) Article 121(2), LOSC.

70) Article 13, LOSC.

71) Article 121(3), LOSC.

72) Craig H. Allen, *International Law for Seagoing Officers*, 6th ed. (New York: Naval Institute Press, 2014), p. 70.

73) "Thus, if the baseline moves, the boundary moves. If a baseline point such as an exposed rock disappears, the boundary generated by that point also disappears." Caron, note 35 above, p. 9.

74) Soons, note 34 above, pp. 218-219; Hayashi, note 37 above, p. 615.

75) Hayashi, note 37 above, p. 614.

must be maintained like the continental shelf of such a feature.⁷⁶⁾ Similarly, Soons asserted that if an island subject to a delimitation agreement disappeared, the state party to which the island produces a detrimental maritime delimitation could continue to respect the original agreement.⁷⁷⁾ Article 61 of the Vienna Convention on the Law of Treaties says that a State party to a treaty may invoke the “impossibility of performing a treaty as a ground for terminating or withdrawing from it if the impossibility results from the permanent disappearance or destruction of an object indispensable for the execution of the treaty.” Soons argued that because execution of the treaty was still possible without the existence of a disappeared island, that State could not invoke the impossibility doctrine.⁷⁸⁾

The foregoing statements do not seem to be consistent with the principle of “the land dominates the sea,” a statement by the ICJ in the 1969 North Sea Continental Shelf Case.⁷⁹⁾ Accordingly, it is the maritime projection of a land area that generates maritime zones and all maritime entitlements originate from the land.⁸⁰⁾ In the *Qatar v. Bahrain* case, the ICJ said, “it is thus the terrestrial situation that must be taken as starting point for the determination of the maritime rights of a coastal state.”⁸¹⁾ If a land area, as in the case of an island, disappears, the maritime areas produced by such features must also be given up. Also, there would be no baseline from which the breadths of maritime spaces are measured.⁸²⁾

Similarly, a rising sea level might convert an island to a rock if “the island loses land mass to the point where it can no longer support human life.”⁸³⁾ These islands would lose their EEZ. Hayashi said that however, such islands would still retain their continental shelf if it is fixed in accordance with LOSC Article 76(9).⁸⁴⁾ For example, the United Kingdom forfeited about 600,000 square nautical miles of maritime space after reclassifying the island of Rockall as a rock.⁸⁵⁾ If a rock

76) Ibid.

77) Soons, note 34 above, p. 228.

78) Ibid.

79) *North Sea Continental Shelf*, Judgment, I.C.J. Reports 1969, p. 52, para. 96.

80) Julia Lisztwan, “Stability of Maritime Boundary Agreements,” *Yale Journal of International Law*, Vol. 37: 1 (2012), p. 165.

81) *Maritime Delimitation and Territorial Questions between Qatar and Bahrain, Merits*, Judgment, I.C.J. Reports 2001, p. 97, para. 185.

82) See Jared D. Hestetune, “The Invading Waters: Climate Change Dispossession, State Extinction, and International Law,” *California Western School of Law* (2010), pp. 27, 28, available at https://works.bepress.com/jared_hestetune/1/. However, island States must be exempted from this rule. As sea levels rise, a once inhabitable land mass may become submerged, and the resident population will need to relocate. Nevertheless, the maritime spaces of such disappeared island States must be retained. This would allow the population to retain the value of their maritime zones, which would facilitate their resettlement. See Caron, note 25 above, p. 650.

83) Michael Gagain, “Climate Change, Sea Level Rise, and Artificial Islands: Saving the Maldives’ Statehood and Maritime Claims through the ‘Constitution of the Oceans,’” *Colorado Journal of International Environmental Law and Policy*, Vol. 23:1 (2012), p. 98. For a discussion explaining the difference between an island and rock, See Ekrem Korkut & Woo Hyun Kang, *China’s Nine Dash Line Claim in Light of the Ruling by the Permanent Court of Arbitration*, 5 Penn. St. J.L. & Int’l Aff. 425 (2017).

84) Hayashi, note 31 above, p. 9.

