10-31-2022

A study on effective implementation of remote ship survey: focus on key elements of stakeholder's perspectives

Ji Heon Lee

WORLD MARITIME UNIVERSITY

Malmö, Sweden

A STUDY ON EFFECTIVE IMPLEMENTATION OF REMOTE SHIP SURVEY

Focus on Key Elements of Stakeholder's Perspectives

By

JI HEON, LEE

Republic of Korea

A dissertation submitted to the World Maritime University in partial fulfilment of the requirements for the award of the degree of

MASTER OF SCIENCE

in

MARITIME AFFAIRS

(MARITIME SAFETY AND ENVIRONMENTAL ADMINISTRATION)

2022

Declaration

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

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

(Signature): 

(Date): 18th September, 2022

Supervised by: Assistant Professor, CHONG-JU CHAE

World Maritime University

Supervisor's affiliation: Maritime Safety and Environmental Administration

Acknowledgements

First of all, I would like to express my deep gratitude to the Korean Register and Chairman, Lee Hyung-chul, for supporting me in many ways in studying at the World Maritime University.

I would particularly like to thank the distinguished supervisor, Professor Chae Chong-Ju. Professor Chae always encouraged and specially guided my dissertation work from the beginning of dissertation and gave me valuable advice and useful suggestions that led me to complete my dissertation. I would like to express my gratitude to the professors and faculties of the World Maritime University who directly or indirectly helped me with my study at WMU. In particular, I would like to express my special gratitude to Professor Raphael Baumler, Professor Dimitrios Dalaklis, Professor Anish Hebbar, and Ms. Rebecca Sheehan of MSEA for helping me broaden my horizons of knowledge with the most useful lectures. In addition, I would like to express my special gratitude to Professor Song Dong-wook and Professor Moon Daniel Seong-hyeok, who have always spared useful advice and encouragement on general ideas throughout my life in Sweden.

Finally, my most sincere thanks go to my parents, Lee Seong-taek, Jang Nam-yi, and my mother-in-law, Seo Young-ja. Especially, I believe that my father will always look at me proudly and support me in heaven no matter when, where, and what I do. I would also like to express my deep gratitude to my lovely children, Lee Jeong-won and Lee Jeong-hoon, who always motivate me a lot. Lastly, I would like to dedicate this dissertation to my wife, Woo In-seon, who is like all of me, and whom I love the most in the world. She always raises me up to more than I can be.

Abstract

Title of Dissertation: **A Study on effective implementation of remote ship survey; Focus on key elements of stakeholder's perspectives**

Degree: **Master of Science**

This dissertation aims to explore what factors should be considered as the primary factors in developing the guidelines for remote ship surveys. This paper identified vital elements necessary for remote ship survey guidelines by comparing the requirements of remote survey guidelines developed and implemented by IACS and classification societies with those discussed in IMO to date. In addition, factors considering the impact of the remote survey from the perspective of seafarers and ships were additionally identified through the literature review.

This dissertation assumes that the remote ship survey will be further expanded in the future. A questionnaire containing 12 items based on major remote survey factors was developed to identify those that require more urgent and enhanced guidance among the components of the remote survey. The survey was conducted on three groups of ship surveyors, ship managers, and seafarers, who can be classified as the most critical stakeholders of the remote survey, and a total of 278 responses were analysed. As a result, it was found that there was a significant difference in the gap between the priority, importance, and achievability of the key elements required to conduct the remote survey for each group. This gap may be understood as a difference in the interests of each group. However, since all three groups are key stakeholders of the remote survey, the key elements that appear differently in each group need to be addressed importantly and carefully in developing international guidelines for remote ship surveys.

In this dissertation, through quantitative measurement and analysis using Borich's Needs Assessment, IPA and The Locus for Focus Model for the key elements investigated from the perspective of stakeholders of remote ship survey, the main factors of the remote survey that should be considered more critical and prioritized were verified. This study is meaningful in that it conducted empirical measurements on the key elements of the remote survey, and it is expected to contribute to developing international guidelines and policy establishment related to remote ship surveys in the future.

KEYWORDS: Remote Ship Survey, Remote Survey, Remote Survey Supporter, Remote Surveyor, Eligibility for Remote Survey, Service Supplier, Cybersecurity, Fatigue of Seafarers, Safety of Seafarers, IPA, Borich's Needs Assessment, Locus for Focus Model

Contents

List of Tables

List of Figures

List of Abbreviation

BV	Bureau Veritas (French CS)
CCS	China Classification Society (Chinese CS)
CMS	Continuous Machinery Survey
CS	Classification Society
FAL	Facilitation Committee
HSSC	Harmonized System of Survey and Certification
IACS PR	IACS Procedural Requirement
IACS Rec.	IACS Recommendation
IACS UR	IACS Unified Requirement
IACS	International Association of Classification Societies
ICT	Information and Communication Technology
III Code	IMO Instruments Implementation Code
III Sub-committee	The Sub-Committee on Implementation of IMO Instruments
IMO	International Maritime Organization
IPA	Importance – Performance Analysis
ISM	International Safety Management
ISPS	International Ship and Port Facility Security
ITC	International Tonnage Certificate
IWS	In-Water Survey
KR	Korean Register (Korean CS)
L/B	Life Boat
L/R	Life Raft
MC	Marine Circular
MMC	Merchant Marine Circular
MMN	Merchant Marine Notice

MSA	Merchant Marine Advisory
MSC	Maritime Safety Committee
MSEA	Maritime Safety and Environmental Administration
NK	Nippon Kaiji Kyokai (Japanese CS)
PMS	Planned Maintenance Scheme
PSC	Port State Control
RIT	Remote Inspection Technique
RO Code	Code for Recognized Organizations
RO	Recognized Organization
ROV	Remote Operated Vehicles
RSO	Recognized Security Organization
WMU	World Maritime University

1. Introduction

1.1 Background

Ship surveys are periodically and continuously required to ensure safe operation and prevent marine pollution throughout the ship's entire life cycle from the construction stage to the scrap stage, which is implemented based on all international conventions of the IMO. The primary purpose of a ship survey is to ensure that the ship is in a suitable condition for intended use by maintaining satisfactory conditions in accordance with the requirements of international conventions of the IMO concerning the structure, arrangement, materials, and specifications of hulls, machinery, and facilities to ensure ship's seaworthiness, ship safety and prevention of marine pollution. Most flag States delegate the authority to survey and certification for IMO conventions to the Recognized Organization (RO) in accordance with the III Code (IMO Instruments Implementation Code) and RO Code (The Code for Recognized Organizations) to ensure compliance with international conventions on the safety and prevention of marine pollution of ships registered in their flag States.

In the course of the COVID-19 crisis that started in China in November 2019 and spread rapidly worldwide, the global shipping industry has severely disrupted the smooth operation of ships. Cross-border travel restrictions have severely restricted seafarers' rotation and resulted in the closure of some international shipping ports (Doumbia, 2020). The inability of surveyors to get onboard ships makes it impossible to carry out surveys and audits required in accordance with international conventions of IMO, which is a very representative reason for the restriction of international

shipping. For a vessel to perform the regular operation, periodical surveys by surveyors from the flag State or RO are required for renewal or endorsement of statutory certificates of the ship in accordance with the various international conventions. This has emerged as a severe problem for the international shipping industry because the smooth entry and departure of the ship is restricted if the ship does not have a valid statutory certificate (Nam & Kim, 2021). The IMO judged this COVID-19 situation as a force majeure and devised measures to extend the survey and validity of ship certificates for three months (IMO, 2021c).

However, as the COVID-19 situation was prolonged, it became difficult to resolve the restriction on ship operation of global shipping, even with a three-month extension to the ship's statutory certificates. Demand for the remote survey has emerged as an alternative in the shipping industry. Since the statutory survey, which must be implemented in accordance with international convention, must be conducted in compliance with the requirements stipulated in the relevant international convention, it is essential to obtain explicit consent from the ship's flag State to carry out the remote survey. This was because there were no agreed standard regulations or procedures in the IMO for partial or complete implementation of the remote survey conducted without the attendance of surveyors (IMO, 2021b). Each flag State has individually issued different guidelines for remote survey for registered ships on its flag State, as shown in Table 1-1 below, which shows that it could be divided into flag State that does not allow remote survey, flag State explicitly allows remote survey or flag State allow remote survey on a case by case. In any case, as a result of this, the use of remote surveys as an alternative to solve the situation where surveyors cannot access the vessel has rapidly increased (Nam & Kim, 2021). However, the guidelines for the remote survey of each flag State lacked specific technical guidelines, and the allowable range and procedures for remote survey for each flag state were also different, so it was insufficient to be used as a survey guideline (IMO, 2020b).

Table 1-1 Non-Exhaustive list of IMO Circular letters pertaining to Remote Surveys (Source: MSC 102/22/11) (IMO, 2020b)

IMO Circular Letter	Circulars/Instructions	Issued by
No.4204/Add.19	Guiding principles for the provision of technical and implementation advice to flag States when considering whether to permit statutory certificate extension beyond 3 months	IMO
No.4225	TECHNICAL ALERT 20-03	Bahamas
No.4228/Add.1	Coronavirus Contingency Plan and Guidelines	Netherlands
No.4230/Add.2	MMN-07/2020	Panama
No.4231/Add.2, Add.6, Add.10, Add.12	-	Italy
No.4251	Circular No.8/2020	Cyprus
No.4259	Contingency Guidelines for Ships and Seafarers against Coronavirus	Republic of Korea
No.4268	MC-4/2020/1	Tuvalu
No.4281	MSIB 09-20	United States
No.4283	-	Vanuatu
No.4299	Marine Circular 53/2020	Kiribati
No.4233	Marine Safety Advisory No.24-20	Marshall Islands
No.4306/Add.2	Merchant Marine Notice MMN-20-003r3	Belize

In response to this, the IMO decided to identify the need to develop standard guidelines for remote surveys at the 102nd meeting of MSC and start discussions at the 103rd meeting of MSC, but practical discussions began with the adoption of the new work programme on the development of remote survey guidelines at the 104th meeting of MSC (IMO, 2020a). At the MSC 104th meeting, "Development of Remote Survey Guidelines" was assigned as a new task at the III Sub-committee (The Sub-Committee on Implementation of IMO Instruments) with the aim of completing the

work by 2024 and IMO considered the need for remote survey triggered by COVID-19 outbreak as a "New Normal" to survey ships remotely instead of existing physically attended survey by ship surveyors due to the development of information and communication technology in the future (IMO, 2021a).

The lack of unified guidelines for the remote survey and the resulting lack of understanding of stakeholders, including ship surveyors, ship managers, and seafarers, can lead to poor ship survey quality, which can have a negative impact on securing ship safety and preventing marine pollution. Therefore, it is imperative to develop internationally unified remote survey guidelines that can be efficiently implemented so that remote surveys can guarantee at least the same level of survey quality as ship surveys through the physical attendance of surveyors.

1.2 Objectives & Scope

The shipping industry's interest and demand for the remote survey, triggered by the prolonged COVID-19 outbreak, is increasing due to the development of information and communication technology and the introduction of the latest inspection equipment. In the future, the remote survey may play a significant alternative role in the traditional survey method in which a surveyor directly attends the ship and surveys the ship, not a ship survey. Discussions have already begun at the IMO to prepare guidelines for an internationally unified remote survey, and various efforts are being made to establish a legal basis through the revision of international conventions.

Therefore, this study aims to identify and analyse factors that require sufficient consideration in the future remote survey guidelines to be developed in IMO. To this end, we draw implications by analysing the requirements and guidelines for remote classification surveys implemented by IACS and major classification societies and also review the discussions related to remote surveys submitted and discussed to IMO so far to develop remote survey guidelines. Representative vital considerations will be identified based on these. After that, a questionnaire survey on the importance

and practical feasibility of crucial factors related to the implementation of remote survey targeting stakeholders (Seafarers, Ship Managers, and Ship Surveyors) of the remote survey will be conducted and analysed closely. The analysis of stakeholder groups from different perspectives can be a beneficial basis for future remote survey systems and factors to be considered in developing future remote survey guidelines.

1.3 Structure of the Dissertation

This study consists of six chapters.

Chapter 1 contains the background, objective of the study and the structure of the dissertation.

Chapter 2 will conduct a literature review on the scope, methods, and procedures of a remote survey currently being implemented by the classification societies, along with the development trends and discussions of remote survey guidelines currently being discussed in the IMO. In addition, issues to be considered from the standpoint of the ship and seafarers undergoing remote survey will be reviewed as well.

Chapter 3 includes the establishment of hypotheses and the questionnaire design for the main factors to be considered related to the implementation of the remote survey identified by the review in Chapter 2. In addition, the research methodology using Borich's Needs Assessment model, IPA (Importance-Performance Analysis) and Locus for Focus model for this study will be shown.

Chapter 4 includes data analysis using Borich's Needs Assessment Model, IPA (Importance-Performance Analysis) and Locus for Focus Model based on the collected questionnaire data. Data analysis will be conducted separately for each stakeholder group (Seafarers, Ship Managers, Ship Surveyors), and comparative analysis will be performed on the analysed data.

Chapters 5 and 6 will include a Discussion of Findings based on the analysed data up to Chapter 4 and the Limitations of this study and conclusions.

2. Literature Review

The survey of ships is largely divided into classification surveys and statutory surveys. Chapter 2.1 reviews the remote survey carried out by classification societies as an RO. Individual guidelines for remote surveys established and implemented by each classification society will be reviewed first. Most classification societies already have their own guidelines for a remote survey, but in an extensive framework, the guidelines amongst each classification society are almost similar. Therefore, the basic requirements for implementing a remote survey described in major classification societies' remote classification survey guidelines are to be reviewed first.

Recently, the International Association of Classification Societies (IACS) issued IACS UR Z29 (Remote Classification Survey) to unify the main criteria for remote classification surveys and establish the minimum requirements. This includes the minimum quality requirements for information and communication technology, the scope and details of remote classification surveys, and the recording and reporting of evidence and documents. The main principle of this unified requirement is that the allowed remote survey requires the equivalent level of survey quality compared to the traditional ship survey with the surveyor's attendance (IACS, 2022a). Also, IACS Recommendation No.42 (Guidelines for Use of Remote Inspection Techniques for surveys), which can be used as a major reference for a remote survey, was introduced in 1996. This is the minimum standard of IACS regarding the use of remote inspection technology and contains essential information necessary for the implementation of

remote surveys (IACS, 2016a). The above two documents will also be reviewed in Chapter 2.1 as essential documents for remote classification surveys.

Chapter 2.2 will review the recent discussions in IMO. Remote surveys discussed in IMO are subject to a statutory survey under the IMO International Conventions. Discussions on a remote survey, which have become active since the 102nd meeting of MSC, were adopted as a New Work Program through MSC 104th and assigned to III-Subcommittee, and are developing remote survey guidelines with the goal of completion by 2024. The development of remote survey guidelines discussed by IMO targets statutory surveys in accordance with IMO conventions. In other words, Chapter 2.1's remote survey refers to its own classification survey for ships registered within the classification societies. However, Chapter 2.2's remote survey corresponding to "Discussion In IMO" is a remote statutory survey that verifies whether the ship complies with the requirements of various international conventions for a ship flying its flag. Of course, it is common to delegate most statutory surveys and certifications to the classification societies according to the RO Code. Accordingly, it produces another issue. First, the details related to the implementation of the remote survey are not specifically described in any International standard of IMO & international convention currently. This may lead to restrictions on delegating tasks to the RO related to the survey and certification of its ships flying its flag. Second, the minimum standards and responsibilities required for conducting a remote survey in delegating remote surveys are not yet clear. In practice and technically, it is not sufficient conditions in the shipping industry to completely replace all surveys of ships with remote surveys. Therefore, when a remote survey is required, the survey must be authorized to RO from the flag State by case-by-case, and clear authorization standards are required. For each necessary element of the remote survey, there is a need for the flag State to determine whether the ship and RO surveyor are ready to perform the remote survey (IMO, 2022a). This should include a variety of factors such as remote survey procedures, techniques, tools, qualifications, records and reporting to maintain minimum remote survey quality.

Chapter 2.3 will review and identify issues that need to be considered from the perspective of the ships and seafarers undergoing remote surveys. In particular, seafarers play a crucial role in implementing remote surveys as one of the critical subjects of remote surveys. Therefore, it will be essential to identify the necessary considerations from the point of view of ships and seafarers concerning the remote survey.

This chapter aims to identify vital practical considerations for remote surveys. For this objective, guidelines on implementing remote surveys by classification societies (IACS), the discussion progress and suggestions of the IMO, and the considerations for remote surveys that may be raised from the ship's and seafarer's point of view, will be compared and reviewed.

2.1 Remote Survey of Classification Societies

Since 2020, due to the COVID-19 pandemic, remote surveys have already been conducted on ships by the classification societies with the ship’s flag State approval on a case-by-case basis. Based on these experiences, each classification society has already established and utilized its own remote survey guidelines, and revisions are frequently made as complementary measures.

Among the primary elements of the remote survey guidelines issued by the current classification societies, the matters commonly mentioned and stipulated are essential elements of the remote survey that should be considered first. Therefore, the typical requirements of the main elements of the remote survey guidelines established by each classification society are to be reviewed first.

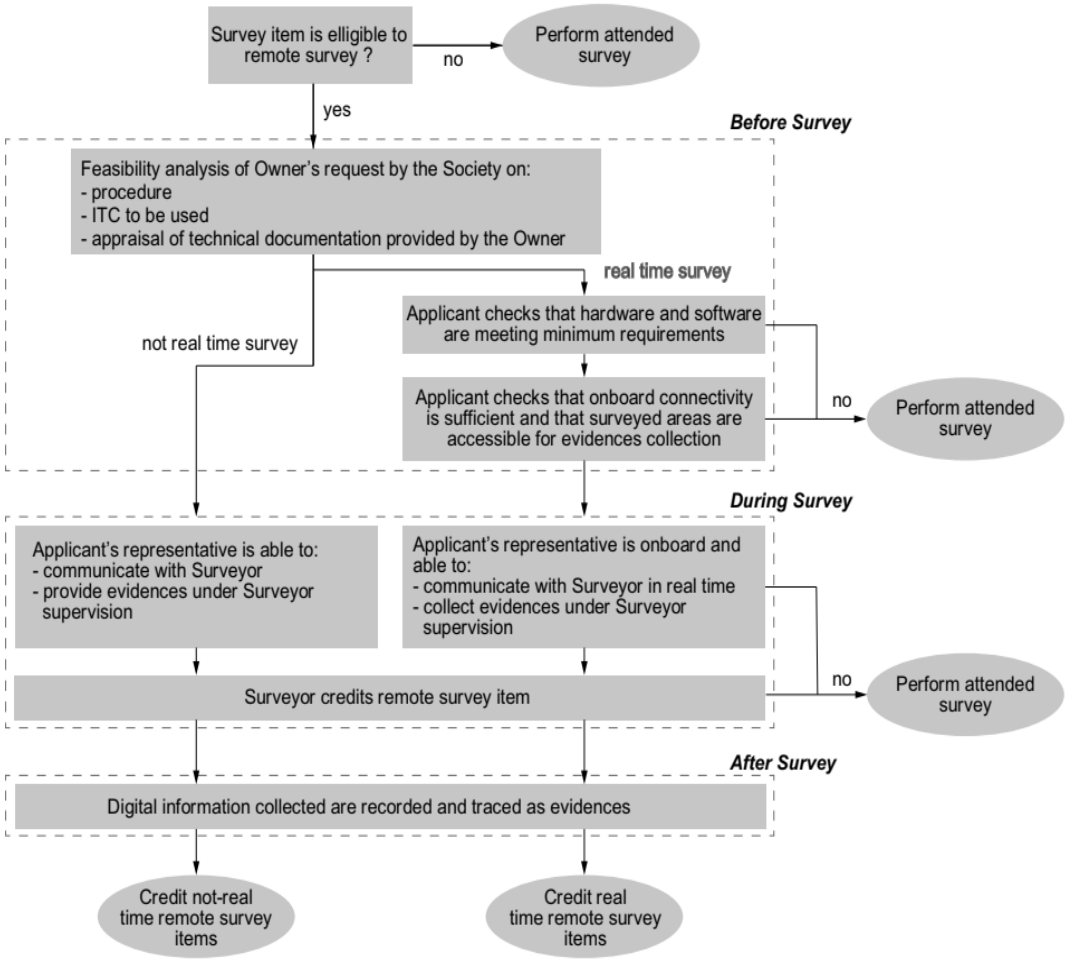
2.1.1 What is Remote Survey

Although the definition of remote survey is slightly different for each classification society, it is common to mean a survey conducted without a surveyor at the site. The IACS (International Association of Classification Societies) recently issued UR Z29 and defined remote surveys as follows;

"A Remote Survey is a process of verifying that a ship and its equipment are in compliance with the rules of the Classification Society where the verification is undertaken, or partially undertaken, without attendance on board by a surveyor." (IACS, 2022a, p.1).

The information that the surveyor should directly confirm on-site is interchanged with the surveyor remotely located office onshore through the process of collecting, storing, retrieving, analysing, and transmitting information using RIT (Remote Inspection Technique) and ICT (Information and Communication Technology). Through this process, the surveyor collects data related to the survey, determines the condition of the ship and its equipment, determines and judges the survey result, and records the relevant information (NK, 2021). However, even if the surveyor is not present, administrative tasks such as reissuance/correction of certificates, update of ship records and document review that do not involve the surveyor's judgment are not considered a remote survey (IACS, 2022a).

Figure 2-1 Flow chart of remote survey procedure
(Source: Guidelines for Remote Survey of BV) (BV, 2021)



2.1.2 Eligibility for Type and Scope of Remote Survey

Although the demand and interest for the remote survey have increased significantly due to the COVID-19 outbreak, it has been identified that there are still many difficulties in performing all surveys remotely (IACS, 2021a).

All classification societies which conduct remote surveys limit the type and scope of the survey that can perform remote survey as shown in Table 2-1 (IMO, 2021a). This is because there is still a lack of explicit guarantees for remote survey procedures, quality of RIT and ICT used for remote surveys, as well as lack of experience and know-how to expand and apply remote surveys for all surveys. Therefore, almost all classification societies currently perform remote surveys have reviewed in advance whether the procedures, RIT, and ICT required for a remote survey can be sufficiently and appropriately prepared before carrying out the remote survey, even if they are satisfied with the scope and type of survey which is allowed by themselves as shown in Table 2-1 (BV, 2021; CCS, 2022; KR, 2021; NK, 2021).

Table 2-1 Type and Scope of Remote Survey of each classification society (Source: MSC 104/15/3) (IMO, 2021a)

Classification Society (CS)	Type and Scope of Remote Surveys Allowed by each Classification Society
CS - A	• Annual Class Surveys: hull, machinery, automation, bridge design and navigational equipment/systems, navigational integrated bridge system, load line, continuous machinery surveys; • Statutory Surveys: inventory of hazardous material, safety radio and underwater examination surveys; and • Occasional Surveys: dry-dock extension, concurrent load line, boiler three-months extension, Condition of Class and Statutory Condition, tail/tube shaft, and minor damage surveys.
CS - B	• Occasional surveys that fall between periodical surveys; • Documentation-based surveys, testing and witnessing systems during normal operation; and • Surveys not ordered together with annual surveys (NB: Periodical surveys, such as the annual survey of a vessel, are not part of the remote survey programme).
CS - C	• Scheduled periodic inspections, booked in advance;

	• Unscheduled inspections, in the event of a breakdown; and • Materials, equipment, component and vendor package verifications.
CS - D	• Three months tail-shaft survey extension; • Continuous Machinery Survey (CMS); • Documentary verification; • Management of minor deficiencies; • Bottom inspection with ship afloat (IWS); • Radio Survey; • Survey for change of name; • Lay-up surveys; and • Survey for change of load line.
CS - E	• Continuous Machinery Survey (CMS); • Three months extension of shaft survey; • Three months extension of boiler survey; • Minor damage survey; • Outstanding Condition of Class, Confirmation of Repair done for deficiencies or corrective actions; and • Periodical Safety Radio Survey.
CS - F	• Postponement of Cargo Handling Gear survey; • Postponement of outstanding Condition of Class (limited to minor ones); • Outstanding Condition of Class related minor damage, including hull structure; • Malfunction of equipment or installations; and • Continuous Machinery Survey (CMS).
CS - G	• Documents and information; • Damage and repair (minor hull damage, equipment and machinery damage, equipment replacement); • Elimination of Condition of Class; • Extension Survey (for Condition of Class, propeller shafts and boilers); • Continuous Machinery Survey (CMS); • Change of Owner; and • Change of name of vessel.

In this way, each classification society allowed the type and scope of the remote survey according to its own individual criteria, which differed amongst classification societies. The criteria for the remote survey were likely to change further depending on the flag State approval for a remote survey. Accordingly, in order to apply the criteria for the type and scope of the remote survey more uniformly, IACS presented the unified criteria through IACS UR Z29 in 2022, which is the unified requirements for the remote classification surveys, including the criteria for the type and scope of remote survey as shown in Table 2-2. This limits the scope of the survey to a level that can be implemented on an equivalent level to the survey attended by the surveyor concerning the qualification of the remote surveyor, planning, performance, evaluation, and reporting of the remote survey. In addition, it is essential to confirm in advance whether the use of RIT and ICT is sufficiently suitable, like each classification society's existing remote survey guidelines. If survey items linked to the statutory survey are included, prior approval for a remote survey from the flag State should also be required (IACS, 2022a).

Table 2-2 Eligible surveys and items related to remote survey by IACS Unified Requirements (Source: IACS UR Z29) (IACS, 2022a)

No.	Surveys and related items eligible to remote survey	Live Streaming required (See Notes)
1	Postponement, issuance, deletion of Condition of Class	Yes (1)
2	Postponement of Class surveys	Yes (1)
3	Items of Continuous Survey for Machinery (UR Z18) or Planned Maintenance Scheme (UR Z20, PMS)	Yes (1)
4	Occasional survey for change of ship’s name	Yes (1)
5	Occasional survey for loss of anchor	Yes (1)

6	Occasional survey for minor machinery or equipment damage	Yes (1)
7	Occasional survey for minor hull damage	Yes (1)
8	Occasional survey for minor deficiencies/defects not subject to a Condition of Class	Yes (1)
9	In-water bottom survey	Yes
10	Specified items of a class periodical survey (excluding additional specific items of initial or renewal surveys), including completion of remaining items of a part held class periodical survey	Yes (1) (2)
11	Non-propelled / un-manned barges/pontoon – annual surveys when no survey of hull compartments is due	Yes
12	Minor retrofit / installation/upgrade of equipment	Yes (1)
13	Documentary or data based initial / periodical / renewal / occasional verifications and surveys	-

Note:

1. "(1)" means that live streaming may not be required for minor survey scope or that a combination remote survey method, such as recorded video, photo or other data or supporting documents provided by the owner's representative, may be used at the sole discretion of the Society.
2. "(2)" means that pure documentary verifications are eligible in accordance with item 13.
3. Live streaming may be required for surveys not marked "Yes" in the Table, depending on the survey scope at the sole discretion of the Society.
4. "Minor" in the items 6, 7, 8 and 12 means that the item can be surveyed remotely according to requirements for equivalency to a survey attended on board by a surveyor such as aspect to the eligibility of the remote survey, qualification of surveyors, planning of the remote survey, performance of the remote survey, assessment of the remote survey and reporting.