85) Clive Schofield and David Freestone, “Options to Protect Coastlines and Secure Maritime Jurisdictional Claims in the Face of Global Sea Level Rise,” in *Threatened Island Nations: Legal Implications of Rising Seas*

becomes habitable, or vice versa, one scholar noted that such changes would not affect the status of such a feature, and that it was in “the interest of peace in the oceans and world peace in general that the maritime spaces, as well as the maritime borders, once fixed in accordance with the 1982 Convention, not be disturbed.⁸⁶⁾ The rock provision in Article 121 was adopted to prevent tiny insular features from generating full-fledged EEZ and continental shelf; without that provision, the high seas areas could shrink enormously.⁸⁷⁾ During the negotiations of the LOSC, the Danish delegate explained the purpose of the rock provision as follows:

Without such a provision tiny and barren islands looked upon in the past as obstacles to navigation, would miraculously become the golden keys to vast maritime zones. This would indeed be an unwarranted and unacceptable consequence of the new law of the sea.⁸⁸⁾

Although a State can fix the outer limit of its continental shelf permanently, according to the LOSC, these provisions should not be taken into account in the case of insular features that changes their status from islands to rocks or to low-tide elevations. In case of the downgrading of an island to rock, a State must also relinquish its continental shelf claim from such rock. Such a solution would be consistent with the purpose of Article 121(3) of the LOSC.

Hayashi asserted that by fixing baselines, a State could maintain its maritime areas produced from islands and rocks in case of the disappearance of such features or sea level rise.⁸⁹⁾ Such an approach, however, would unnecessarily limit the high seas. Accordingly, the baseline fixing method in case of disappearance of insular features should not be employed for the reasons mentioned above.

The LOSC Article 121(1) says that “an island is a naturally formed area of land, surrounded by water, which is above water at high tide.” Because of the word *naturally* in Article 121(1), it is accepted that “artificially wrought changes in its elevation will not entitle a rock of naturally lower elevation to serve as a base point to generate various maritime zones (unless it qualifies, in its natural state, as a low-tide elevation, in which case it may have a limited effect on the baseline).”⁹⁰⁾ Similarly, LOSC Articles 60(8) and 80 do not count artificial islands, installations and structures as islands. Some States are fortifying their insular features to prevent them from being submerged. For example, Japan has spent more than \$700 million to protect the island of Okinotorishima.⁹¹⁾ One argument asserts that land preservation efforts do not change

and a *Changing Climate Change*, ed. Michael B. Gerrard and Gregory E. Wannier (Cambridge: Cambridge University Press, 2013), p. 147.

86) J.L. Jesús, note 32 above, p. 594.

87) *Ibid.*, p. 583.

88) *Third United Nations Conference on the Law of the Sea, Volume XVI (Summary Records, Plenary, First and Second Committees, as well as Documents of the Conference, Eleventh Session)*, Document A/CONF. 62/SR.171, p. 106.

89) Hayashi, note 37 above, p. 618.

90) Jonathan I. Charney, “Rocks that cannot Sustain Human Habitation,” *The American Journal of International Law*, Vol. 93: 4 (Oct., 1999), p. 867.

91) Latif Nasser, “When island nations drown, who owns their seas?” *Boston Globe*, October 19, 2014,

the status of an island, as long the island was natural initially.⁹²⁾ Some scholars argue that sea level rise may extinguish the statehood of island States such as the Maldives, Kiribati and Tuvalu since a defined territory is a requirement for the statehood.⁹³⁾

8. Conclusion

Without a doubt, rising sea levels will have an increasingly greater effect on coastlines and baselines of maritime states, creating the potential for economic and political uncertainty. International law and the LOSC do not offer a solution to the effects of sea-level rise, except in Article 7(2), which fixes straight baselines in highly unstable coastlines in a delta or similar area, and Article 76(9), which permanently fixes the outer limits of the continental shelf. Most scholars have proposed a freeze of the existing baselines or outer limits of maritime spaces and have urged the international community to adopt a rule on this issue. We would argue an exception to the above solution in the case of rocks and islands. Although most scholars argue that a rock or island must retain its continental shelf in case of submersion, such interpretation does not seem to be consistent with the purpose of Article 121(3) of the LOSC, which was adopted to deny tiny rocks from having an EEZ and continental shelf.⁹⁴⁾ Such entitlements from disappeared islands do not comply with the principle of “the land dominates the sea,” and therefore be exempted from the freeze.