As shown in Table 2-2, the acceptable items of remote survey stipulated by IACS as Unified Requirements allow the type and scope of remote survey only for items with the low difficulty of a survey, including documents and data review/verification, rather than items included in periodical surveys that require comprehensive verification and review. Therefore, it can be considered that the expansion of remote surveys has not yet been significantly applied, at least at the IACS level.

2.1.3 Restriction of ships for remote survey

For ships on international voyages, the condition of ships may vary greatly depending on the type and age of the ship. Since this study deals with the issues related to the survey of ships, the condition of ships is only mentioned in relation to whether the ship's safety and marine environment protection facilities are satisfied with international conventions. On the other hand, the condition of a ship is also greatly influenced by the ship's management status and the seafarers' maintenance ability, regardless of the type of ship and age. What is important is whether the ship's condition needs to be a criterion for judging whether a remote survey is possible.

In some classification societies, Class Notation for the remote survey is granted to determine whether the vessel is ready for the remote survey, although it is not mandatory for a remote survey. In order to obtain a class notification for the remote survey, the remote survey procedure must be documented for the ship and approved by the classification society of survey procedure, list of survey equipment, equipment instruction, equipment management procedure, and designated remote survey support personnel (person in charge). In addition, it should be surveyed periodically whether the remote survey equipment provided on the ship is suitable (KR, 2021; NK, 2021). However, no classification society yet requires compulsory class notation for remote surveys.

As previously reviewed in Chapter 2.1.2, classification societies are currently implementing remote surveys by limiting the type and scope of the survey of ships to a reasonably simple level of surveys. Although a superficial level of remote survey within a limited scope may not be the case, a wide range of periodical surveys (annual, intermediate, renewal surveys), for example, including compartment surveys such as tanks and holds, are not yet easy to perform an equivalent level of survey on-site that can guarantee ship safety and seaworthiness (IMO, 2021b). The ultimate goal of a remote survey in the future is to secure at least an equivalent level of survey quality compared to the existing survey methods in which surveyors are present on-site

(IACS, 2022a). Including the IACS UR Z29, all of the guidelines of the classification societies stipulate that the possibility of a remote survey is checked and determined in advance of the remote survey (BV, 2021; CCS, 2022; KR, 2021; NK, 2021; IACS, 2022a). From that point of view, a prior evaluation of the overall safety condition of the ship subject to a remote survey may be considered if further remote surveys are expanded to the broader scope of surveys in the future. Some classification societies restrict the possibility of remote surveys in consideration of PSC performance records and the acquisition of class notation for the remote survey of ships (KR, 2021).

2.1.4 ICT used for Remote Survey

According to IACS UR Z29, ICT (Information & Communication Technology) used for the remote survey is defined as "Technologies used in the scope of remote surveys for gathering, storing, retrieving, processing, analysing, and transmitting information which includes both hardware and software" (IACS 2022). ICT can be largely divided into hardware and software. Hardware refers to smartphones, tablets, and PC capable of video conferencing that can deliver survey information such as documents, photos, videos, and live streaming to a surveyor, and software refers to a communication application that transmits information using hardware (BV, 2021; CCS, 2022; KR, 2021; NK, 2021). Separately, equipment for information collection that can be connected to hardware is required, which includes video, camera, and scanner. Equipment for information collection and ICT shall be subject to technical requirements that consider hardware and software reliability. The data format of recorded videos and photos should be universal, and a communication environment that can stably and reliably transmit and receive recorded videos and photos with quality suitable for remote surveys should be ensured. The quality of videos and photos should be sufficient for a surveyor to confirm the ship's conditions, such as hull structure and machinery. Communication quality should be maintained at a level suitable for the remote survey that does not cause communication problems such as interruption or significant time delay. In addition, the date, time, and location of the survey should be displayed as accurately as possible to verify the validity of the remote survey information transmitted (KR, 2021; IACS, 2022a).

2.1.5 Remote survey supporter

A remote survey supporter means a person who supports a remote survey on a ship (KR, 2021). However, in remote survey guidelines of each classification society, it is used under various names such as "Applicant", "Applicant Representative", and "Person in charge for assisting remote surveys", and is called "Owner's Representative" in IACS UR Z29 (BV, 2021; CCS, 2022; NK, 2021; IACS, 2022a). However, it is the same person who plays the same role in the remote survey. In this study, to prevent confusion about the name and relatively clearly associate the purpose of the related work, it will be unified and called "Remote Survey Supporter".

In order to conduct a remote survey, a remote survey supporter must be designated in the remote survey procedure for the smooth progress of the remote survey. Since the remote survey is conducted on a ship, the person in charge of the ship's relevant work, according to the division of duties in the ship's safety management system, shall be designated as a remote survey supporter. However, depending on the ship's situation, another person designated by the shipowner may replace him. A remote survey supporter shall provide remote survey information to the surveyor that guarantees the equivalent level to that of the on-site survey. Therefore, remote survey supporters should be fully aware of the maintenance, instruction of remote survey equipment and procedures of the remote survey. The remote survey supporter shall confirm the survey scope according to the survey method designated by the surveyor through the remote survey preparation meeting with the surveyor and provide the collected information (Live stream, video, photo, document) to the surveyor according to the surveyor's instructions (BV, 2021; CCS, 2022; KR, 2021; NK, 2021). The remote survey supporter is responsible for conducting the overall remote survey on the ship and plays an essential role in determining the quality of the remote survey. If the information provided by the remote survey supporter does not meet the criteria of sufficient quality for the surveyor's verification, the remote survey may be rejected. Therefore, the role of remote survey supporters in remote surveys is of utmost importance (IACS, 2022a).

2.1.6 Service Suppliers

Service supplier means persons who provide inspection services as a third party of a survey, such as life-saving equipment (L/Boat, L/Raft etc.), fire extinguishing equipment, Radio equipment, thickness measurement, and underwater inspection. In IACS UR Z17, which details the approval, supervision and procedures of the service supplier involved in the ship inspection work, the service supplier is defined as "A person or company, not employed by an IACS Member, who at the request of an equipment manufacturer, shipyard, vessel's owner or other client acts in connection with inspection work and provides services for a ship or a mobile offshore unit such as measurements, tests or maintenance of safety systems and equipment, the results of which are used by surveyors in making decisions affecting classification or statutory certification and services" (IACS, 2021b.p.2). A service supplier is a person who provides essential information for a surveyor to determine the condition of a ship. The Service Provider inspects most of the survey items that the remote survey supporter cannot perform. This includes using remote inspection methods for the survey that require very specialized techniques such as Divers, Unmanaged robot arms, Remote Operated Vehicles (ROV), Climbers, and Drones (IACS, 2016a). Therefore, the service supplier's work competency and reliability must be significant factors in performing a complete remote survey. Each classification society and IACS have established a unified standard for service suppliers since 1997 and are implementing it as a common standard (IACS, 2021b). However, in the case of a remote survey where no surveyor is present on-site of a survey, the service supplier performs an inspection outside the surveyor's actual control. Therefore, in situations where the surveyor is not present, the role and function of service suppliers become more important. Accordingly, their reliability and work competency are critical considerations in securing the reliability of remote surveys.

2.1.7 Remote Surveyor

The surveyor carrying out the ship survey shall be fully qualified under the training and standard procedures in accordance with IMO RO Code (Res.MSC.349(92) and

IACS Procedural Requirement PR7. (IMO, 2013; IACS, 2020). However, remote surveyors perform survey work in a unique environment different from an on-site survey. Therefore, in addition to the basic qualifications, knowledge and experience of field surveys, remote surveyors should have additional knowledge of ICT used in remote surveys and the ability to review and analyse remote survey information as well as sufficient knowledge of remote survey procedures different from general survey on-site is obligatorily required (IACS, 2022a). The remote surveyor shall effectively perform a remote survey so that the quality of the remote survey equivalent to the on-site survey can be achieved based on background knowledge from the on-site survey experiences. However, if a remote survey is further expanded in the future for more survey types and scope, it is necessary to consider the possibility that there will be fewer opportunities to accumulate on-site survey experience and know-how by the remote surveyor. Since the remote surveyor is an important subject of remote survey and must perform the survey by combining remote inspection technology based on field survey experience and know-how, it is necessary to fully consider the remote surveyor's training, qualification, and monitoring.

2.1.8 Reporting and Record Keeping

The results of the remote survey should be submitted to the remote surveyor in a much more considerable amount of survey data and evidence than the on-site survey. Materials that need to be reviewed include pre-recorded video and audio, photos, master's/chief engineers' statement, ship's log book, owner's confirmation, and various files and certificates of the ship. In addition, live streaming video and audio are also provided to the surveyor in real-time. Most of the remote survey guidelines of the classification societies established and stipulated the reporting methods and levels of data collected from ships. However, there is no explicit requirement for data and recording-keeping standards in the remote survey guideline (BV, 2021; CCS, 2022; KR, 2021; NK, 2021). However, IACS requires that each classification society be kept recording according to the standard procedure of each classification society in accordance with the criteria for "Retainment / Filing of the evidence" of IACS UR Z29. In addition, recording and retaining are not required for real-time live streaming data used for a remote survey unless the surveyor considers it particularly necessary

(IACS, 2022a). Therefore, a remote survey seems to require a similar level of data record keeping, although the amount of data reported is much more considerable than that of a conventional on-site survey. However, as mentioned earlier, since a remote survey is conducted in a condition where no surveyor is on board the ship, unlike a general on-site survey, there is a possibility of controversy over whether the remote surveyor performs an effective remote survey after the completion of a remote survey. Accordingly, it is considered that sufficient discussion and further consideration are needed for the criteria for record keeping of evidence data in order to keep mutual explanatory data on whether an effective remote survey has been performed or not.

2.1.9 Cybersecurity

Concerns about cybersecurity threats to the shipping industry have been raised early before the discussion of the remote survey. Accordingly, IMO adopted MSC-FAL.1/Circ.3 on Guidelines on maritime cyber risk management in 2017 and Resolution MSC.428(98) on Maritime Cyber-Risk Management in Safety Management System (SMS) in 2017, and has been dealing with cybersecurity issues (IMO, 2017; IMO, 2021d). In line with this, IACS also presented security standards for the "On Board Use and Application of Computer-based system" through IACS UR E22 and prepared and applied comprehensive standards for "Cyber Resilience" of ships through IACS Rec.166 (IACS, 2016b; IACS, 2022b). A remote survey is characterized by the need to exchange much more information between ship and shore than conventional surveys on-site of a ship. As a result, a vulnerability can be more exposed to cybersecurity threats. Therefore, all classification societies are responding to the cybersecurity issue of the remote survey according to their standards in accordance with the above-mentioned international standards from IMO and IACS. In particular, hardware and software used for remote surveys are subject to a preliminary review considering cybersecurity threats before approval of implementation of remote surveys (BV, 2021; CCS, 2022; KR, 2021; NK, 2021). In addition, some classification societies require remote survey equipment to be supported independently of the ship's main communication equipment for cybersecurity (KR, 2021). IACS UR Z29, which provides detailed guidelines for the remote survey, also emphasizes the process of proving the safety for cybersecurity

of software used for the remote survey before a remote survey is implemented. Protecting the collected data onboard and the transmitted data's confidentiality is considered a core of cybersecurity related to a remote survey (IACS, 2022a). Accordingly, cybersecurity must be a critical factor for the adequate performance of remote surveys.

2.2 Discussions on Remote Survey In IMO

2.2.1 MSC 102nd Session

Discussions on the development of the remote survey guidelines in IMO began at the MSC 102nd session. The MSC 102/22/11 document, submitted by the Republic of Korea, highlighted the urgent need for international standards and procedures for remote surveys within IMO at an international level, noting that the need for remote surveys during the COVID-19 pandemic has increased significantly and that the development of information and communication technology could make the remote survey more practical in the future (IMO, 2020b). The IMO recognised that the lack of standard guidelines for remote surveys not only burdens the shipowners and seafarers but also impairs the reliability of remote survey quality and equity between each flag State and ROs, and the issue of the validity of remote surveys may arise from a port state control perspective. As a result, the Member States and international organisations in IMO were invited to submit a new output proposal related to the development of guidelines for the remote survey to the next Committee meeting (MSC 103) (IMO, 2020a).

2.2.2 MSC 104th Session

Due to the influence of COVID-19, the 103rd meeting of MSC was held as a remote video conference, and as a result, the discussion on remote investigation was postponed to the 104th meeting of MSC due to the delay in session time. At the MSC 104th session, the Member States submitted four significant documents on the development of remote survey guidelines (IMO, 2021e).

MSC 104/15/3, submitted by the Republic of Korea, emphasized that remote survey is being conducted based on different standards in some flag States and ROs as the COVID-19 pandemic makes it difficult for surveyors to access ships for a survey. This document emphasized that the Remote Inspection Technique (RIT) and remote survey are different concepts and explained the need to develop remote survey guidelines. Therefore, it urged the rapid development of internationally unified remote ship survey guidelines so that remote surveys can ensure the same survey quality as an on-site survey with a surveyor in order to secure the safety of life and ship at sea and protect the marine environment (IMO, 2021a).

MSC 104/15/6, submitted by Austria et al., proposed the development of new guidelines for a remote survey and remote audit or the revision of Harmonized System of Survey and Certification (HSSC) guidelines as a new work programme. This document also noted that RIT is used as an additional inspection tool for physical survey attendance and emphasized that separate guidelines for remote surveys should be prepared. In addition, it is noted the necessity of evaluating the possibility of whether the remote survey can replace the existing survey method with the attendance of the surveyor. Therefore, the minimum considerations necessary for case-by-case approval for the remote survey are presented as shown in Table 2-3. This document also urged the development of remote survey guidelines as soon as possible to ensure the same level of safety as the survey conducted by physical attendance of surveyors (IMO, 2021b).

Table 2-3 Items to be considered for Remote survey on case-by-case approval by the flag State (Source: MSC 104/15/6) (IMO, 2021b)

No.	To be Considered for Remote Survey on Case-by-Case approval
1	The safety performance of the safety management of the ship
2	The detailed and documented justification for the use of remote surveys/audits (e.g. extraordinary circumstances and/or force majeure situations such as warfare, pandemics or natural disasters that do not allow physical attendance of a surveyor on board the vessel)
3	The scope of remote surveys/audits (e.g. survey planning, survey items that could be done remotely, type of ship and equipment, harmonization of requirements between ROs)
4	The consultation with the flag State in case the survey/audit has been delegated to a RO (e.g. coordination of surveys and full responsibility for the outputs)
5	The technical requirements for remote survey/audit (use of approved remote inspection techniques, audio and video communication, two-way communication, etc.)
6	The potential need for a validation by a physically attended survey or audit
7	The roles, responsibility, impartiality and liability of the involved parties, including personnel involved in physical inspection on board the ship (e.g. tests, examinations, gathering of evidence on the condition of the ship)
8	The qualifications of personnel involved in physical inspection on board ship
9	The provision of information and evidence to the surveyor/auditor (e.g. audio and video records, the confidentiality of the information)
10	The reporting requirements and records (e.g. master statement, survey report, service suppliers' report)
11	The transparency of information on the remote methods used and the survey status indicates whether the surveys were carried out remotely or physically.

MSC 104/15/12, submitted by Austria et al., proposed the development of guidelines for remote audit and verification related to maritime security. This document mainly focuses on remote audits for ship security audits according to the ISPS (International Ship and Port Facility Security) Code. However, as it deals with ship security issues, it includes concerns about cybersecurity threats caused by network use during the remote audit (IMO, 2021f).

MSC 104/15/24, submitted by China, proposed a review of technical requirements and legal scope for a remote survey. This aims to designate the scope of regulatory application for a remote survey and to develop technical requirements related to information and communication technology for a remote survey. This is to classify the degree of complexity of the survey by each item into categories and to classify the survey items accordingly to define the survey requirements and survey methods for each category. To this end, in this document, in consideration of new technology trends, a remote survey was divided into four categories, as shown in Table 2-4 (IMO, 2021g).

Table 2-4 Classification of Remote survey
(Source: MSC/104/15/24) (IMO, 2021g)

Category	Classification of Remote Survey
Remote document review	Documentary materials are sent and collected via email to be reviewed by surveyors in offices for document verification, etc.
Elementary remote surveys	Inspections for minor sea damage and repair, the withdrawal of class conditions, extension of class conditions, etc. are carried out remotely through photos, videos, and real-time communication software to decide the compliance of the inspected items
Advanced remote surveys	Surveys conducted through real-time audio/video communication on a professional platform for annual surveys, etc.

Data-based remote surveys	With the development of digital and intelligent ships, the digital monitoring and verification of the structural condition, machinery status and system operation performance of applicable ships can be achieved by the application of high-technologies including online monitoring, data analysis, condition evaluation, smart diagnosis and risk assessment technologies.

Accordingly, MSC finally approved a Work Programme to develop guidelines for remote ship survey, ISPS security audit, and ISM audit so that III-subcommittee would proceed with the development of guidelines for remote survey with the aim of adoption by 2024 (IMO, 2021e).

2.2.3 III 8th Session

At the eighth session of the III-subcommittee, two primary documents were identified for reference to this study for considerations related to the development of the remote survey guidelines. Until the MSC 104th meeting, the necessity and background of the development of remote survey guidelines were mainly discussed, while the III 8th session presented more specific and detailed directions for the development of remote survey guidelines.

III 8/12/1, submitted by Austria et al. and IACS, introduced RIT guidelines of IACS and suggested that more detailed IMO RIT guidelines should be prepared before developing remote survey guidelines. In addition, it was suggested that cybersecurity should be fully considered because remote sharing of documents requiring confidentiality is essential during a remote survey. And so far, there is no basis for judging that the reliability of a remote survey is equivalent to that of an on-site survey with a surveyor. Therefore, the initial and renewal surveys should not be conducted remotely, considering their importance until international methodology is verified. Regarding human factors, it was also suggested that while remote survey requires seafarers' cooperation, the implementation of the remote survey should not be an

additional burden on seafarers. In addition, this document identifies and proposes considerations according to the main principles necessary for the application of remote survey, along with the amendment to add information related to remote survey to the survey guidelines for HSSC, as shown in Table 2-5 (IMO, 2021h; IMO, 2022a).

Table 2-5 Consideration for Remote Survey Guidance (Source: III 8/12/1) (IMO, 2022a, Annex 3, pp.2-3)

No.	Considerations for Remote survey Guidance
1	The prerequisites for the use of remote methods for surveys, audits and verifications, such as the safety performance of the ship and the company, PSC performance, type and age of the ship
2	The documented justification for the use of remote methods for surveys, audits and verifications, and conditions and circumstances under which these activities could be performed remotely
3	The scope of the remote surveys, audits and verifications, with consideration of those items that could be verified remotely for compliance with the applicable requirements, including applicable performance standards or acceptance criteria, to achieve the same level of assurance and equivalence when compared to physically attended surveys/audits/verifications. Items that could not be verified remotely should be verified by on-site survey/audit/verification.
4	The consultation with the Administration in case the survey/audit/verification has been delegated to a recognized organization (RO) or a recognized security organization (RSO) for the review and acceptance of the RO's or RSO's procedure for remote surveys/audits/verifications, and for instructions for the execution and reporting of remote survey/audit/verification and, where needed, verification and validation of remote survey/audit/verification by a physically attended survey/audit/verification.

5	The technical requirements for the use of remote surveys/audit/verification, such as the use of information and communication technology (ICT), mandatory use of two-way audio and video or other alternative means of communication during surveys/audits/verifications, confidentiality and security of information, and data protection. The confidentiality and security of information for ISPS verifications, in particular, need to be ensured. A minimum quality level of the means of communication should be prescribed (video, audio and internet stability requirements)
6	The roles and responsibilities of the involved parties, including personnel involved in physical examinations and tests/audit activities on board ship when gathering evidence on the compliance with applicable requirements, with due consideration of appropriate arrangements to address impartiality and liability issues of personnel involved. In this regard, the current liability regime regulating surveys/audits/verifications between flags', ROs', RSOs' and shipowners' obligations shall not be changed
7	The qualifications of personnel involved in physical survey/audit/verification activities on board the ship and of the surveyors/auditors performing remote surveys/audits/verifications
8	The provision of information and evidence to the surveyor/auditor to confirm the scope of the survey/audit/verification and compliance with the applicable requirements, including applicable performance standards or acceptance criteria, requirements of the ISM Code or ISPS Code, such as audio and video records, photo records, master's and crew statements, ship's log book, service suppliers' reports, etc.
9	The reporting requirements and the transparency of information on the remote methods used in the ship's and company's status indicate whether the surveys/audits/verifications were carried out remotely or physically
10	For audits, consideration should be given to confidentiality of interviews to crew members as well as to their availability and hours of rest.
11	For remote surveys, audits and verifications, consideration should be given to general data protection and security of transfer of data and information.

III 8/12/1, submitted by China, suggested that the remote survey guidelines should be developed with a focus on the definition, scope, hardware, software, qualifications, responsibilities, verification, documentation, supervision of results, and other relevant aspects (IMO, 2022b).

2.3 Remote Survey from the Perspective of Seafarer and Ships operation

2.3.1 Time and Cost efficiency of Remote Survey

Compared to on-site surveys attended by surveyors, remote surveys have the advantages such as recording some survey items in advance according to the ship's schedule convenience and the surveyor's travel time, so efficiency in terms of time can be expected. In addition, since surveyors do not get on board, the cost of travel for surveyors will also be significantly saved (IMO, 2021g). On the other hand, it can be expected that the survey time increases due to delayed remote surveys for unexpected reasons. In addition, if there are cases where surveyors have to check on board again later, it may not be cost-effective. The increase in the cost for communication between ship and remote surveyor and costs used for the purchase/repair of remote survey equipment is one of the factors to be considered. The remote survey requires the support of seafarers on ships. Therefore, the cost of training for seafarers related to remote survey procedures could also be considered (IACS, 2021a; IMO, 2022a; McCabe, 2020; Redouane, n.d.; Safety4sea, 2020). Time and cost efficiency will be essential in determining the need for a remote survey if it is widely implemented as an ordinary survey method in the future, not in extraordinary situations such as COVID-19.

2.3.2 Safety of Seafarers during Remote Survey

During the remote survey, the ship's crew performs the survey work of the ship on behalf of the surveyor. In particular, when live streaming or video recording using a camera, it is inevitable to consider the safety of sailors. When inspecting the high-area or enclosed space in a ship, surveyors on-site are also required to comply with necessary safety measures and procedures. Therefore, it is necessary to establish safety procedures for the progress of remote surveys for seafarers who perform a remote survey on behalf of the remote surveyor (Safety4sea, 2021; Eason, 2020). Requirements for the safe progress of remote survey for crew shall be prepared in the ship's remote survey procedures to ensure the safety of seafarers who support remote survey on the ship (KR, 2021).

2.3.3 Fatigue of Seafarers by Remote Survey

Many problems with seafarers' fatigue have long been publicized. In particular, the IMO adopted Resolution A.772(18) for fatigue factors with regard to manning and safety in 1993. This Resolution provides a general description of fatigue and identifies ship operating factors that may contribute to fatigue that should be considered when making decisions on ship operations. After continuous review and discussion in IMO, the IMO approved MSC.1/Circ.1518 and issued guidelines for fatigue relief and fatigue management on ships. MSC.1/Circ.1518 identifies stress related to inspection/survey/audit in ships as one of the fatigue cases of ship operating factors (IMO, 2019; IMO, 1993). A remote survey has much more work assigned to seafarers than to an on-site ship survey attended by the surveyor, to the extent that most of the ship survey scope must be conducted by the seafarers on the ship (IMO, 2022a). Therefore, the remote survey is likely to act as a threat to the safety of ships because it can increase the seafarer's fatigue by adding to the seafarer's work burden associated with the remote survey (Eason, 2020).

3. Research Methodology

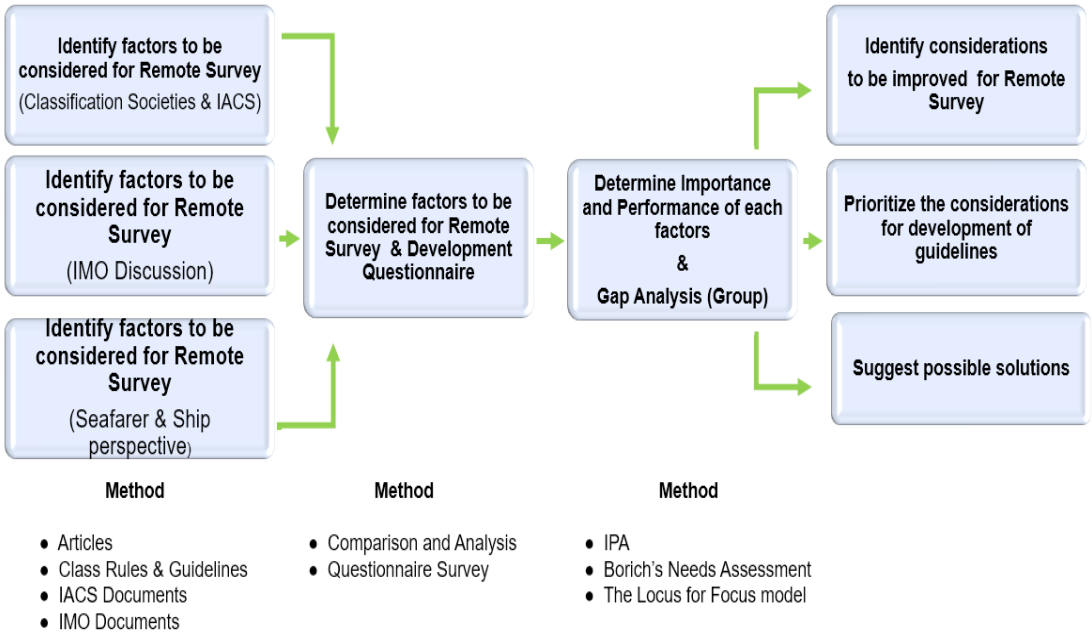
3.1 Procedure and Methods Overview

The purpose of this study is to identify the factors that should be considered in the future remote survey guidelines developed and adopted by IMO and to identify how stakeholders of remote surveys perceive the importance and efficient feasibility of each factor involved in the remote survey. In Chapter 2, through literature review, the guidelines for remote survey implemented at each classification society and the common rules of the remote survey according to IACS UR Z29 were compared to find the factors necessary for the remote survey. In addition, various agenda documents submitted to IMO and IMO Resolution and Circular were compared to review the progress of discussions on the development direction of remote survey and suggestions from the Member States in IMO. In addition, the influence of the seafarers on the remote survey, which was mentioned and highlighted in various articles, and the efficiency of the remote survey were reviewed.

This study will compare and analyse the primary considerations of the remote survey identified through the literature review to identify a list of significant considerations necessary for the effective development of remote survey guidelines. In addition, a questionnaire survey will be conducted on the importance and feasibility of identified considerations required for the remote survey. The questionnaire survey will be analysed in three groups: seafarers, ship managers, and ship surveyors, who are representative stakeholders in the remote survey. Although the questionnaire survey is divided into three groups, all group questionnaires are composed of the same

questions. All questions related to the considerations of the remote survey will consist of questions using the Likert scale answers. The collected survey data will be analysed using the Importance & Performance Analysis (IPA) (Martilla & James, 1977), Borich's Needs Assessment (Borich, 1980), and the Locus for Focus Model (Mink et al., 1991). IPA, Borich's Needs Assessment, and Locus for Focus model have widely used analysis methods in social science to identify the importance of factors in the system and perform demand analysis (Chae et al., 2021). The primary purpose of this study is to identify how three different groups perceive each factor's importance and feasibility for remote survey consideration and to identify which factor should be considered as priorities in developing remote survey guidelines. The schematic procedure and method of this study are shown in Figure 3-1.