In conclusion, then, the best solution for protecting the stability of maritime boundaries would be a freeze on existing baselines or outer limits of maritime spaces, with the above exception. These maritime boundaries are crucial in maintaining peace, security, cooperation and friendly relations among nations, as stated in the preamble of the LOSC, and it is imperative that the international maritime community takes action on this issue.

<https://www.bostonglobe.com/ideas/2014/10/18/when-island-nations-drown-who-owns-their-seas/hyH9W5b1mCAyTVgwFh7qO/story.html>.

92) Soons, note 34 above, p. 222; J. L. Jesús, note 32 above, p. 592.

93) Gagain, note 83 above, p. 91; Jenny Grote Stoutenburg, “When do States Disappear? Thresholds of Effective Statehood and the Continued Recognition of ‘Deterritorialized’ Island States,” in *Threatened Island Nations: Legal Implications of Rising Seas and a Changing Climate Change*, ed. Michael B. Gerrard and Gregory E. Wannier (Cambridge: Cambridge University Press, 2013), p. 57.

94) For our reasoning, see the Section “VII. Implications for Insular Features.”

References

- Allen, Craig H. *International Law for Seagoing Officers*. 6th ed. New York: Naval Institute Press, 2014.
- Burke, Naomi. "Annex VII Arbitral Tribunal Delimits Maritime Boundary Between Bangladesh and India in the Bay of Bengal." *ASIL Insights Home* 18: 20 (2014).
- Caron, David D. "When Law Makes Climate Change Worse: Rethinking the Law of Baselines in Light of a Rising Sea Level." *Ecology Law Quarterly* 17, Issue 4 (1990): 621-654.
- Charney, Jonathan I. "Rocks that cannot Sustain Human Habitation." *The American Journal of International Law* 93: 4 (1999): 863-878.
- Dorst, Leendert L., Alex Oude Elferink and Thijs Ligteringen. "Recent Changes in the Dutch Baseline: The Inseparable Connection Human Activities and Natural Processes" (2012).
- Gagain, Michael. "Climate Change, Sea Level Rise, and Artificial Islands: Saving the Maldives' Statehood and Maritime Claims through the 'Constitution of the Oceans.'" *Colorado Journal of International Environmental Law and Policy* 23:1 (2012): 79-120.
- Gerrard, Michael B. and Gregory E. Wannier, eds. *Threatened Island Nations: Legal Implications of Rising Seas and a Changing Climate*. Cambridge: Cambridge University Press: 2013.
- Hayashi, Moritika. "Sea Level Rise and the Law of the Sea: How can the Affected States be Better Protected?" In *Limits of Maritime Jurisdiction*, edited by Clive H. Schofield, Moon-Sang Kwon, and Seokwoo Lee. Leiden: Brill, 2013.
- Hestetune, Jared D. "The Invading Waters: Climate Change Dispossession, State Extinction, and International Law." *California Western School of Law* (2010). available at https://works.bepress.com/jared_hestetune/1/.
- IPCC, 2013: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp, doi: 10.1017/CBO9781107415324.
- Jesús, Jose Luis. "Rocks, New-born Islands, Sea Level Rise and Maritime Space." In *Verhandeln für den Frieden* [Negotiating for Peace], edited by Jochen Frowein et al. Berlin: Springer, 2003.
- Khadem, Alain. "Protecting Maritime Zones from the Effects of Sea Level Rise." *IBRU Boundary and Security Bulletin* (Autumn, 1998): 76-78.
- Leva, Charles Di and Sachiko Morita. "Maritime Rights of Coastal States and Climate Change: Should States Adapt to Submerged Boundaries?" *Law and Development Working Series* 5 (2008).
- Lisztwan, Julia. "Stability of Maritime Boundary Agreements." *Yale Journal of International*