Figure 3-1 Procedure and methods performed in this study

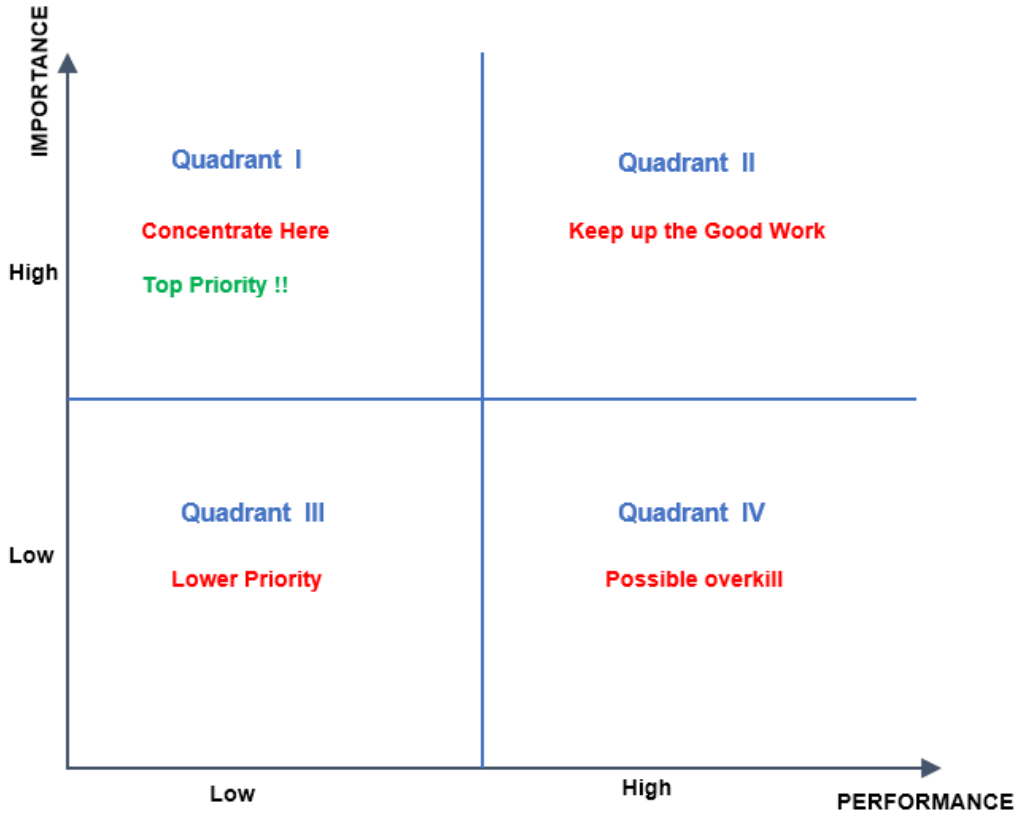


3.2 Analysis Method

3.2.1 IPA (Importance – Performance Analysis)

In the Journal of Marketing, published in 1977 by Martilla & James, IPA was introduced as an analysis method. In short, it is a method of exploring the priorities of elements to be focused on by comparing the importance of certain elements with the current performance (Martilla & James, 1977). As shown in Figure. 3-2, quadrant I is an area where improvement is urgent because it has high importance but low performance. Since quadrant II has high importance and high performance, it is an area to be continuously strengthened while maintaining the current state. Quadrant III is an area where performance is low, but the importance is also low, so it is to be gradually improved, but the priority is not urgent. Finally, the area of quadrant IV is low in importance but high in performance, so it can be reviewed that it could be maintained in its current state (Jeong & Kim, 2015; Cho, 2009). However, in order to distinguish the area of the quadrant in IPA, the centre values of the importance axis and performance axis must be set. This is because the direction of the response search strategy is determined according to the location of the centre value. However, when setting the centre value with any criterion set by the researcher or average value, care should be taken because errors may occur in the analysis of the results (Chae et al., 2020; Oh, 2001). In IPA, paying attention to the items corresponding to quadrant I with high importance but low performance is necessary.

Figure 3-2 IPA (Importance – Performance Analysis)



3.2.2 Borich's Needs Assessment

When setting the centre value for classifying the quadrant area in IPA, there is a disadvantage that an error in the result analysis may occur when the average value is based. To compensate for these shortcomings, Borich's Needs Assessment might be a further considerable analysis method. In IPA, priorities are simply compared according to the importance and performance of the collected result, but Borich's Needs Assessment adds weight to the importance of affecting the results. Figure 3-3 shows the formula for Borich's needs assessment. "Importance" and "Performance" mean importance and performance scores, respectively. “N” means the total number

of respondents, and " $\overline{Importance}$ " means the average of the importance level. According to the Borich's needs formula shown in Figure 3-3, as the importance value rises and the performance value falls, Borich's needs coefficient rises. Therefore, Borich's needs coefficient provides a basis for determining priorities using relative rather than absolute values. Items with a high Borich's Needs Coefficient are highly prioritised, so improvement needs to be considered (Chae et al., 2021).

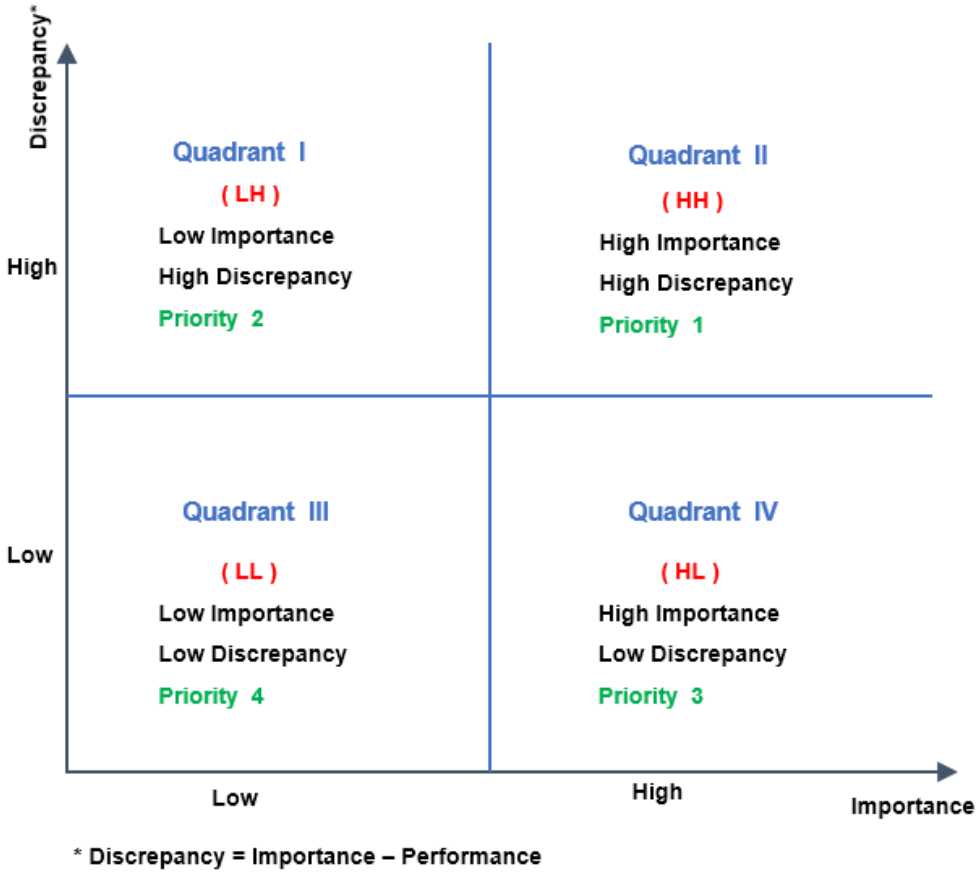
Figure 3-3 Formula for Borich's Needs Coefficient

$$\boldsymbol{Borich's\ Needs\ Coefficient} = \frac{\sum(\boldsymbol{Importance\ -\ Performance})}{\boldsymbol{N}}\ \boldsymbol{X}\ \overline{\boldsymbol{Importance}}$$

3.2.3 Locus for Focus Model

The Locus for Focus Model is frequently used in conjunction with Borich's Needs Assessment to determine priorities that take into account performance according to importance. Figure 3-4 is a schematic presentation of the analysis of the Locus for Focus model. As shown in Figure 3-4, in the Locus for Focus Model, the map could be expressed as a dot on the quadrant using the difference between importance and performance (vertical axis) and importance (horizontal axis). This map expresses the relationship between importance (horizontal axis) and discrepancy (vertical axis), which means the difference between importance and performance. Generally, priority is given in the order of Quadrant II – Quadrant I – Quadrant IV – Quadrant III. Since Quadrant II has high importance and a large discrepancy between importance and performance, it is necessary to consider improvement as a top priority (Chae et al., 2021).

Figure 3-4 Locus for Focus Model



3.3 Analysis of Key Elements of Remote Survey

3.3.1 Classification Societies and IACS

In Chapter 2.1, the remote survey guidelines used in classification societies and IACS UR Z29 were compared to review the elements required for remote ship surveys. As a result of the review, the elements generally required for remote survey by each classification society and IACS were identified, as shown in Table 3-1.

Table 3-1 Identified key elements from Classification Societies & IACS

No.	Elements required in Guidelines of Classification Societies & IACS UR Z29
1	Eligibility for Type and Scope of Remote Survey
2	Restrictions of ships for Remote Survey
3	ICT used for Remote Survey
4	Remote survey supporter
5	Service Suppliers
6	Remote Surveyor
7	Reporting and Record Keeping
8	Cybersecurity

3.3.2 IMO Discussion

Chapter 2.2 reviewed the documents submitted to IMO and discussions in IMO until recently. Currently, it is common that each flag States does not have detailed guidelines for the remote survey. The flag State determines only the possibility of a remote survey and delegates it to a Case-by-Case basis so that the RO can perform a remote survey. The documents submitted by the Member States to the IMO regarding the development of remote survey guidelines were mostly pre-discussed with IACS, an association representing ROs, and most of the documents were drafted based on IACS documents. Therefore, the essential elements required for remote surveys submitted to the IMO tended to overlap in many respects with the requirements of IACS for the remote survey. Table 3-2 shows essential elements to be considered in the development of remote survey guidelines under discussion in IMO. Table 3-2 was identified based on the overall review of documents submitted to the IMO in relation to the remote survey.

Table 3-2 Identified Elements to be considered for Development of Remote Survey Guidelines in IMO

No.	Elements to be considered for Development of Remote Survey Guidelines in IMO
1	Safety performance of the ship and the company, PSC performance, type and age of ship
2	The scope of the remote surveys
3	The consultation with the flag State in case the survey has been delegated to an RO.
4	The technical requirements for the use of remote survey
5	The roles, responsibility, impartiality and liability of the involved parties in physical examinations and tests/audit activities on board ship
6	The qualifications of personnel involved in physical survey on board ship
7	The qualifications of surveyor involved in remote survey
8	The reporting requirements, records and transparency of information
9	Data protection and security of transfer of data and information

3.3.3 Perspectives of Seafarers and Ship Operation

In Chapter 2.3, through a literature review related to the remote survey, an overall review was conducted on elements that remote survey can affect the operation of ships and seafarers. As a result, elements, as shown in Table 3-3, were identified. Since these elements can affect seafarers and ship operations if the remote survey is performed, therefore, it is expected that sufficient consideration and reference will be required when developing remote survey guidelines.

Table 3-3 Elements influenced by remote survey for seafarers and ship operation.

No.	Elements to be considered for remote survey in perspectives of seafarers and ship operation
1	Time and Cost Efficiency of Remote Survey
2	Safety of Seafarers during Remote Survey
3	Fatigue of Seafarers by Remote Survey

3.4 Survey Questionnaire Development

In Chapters 3.1, 3.2, and 3.3, essential elements to be considered remote survey were identified from rules of classification societies and IACS, documents and discussions in IMO, and various literature reviews. In addition, in order to compare and integrate each element and to compose key elements necessary for the remote survey, considerations for classification societies, IACS, IMO, and seafarers and ship operational aspects were compared with each other. Table 3-4 shows the comparison of elements in terms of classification societies & IACS, IMO, and seafarers and ship operation related to the remote survey.

Table 3-4 Comparison of elements for Remote Survey amongst Classification Society (IACS) / IMO discussion / Seafarers and Ship operation aspect

Classification Societies & IACS	IMO Discussion	Seafarers & Ship operation
Eligibility for Type and Scope	The scope of the remote surveys	-
Restrictions of ships	Safety performance, PSC performance, type and age of ship	-
-	The consultation between flag States and ROs	-
ICT used for Remote Survey	Technical requirements	-
Remote survey supporter	The qualifications of personnel in physical survey on board ship	-
Service Suppliers	The roles, responsibility, impartiality and liability of personnel in physical examinations and tests activities on board ship	-
Remote Surveyor	The qualifications of remote surveyor	-
Reporting and Record Keeping	reporting requirements, records and transparency of information	-
Cybersecurity	Data protection and security of transfer of data and information	-
-	-	Time and Cost Efficiency
-	-	Safety of Seafarers
-	-	Fatigue of Seafarers

As a result, 12 key elements for the remote ship survey were finally extracted, as shown in Table 3-5, based on various elements compared and reviewed in Table 3-4. The questionnaire consists of 12 topics according to finally identified key elements of the remote survey. Each topic consisted of two questions asking about the importance and performance (to be expected) of the corresponding key element. Answers to questions are designed to use the Likert 5-point scale for analysis by applying IPA, Borich's Needs Assessment, and the Locus for Focus model. The participants of the survey were divided into three expert groups. Expert group A comprised ship surveyors, expert group B was of ship managers, and expert group C was of seafarers. Regardless of the survey participants, the questionnaire was configured in the same way. This is to compare and analyse the differences in responses amongst each expert group for the same element. As a result, the finally developed survey questionnaire is shown in Appendix 1.

Table 3-5 Key Elements of remote survey for Survey Questionnaire

No.	Key Elements of remote survey for Survey Questionnaire
Q 1	Time and Cost Efficiency of Remote Survey
Q 2	Safety of Seafarers during Remote Survey
Q 3	Fatigue of Seafarers by Remote Survey
Q 4	Hardware used for remote survey
Q 5	Software used for remote survey
Q 6	Competency and Reliability of remote survey supporters
Q 7	Competency and Reliability of service suppliers
Q 8	Competency of the surveyor in charge of remote survey
Q 9	Reporting and Record keeping related to remote survey
Q 10	Cyber-security of Remote survey
Q 11	Restriction of ships for remote survey
Q 12	Restrictions on types & scope of remote survey

4. Data Analysis

The questionnaire survey for this study was conducted for a week, from August 4, 2022, to August 10, 2022. There was a total of 278 participants, and the composition of the respondents is as shown in Table 4-1. The survey was conducted by dividing the subjects into three expert groups. The expert group was divided into ship surveyors (Expert Group A), ship managers (Expert Group B), and seafarers (Expert Group C), which are the primary stakeholders of the remote survey.

Table 4-1 Number and Characteristic of Participants of Questionnaire Survey

Division		Expert Group A (Ship Surveyor)	Expert Group B (Ship Managers)	Expert Group C (Seafarers)	Sum
No. of Participants		**67**	**73**	**138**	**278**
Work Experiences (Industry total)	**Less than 3 Years**	1 (1%)	3 (4%)	22 (16%)	26
	3 – 4.9 Years	0 (0%)	3 (4%)	14 (10%)	17
	5 – 9.9 Years	9 (13%)	8 (11%)	17 (12%)	34
	10 – 19.9 Years	36 (54%)	47 (64%)	44 (32%)	171
	20 Years or more	21 (31%)	12 (16%)	31 (30%)	64
Rank	**Junior Level**	24 (36%)	24 (33%)	26 (19%)	74
	Senior Level	43 (64%)	49 (67%)	112 (81%)	204
Total		67 (100%)	73 (100%)	138 (100%)	**278**

The questionnaire was prepared based on the 12 Key Elements of the remote survey shown in Table 3-5, which were reviewed and identified in Chapter 3. To apply IPA, Borich's Need Assessment and the Locus for Focus Model, the analysis method for this study, questions for all key elements were organized using the Likert 5-point scale, which can measure importance and performance (expected values), such as ① Strongly Disagree - 1 point, ② Disagree – 2 points, ③ Neutral – 3 points, ④ Agree – 4 points, ⑤ Strongly Agree – 5 points. Each key element is composed of two questions, one for importance and one for performance (expected value). The Detailed questionnaire finally developed and used in the questionnaire survey is shown in Appendix 1. An overview of the composition of questions is shown in Table 4-2.

Table 4-2 Overview of questionnaire organization

No.	Key Elements of remote survey for Survey Questionnaire	Importance and Performance (Expected value) questionnaires
Q 1	Time and Cost Efficiency of Remote Survey	Q 1-1 Importance Q 1-2 Performance (Expected)
Q 2	Safety of Seafarers during Remote Survey	Q 2-1 Importance Q 2-2 Performance (Expected)
Q 3	Fatigue of Seafarers by Remote Survey	Q 3-1 Importance Q 3-2 Performance (Expected)
Q 4	Hardware used for remote survey	Q 4-1 Importance Q 4-2 Performance (Expected)
Q 5	Software used for remote survey	Q 5-1 Importance Q 5-2 Performance (Expected)
Q 6	Competency and Reliability of remote survey supporters	Q 6-1 Importance Q 6-2 Performance (Expected)
Q 7	Competency and Reliability of service suppliers	Q 7-1 Importance Q 7-2 Performance (Expected)
Q 8		Q 8-1 Importance

	Competency of the surveyor in charge of remote survey	Q 8-2 Performance (Expected)
Q 9	Reporting and Record keeping related to remote survey	Q 9-1 Importance Q 9-2 Performance (Expected)
Q 10	Cyber-security of Remote survey	Q 10-1 Importance Q 10-2 Performance (Expected)
Q 11	Restriction of ships for remote survey	Q 11-1 Importance Q 11-2 Performance (Expected)
Q 12	Restrictions on types & scope of remote survey	Q 12-1 Importance Q 12-2 Performance (Expected)

4.1 Ship Surveyors (Expert Group A)

A total of 67 people participated in Expert Group A's survey of ship surveyors. The difference in perception of the remote survey key elements of ship surveyors were analysed by dividing into IPA, Borich's Needs Assessment, and The Locus for Focus Model. Table 4-3 summarises the results of the IPA, Borich's Needs Assessment, and the Locus for Focus Model. Figure 4-1 graphically provides the IPA analysis results. Quadrant I corresponds to an area with high importance while low-performance expectation. Therefore, key elements in quadrant I are the most prioritised. Figure 4-2 graphically provides the analysis results according to the Locus for Focus Model. The area of quadrant II has high importance, while the discrepancy (Importance – Performance) is high. Therefore, Quadrant II is an area where elements in priority are needed to improve performance.

Table 4-3 IPA, Borich's Needs Assessment, and the Locus for Focus Model for Expert Group A (67 Ship Surveyors)

Questionnaire	Borich's Needs Assessment		IPA		Locus for Focus Model
	Borich's Needs	Priority	Importance	Performance	
Q 1	1.54	12	3.43	2.99	LL
Q 2	6.65	3	4.09	2.46	HH
Q 3	3.56	9	3.73	2.78	LL
Q 4	6.33	4	4.24	2.75	HH
Q 5	6.19	5	4.15	2.66	HH
Q 6	8.05	1	4.31	2.45	HH
Q 7	7.58	2	4.49	2.81	HH
Q 8	5.62	6	4.09	2.72	HH
Q 9	4.51	7	4.03	2.91	LL
Q 10	3.95	8	3.90	2.88	LL
Q 11	2.42	10	4.37	3.82	HL
Q 12	1.79	11	4.28	3.87	HL

Figure 4-1 IPA for Expert Group A (Ship Surveyors)

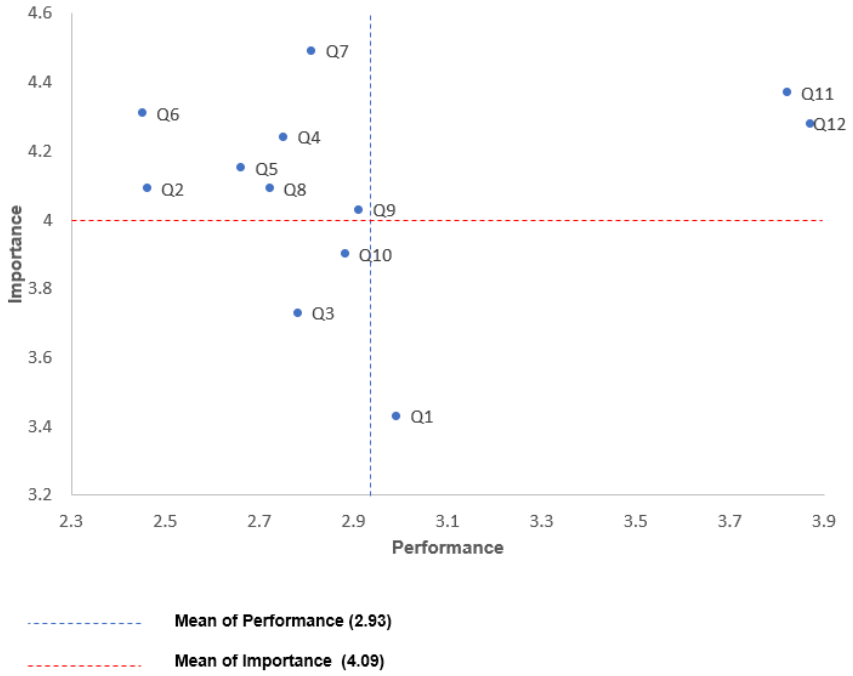
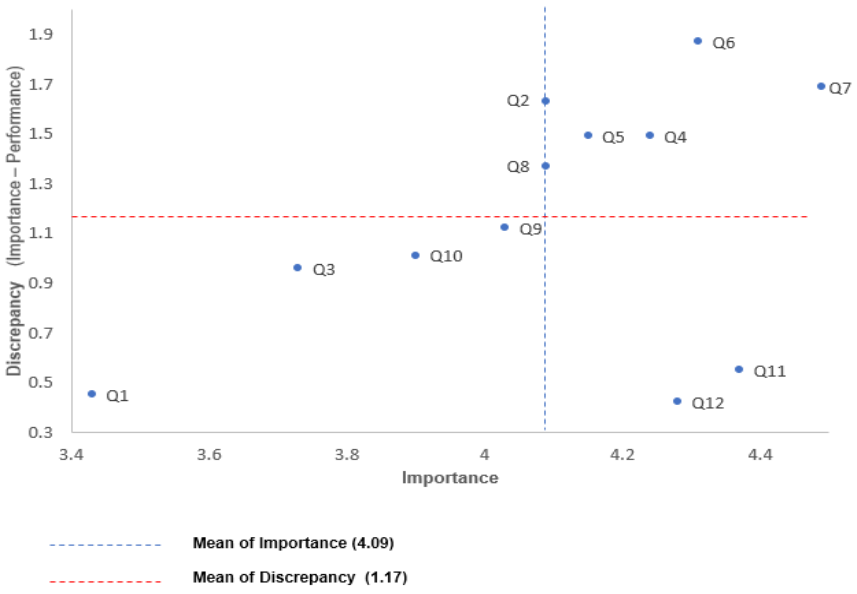


Figure 4-2 Locus for Focus for Expert Group A (Ship Surveyors)



Amongst the key elements of the remote survey from the perspective of the ship surveyors, those are analysed and identified to be considered and improved preferentially according to the IPA, Borich's Needs Assessment, and The Locus for Focus Model are shown in Table 4-4.

Table 4-4 Identified Key Elements Priorities (Expert Group A)

Borich's Needs (Top 5 Priority)	IPA (Quadrant I)	Locus for Focus (Quadrant II)
Q 6 Q 7 Q 2 Q 4 Q 5	Q 2, Q 4, Q 5, Q 6, Q 7, Q 8, Q 9	Q 2, Q 4, Q 5, Q 6, Q 7, Q 8

4.2 Ship Managers (Expert Group B)

A total of 73 people participated in the survey of Expert Group B, which consists of ship managers. The difference in perception of the remote survey key elements of ship managers were analysed by dividing into IPA, Borich's Needs Assessment, and The Locus for Focus Model. Table 4-5 summarises the results of the IPA, Borich's Needs Assessment, and the Locus for Focus Model. Figure 4-3 graphically provides the IPA analysis results. Quadrant I corresponds to an area with high importance while low-performance expectation. Therefore, key elements in quadrant I are the most prioritised. Figure 4-4 graphically provides the analysis results according to the Locus for Focus Model. The area of quadrant II has high importance, while the discrepancy (Importance – Performance) is high. Therefore, Quadrant 2 is an area where elements in priority are needed to improve performance.