- Law*, 37: 1 (2012): 153-200.
- Obregon, Edgardo Sobenes. "Historic Waters Regime: A Potential Legal Solution to Sea Level Rise." *International Journal of Maritime Affairs and Fisheries* 7:1 (2015): 17-32.
- Powers, Ann. "Sea-Level Rise and its Impact on Vulnerable States: Four Examples." *Louisiana Law Review* 73 (2012): 151-174.
- Reed, Michael W. *The Development of International Maritime Boundary Principles through United States Practice*. Vol. 3 of Shore and Sea Boundaries. Washington, DC: U.S. Department of Commerce, 2000.
- Schofield, Clive. "Holding Back the Waves? Sea Level Rise and Maritime Claims." In *Climate Change: International Law and Global Governance: Legal Responses and Global Responsibility*, edited by O. C. Ruppel, C. Roschmann and K. Ruppel-Schlichting. Vol. 1, 2013.
- Sefrioui, Sarra. "Adapting to Sea Level Rise: A Law of the Sea Perspective." *In the Future of the Law of the Sea: Bridging Gaps Between National, Individual and Common Interests*, edited by Gemma Andreone. Springer: 2017.
- Sohn, Louis B., Kristen Juras, John Noyes and Erick Franck. *Cases and Materials on the Law of the Sea*. 2nd ed. Leiden: Brill, 2014.
- Soons, A.H. "The Effect of a Rising Sea Level on Maritime Limits and Boundaries." *Netherlands International Law Review* 37:2 (1990): 207-232.
- Symmons, Clive R. and Michael W. Reed. "Baseline Publicity and Charting Requirements: An Overlooked Issue in the UN Convention on the Law of the Sea." *Ocean Development and International Law* 41:1 (2010): 77-111.
- Vidas, Davor, David Freestone and Jane McAdam. "International Law and Sea Level Rise: The New ILA Committee." *ILSA Journal of International & Comparative Law* 21:2, Article 9 (2015).

Notes to Contributors

Manuscript. Submissions should be clear and concise. Manuscripts will be accepted with the understanding that their content is unpublished and not being submitted for publication elsewhere. All parts of the manuscript, including the title page, abstract, tables and legends should be typed in English. Allow margins of at least 3cm on all sides of typed pages. Pages must be numbered consecutively throughout the paper.

Title. Must be as brief as possible and consistent with clarity (6 to 12 words). Authors should also supply a shortened version of the title suitable for the running head, not to exceed 50 character spaces.

Author Affiliation. Include the full names of authors, academic and/or professional affiliations and the complete mailing address of the author to whom proofs and correspondence should be sent.

Abstract. Each paper should be summarized in an abstract of not more than 150 words. Avoid abbreviations, diagrams and reference to the text.

Key words. Authors must supply three to five keywords or phrases which identify the most important subjects covered by the paper.

Mathematical Notation. Use only essential mathematical notation as it is costly to typeset and may limit readership. Where mathematical notation is essential, keep it simple and in conformance with conventions of the profession.

References. Citations within the text must include author name(s) and the data in parentheses [i.e., Smith, Jones, and Cutler (1993)]. Use *et al.* in the text only when four or more authors are cited. Do not use *et al.* in the references. Alphabetize the reference section and include all text citations. For more information, consult the *Chicago Manual of Style*. Follow these examples:

Journal Koenig, E. F. (1984) Fisheries Regulation Under Uncertainty: A Dynamic Analysis. *Marine Resource Economics* 1(2):193-208.

Book Heaps, T., and J. F. Helliwell. (1985) *The Taxation of Natural Resources. Handbook of Public Economics*, Vol. I, A. J. Auerback and M. Feldstein (eds.), pp.21-72. Amsterdam : North-Holland.

Data and Documentation. Data sources, models and estimation procedures are expected to be documented to permit replication by other researchers. Data used in the analyses should be made available to other researchers for replication purposes. Submission of appendices, model documentation and other supporting materials is encouraged to facilitate the review process.