Table 4-5 IPA, Borich's Needs Assessment, and the Locus for Focus Model for Expert Group B (73 Ship Managers)

Questionnaire	Borich's Needs Assessment		IPA		Locus for Focus Model
	Borich's Needs	Priority	Importance	Performance	
Q 1	0.49	10	3.55	3.41	LL
Q 2	3.66	2	4.25	3.38	HH
Q 3	1.69	9	3.86	3.42	LL
Q 4	2.82	4	4.29	3.63	HH
Q 5	1.74	8	4.10	3.67	HL
Q 6	4.10	1	4.27	3.32	HH
Q 7	2.89	3	4.30	3.63	HH
Q 8	2.22	5	3.96	3.40	LH
Q 9	2.20	6	4.12	3.59	HH
Q 10	2.03	7	4.01	3.51	LH
Q 11	0.00	11	3.58	3.58	LL
Q 12	-0.05	12	3.82	3.84	LL

Figure 4-3 IPA for Expert Group B (Ship Managers)

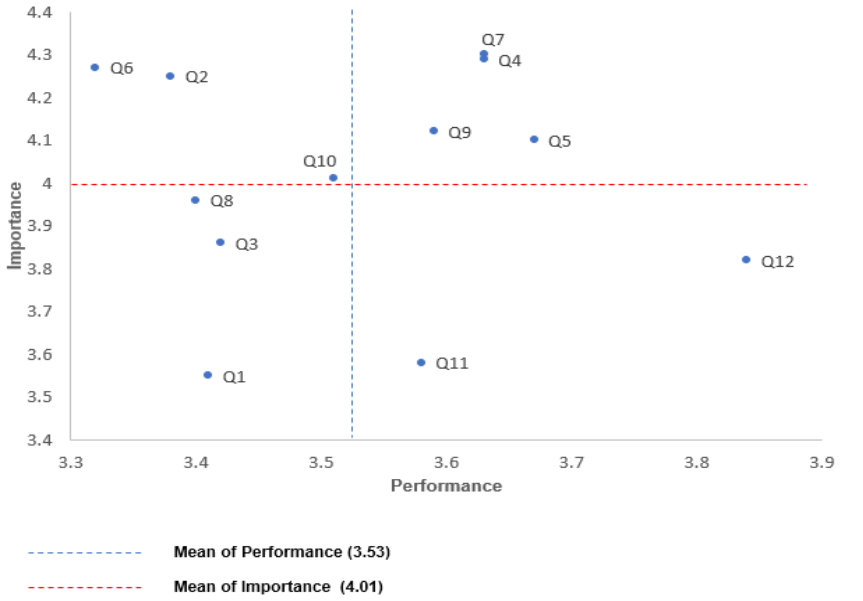
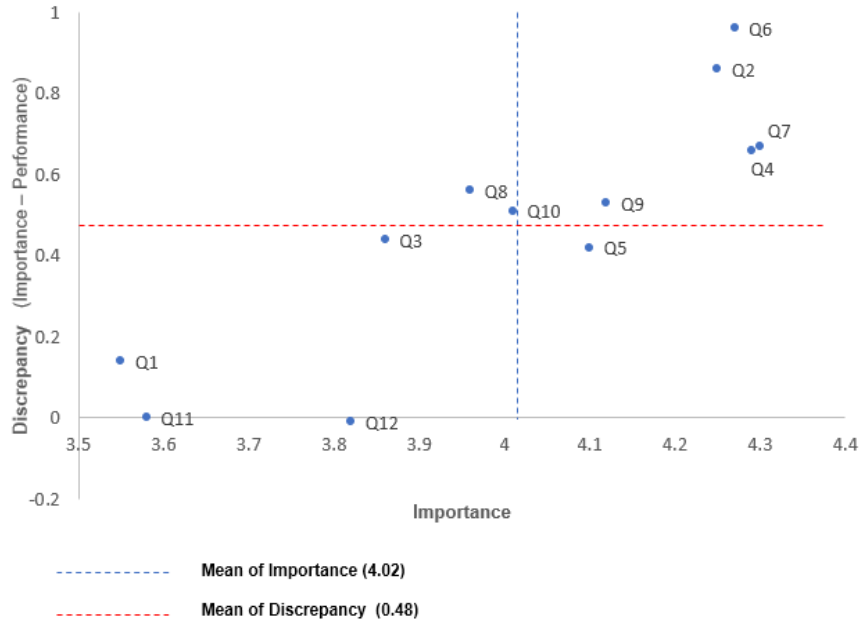


Figure 4-4 Locus for Focus for Expert Group B (Ship Managers)



Amongst the key elements of the remote survey from the perspective of the ship managers, those are analysed and identified to be considered and improved preferentially according to the IPA, Borich's Needs Assessment, and The Locus for Focus Model shown in Table 4-6.

Table 4-6 Identified Key Elements Priorities (Expert Group B)

Borich's Needs (Top 5 Priority)	IPA (Quadrant I)	Locus for Focus (Quadrant II)
Q 6	Q 2, Q 6, Q 10	Q 2, Q 4, Q 6, Q 7, Q 9
Q 2		
Q 7		
Q 4		
Q 8		

4.3 Seafarers (Expert Group C)

A total of 138 people participated in the survey of Expert Group C, which consists of seafarers. The difference in perception of the remote survey key elements of seafarers was analysed by dividing into IPA, Borich's Needs Assessment, and The Locus for Focus Model. Table 4-7 summarises the results of the IPA, Borich's Needs Assessment, and the Locus for Focus Model. Figure 4-5 graphically provides the IPA analysis results. Quadrant I corresponds to an area with high importance while low-performance expectation. Therefore, key elements in quadrant I are the most prioritised. Figure 4-6 graphically provides the analysis results according to the Locus for Focus Model. The area of quadrant II has high importance, while the discrepancy (Importance – Performance) is high. Therefore, Quadrant II is an area where elements in priority are needed to improve performance.

Table 4-7 IPA, Borich's Needs Assessment, and the Locus for Focus Model for Expert Group C (138 Seafarers)

Questionnaire	Borich's Needs Assessment		IPA		Locus for Focus Model
	Borich's Needs	Priority	Importance	Performance	
Q 1	0.74	10	3.63	3.43	LL
Q 2	3.65	3	4.17	3.29	HH
Q 3	3.02	4	4.21	3.49	HH
Q 4	2.72	7	4.12	3.46	HH
Q 5	2.78	5	4.09	3.41	LH
Q 6	3.76	1	4.15	3.25	LH
Q 7	3.74	2	4.30	3.43	HH
Q 8	2.45	8	3.97	3.36	LH
Q 9	2.39	9	4.02	3.43	LH
Q 10	2.73	6	4.06	3.38	HH
Q 11	0.31	11	3.90	3.82	LL
Q 12	0.11	12	3.88	3.86	LL

Figure 4-5 IPA Expert Group C (Seafarers)

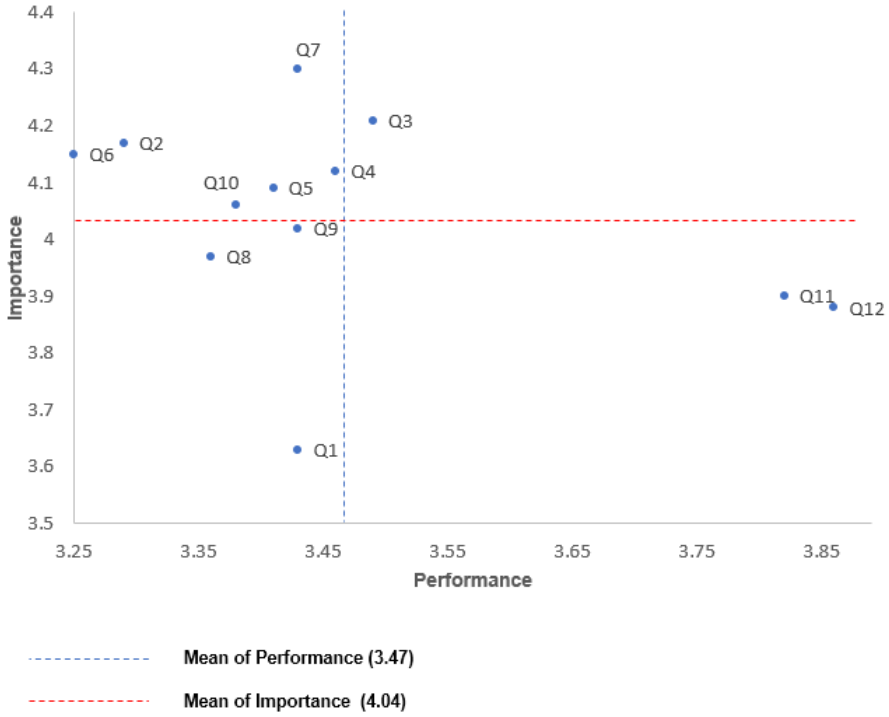
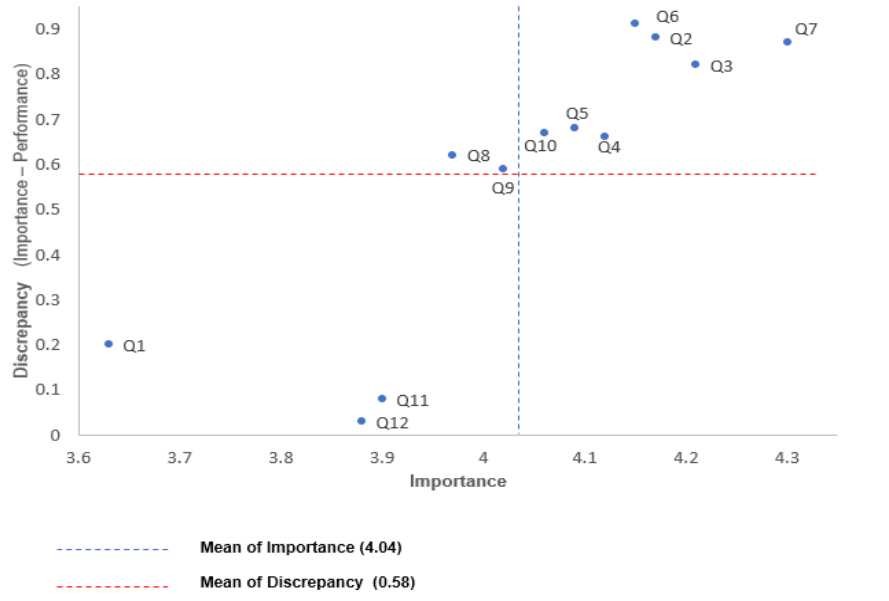


Figure 4-6 Locus for Focus Model for Expert Group C (Seafarers)



Amongst the remote survey's various key elements from the seafarers' perspective, those are analysed and identified to be considered and improved preferentially according to the IPA, Borich's Needs Assessment, and The Locus for Focus Model are shown in Table 4-8.

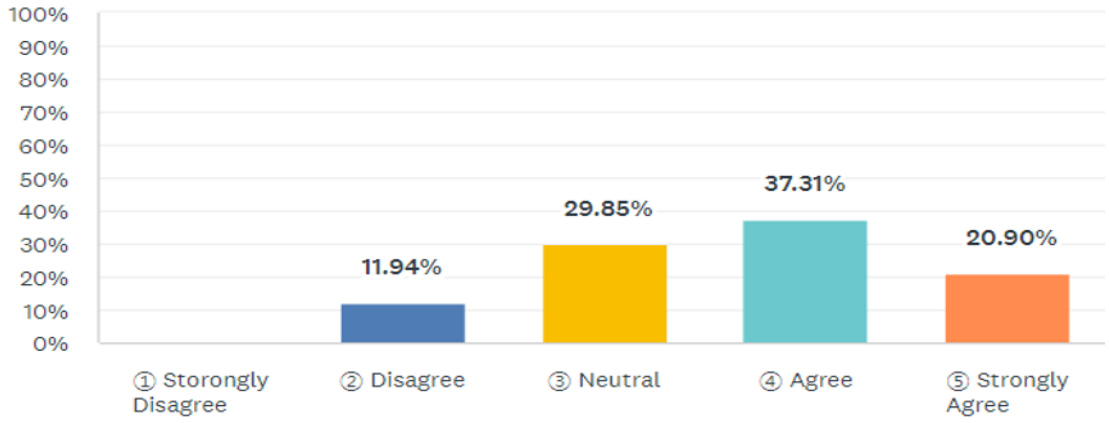
Table 4-8 Identified Key Elements Priorities (Expert Group C)

Borich's Needs (Top 5 Priority)	IPA (Quadrant I)	Locus for Focus (Quadrant II)
Q 6 Q 7 Q 2 Q 3 Q 5	Q 2, Q 4, Q 5, Q 6, Q 7, Q 10	Q 2, Q 3, Q 4, Q 5, Q 6, Q 7, Q 10

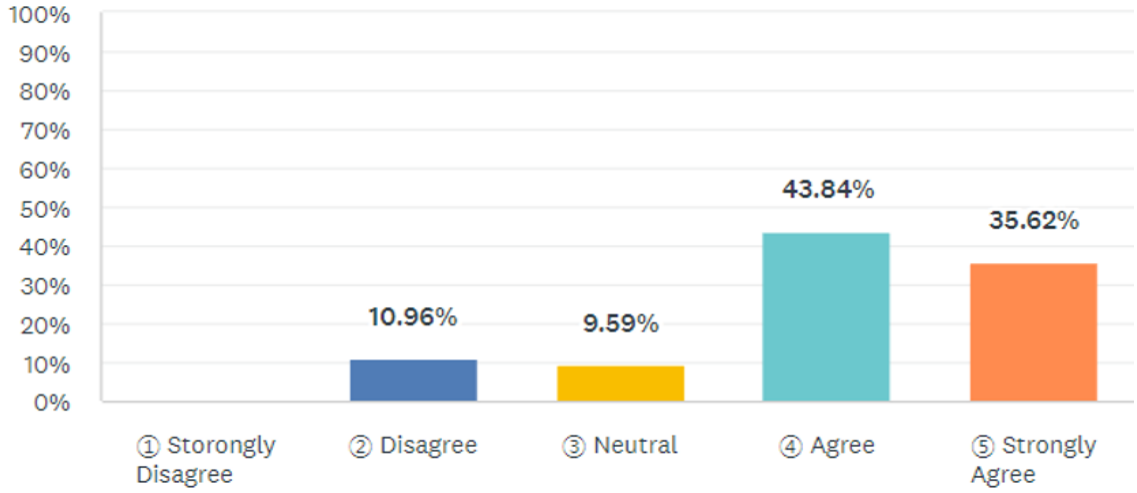
4.4 Predictions for Future Remote Ship Survey

At the beginning of the questionnaire survey for this study, the "Prospect of how much remote survey will expand in the future" and the "Expectation of how effective remote survey can be conducted in the future, compared to the current on-site ship survey" were asked to all participants. According to the collected data, the question of "expansion of future remote survey" predicted that all groups of experts would expand to almost a similar level in the future, as shown in Figure 4-7.

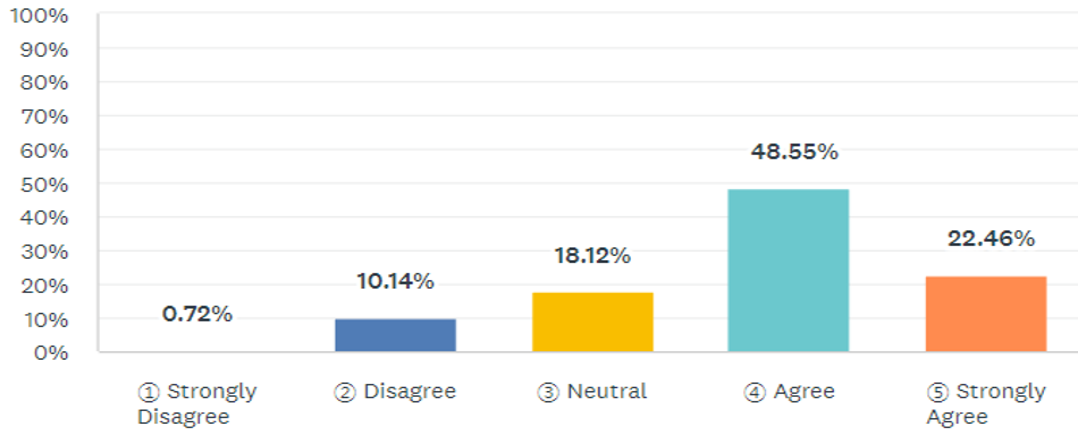
Figure 4-7 Prediction of Expansion of remote survey in the future (a),(b),(c)



(a) Ship Surveyor Group



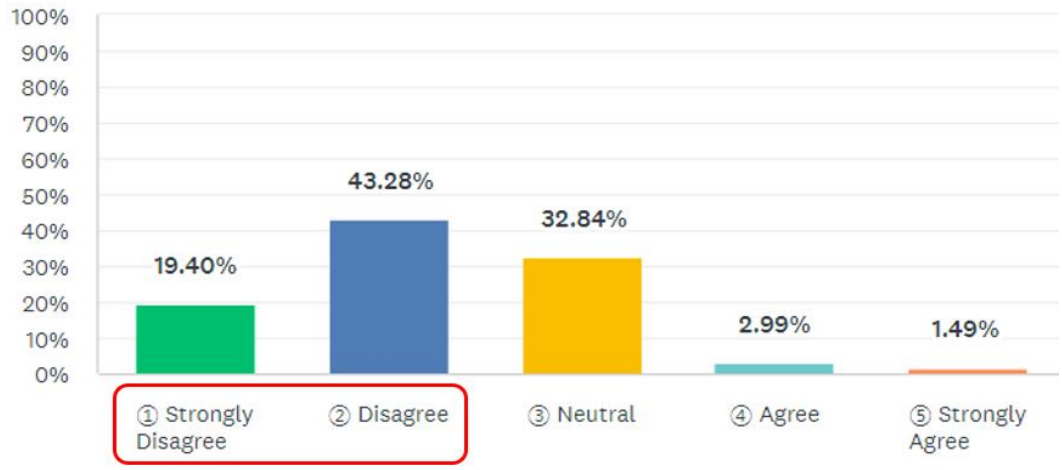
(b) Ship Manager Group



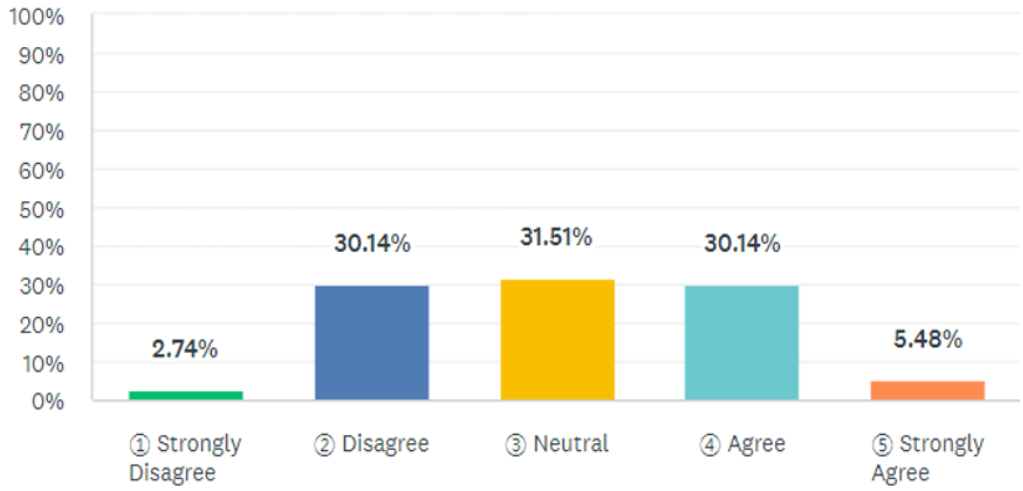
(c) Seafarer Group

However, as shown in Figure 4-8, especially (a) Ship Surveyor Group, the ship surveyors group showed an opposing view, unlike ship managers and seafarers, on the question of the effectiveness of remote surveys in the future. This ratio accounts for more than half of all respondents of ship surveyors, except for "Neutral", indicating that a significant number of ship surveyors do not trust the effectiveness of remote ship surveys. This study aims to identify key elements that must be secured when the remote survey is expanded and to identify priorities amongst key elements identified for each stakeholder group. However, if groups have a position to question the reliability and effectiveness of remote surveys, it may affect the importance of key elements and predictive performance between those groups with positive and other groups with negative.

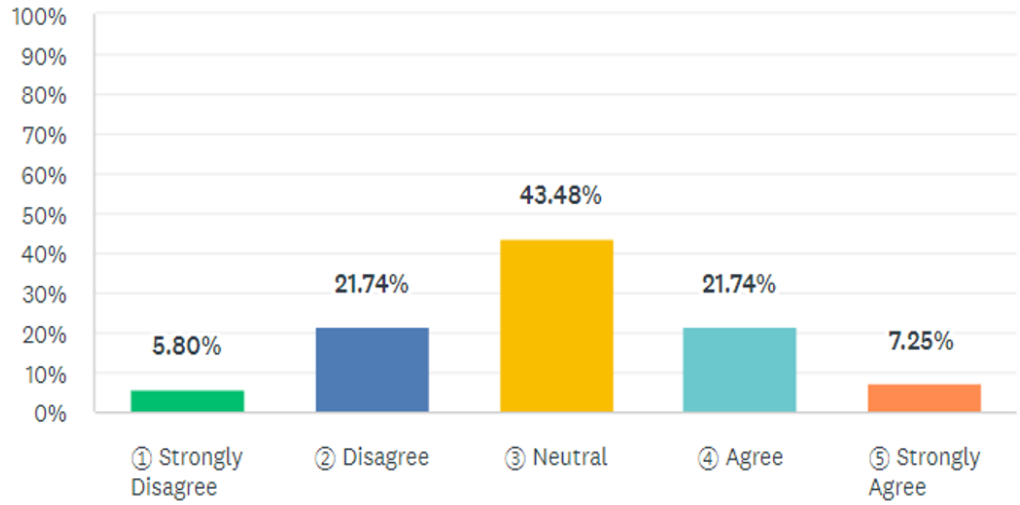
Figure 4-8 Prediction of Quality of remote survey in the future compared with on-site survey (a),(b),(c)



(a) Ship Surveyor Group



(b) Ship Manager Group



(c) Seafarer Group

5. Discussion and Limitations

5.1 Discussion of Findings

5.1.1 Expert Group A

According to Fig.4-1, 4-2 and Table 4-3, 4-4 of Chapter 4.1, in the ship surveyors group, it was identified that the priority order of Remote Survey Supporter (Q6), Service Suppliers (Q7), Safety of Seafarers (Q2), Hardware (Q4), and Software (Q5) to be considered according to Borich's Needs Coefficient. In addition, quadrant I of IPA and quadrant II of Locus for Focus Model include elements such as Safety of Seafarers (Q2), Hardware (Q4), Software (Q5), Remote Survey Supporter (Q6), Service Supplier (Q7), Remote Surveyor (Q8) and Reporting and Record Keeping (Q9), which are needed to be considered as high priorities to be improved for effective remote ship survey in the future.

Among them, the most notable part is the Locus for Focus Model's quadrant I, which represents the relationship between importance and discrepancy (importance – performance). Because this area is the most important and requires much improvement, it is an area that should be considered urgent to improve. Therefore, it was found that Expert Group A (ship surveyors) considered the issues such as safety for seafarers, technical requirements for hardware and software, qualifications and capabilities of remote survey supporters, service suppliers, capabilities of remote surveyors and reporting and record-keeping need to be and improved as high priorities for effective implementation of the remote survey in the future. These

elements are particularly emphasized and supported in the documents of Member States recently submitted to the IMO 8th III Sub-committee (IMO, 2022a; IMO, 2022b; IMO 2022c). In addition, these elements are very consistent with the elements that IACS, an organization representing ship surveyors, pays attention to and considers as tasks to be solved for the remote survey in the future (IACS, 2021a).

In particular, there were some other comments expressing concern about the reliability of the Remote Survey Supporter. Therefore, there were opinions that transparency of the remote survey supporter should be secured for areas that the surveyors cannot directly confirm. This issue has already been mentioned in the document submitted to the IMO and guidelines of some classification societies regarding the qualifications and capabilities of remote survey supporters conducting inspections on board (IMO, 2022a; KR, 2021; NK, 2021; CCS, 2022).

5.1.2 Expert Group B

According to Fig.4-3, 4-4 and Table 4-5, 4-6 of Chapter 4.2, in the ship managers group, it was identified that the priority order of Remote Survey Supporter (Q6), Safety of Seafarers (Q2), Service Suppliers (Q7), Hardware(Q4), and Remote Surveyor(Q8) to be considered according to Borich's Needs Coefficient. In addition, quadrant I of IPA and quadrant II of Locus for Focus Model include elements such as Safety of Seafarers (Q2), Hardware(Q4), Remote Survey Supporter(Q6), Service Suppliers (Q7), Reporting and Record Keeping(Q9) and Cybersecurity(Q10), which are needed to be considered as high priorities to be improved for effective remote ship survey in the future.

Therefore, for effective implementation of the remote survey in the future, it was found that Expert Group B (ship managers) considered the issues, such as safety for seafarers, technical requirements for hardware, qualifications and capabilities of remote survey supporters, service suppliers, and reporting and record-keeping, need to be improved as high priorities. These elements are particularly emphasized and

supported in the documents of Member States recently submitted to the IMO 8th III Sub-committee (IMO, 2022a; IMO, 2022b; IMO 2022c). In the ship managers group, it is notable that the hardware aspect was emphasized rather than the software aspect, which is the technical requirements for the remote survey. Although remote inspection equipment has developed a lot due to recent technological advances, it has not yet reached the same level as the survey performed directly by the surveyor (Poggi et al., 2020). In line with this, elements of remote survey supporters and service supporters also appear to need more improvement.

In addition, as in other comments, there was an opinion that the level of technical requirements should be high because the survey quality may vary significantly depending on the hardware and software performance.

5.1.3 Expert Group C

According to Fig.4-5, 4-6 and Table 4-7, 4-8 of Chapter 4.3, from the seafarer's group, it was identified that the priority order of Remote Survey Supporter (Q6), Service Suppliers (Q7), Safety of Seafarers (Q2), Fatigue of Seafarers(Q3), Software(Q5) to be considered according to Borich's Needs Coefficient. In addition, quadrant I of IPA and quadrant II of Locus for Focus Model include elements such as Safety of Seafarers (Q2), Fatigue of Seafarers(Q3), Hardware(Q4), Software(Q5), Remote Survey Supporter(Q6), Service Suppliers (Q7) and Cybersecurity(Q10), which are needed to be considered as high priorities to be improved for effective remote ship survey in the future.

Therefore, it was found that Expert Group C (seafarers) considered the issues, such as safety and fatigue for seafarers, technical requirements for hardware and software, qualifications and capabilities of remote survey supporters, service suppliers, and cybersecurity need to be improved as high priorities for effective implementation of the remote survey in the future. These elements are particularly emphasized and supported in the documents of Member States recently submitted to the IMO 8th III

Sub-committee (IMO, 2022a; IMO, 2022b; IMO 2022c). Seafarers play the most crucial role in the remote survey. The remote survey can increase fatigue and exposure to many safety risks. Various ship surveys are considered one of the significant external factors among the fatigue added to the seafarers (Bloor et al., 2004). Cybersecurity is also one of the critical factors threatening seafarers. Exposure to cybersecurity from the remote survey is one of the factors of particular concern for seafarers to be improved.

Among other comments related to seafarers' fatigue, the biggest concern is that in addition to the fatigue that will be aggravated during the remote survey, the remote survey preparation may further increase the fatigue of the seafarers outside the remote survey.

5.1.4 Comparative Analysis amongst Expert Groups

First, Expert Group A is the group that expressed the most significant concern about whether the remote survey can be efficiently implemented in the future, as identified in Chapter 4.4. Therefore, comparing the key elements identified by Expert Group A to those of other groups may be significant. Comparing elements in high priorities amongst different groups provides an opportunity to look more deeply for key elements of the remote survey from the stakeholders' perspective. Amongst the key elements in priority identified by the ship surveyors group, unlike the other two groups, the difference in importance and expected performance of the Remote Surveyor(Q8) was remarkable. In addition, the element of Software(Q5) was emphasized more than the ship managers group, and the element of Reporting and Record Keeping(Q9) was emphasized more than the seafarer's group. This is understood that the group of ship surveyors, who directly conduct remote surveys, believes that smooth communication, reporting, and storage of remote survey data can significantly affect the quality of remote ship surveys. In general, it was found that the factors identified as important and necessary for improvement in the group of ship surveyors were specifically and importantly addressed in IACS UR Z29 (IACS, 2022a).

The survey analysis of the ship managers group emphasized Cybersecurity(Q10) compared to the ship surveyors group, and the reporting and record-keeping(Q9) were more emphasized than the seafarer's group. It is understood that ship managers are more affected by the cybersecurity threat than ship surveyors and consider the importance of reporting and record-keeping for managing remote surveys between ships and surveyors. This is because the loss of shipping companies due to cybersecurity is difficult to estimate (Jones et al., 2016). In addition, ship managers should mainly serve as intermediate media between ships and surveyors to conduct remote surveys.

Lastly, in the seafarer's group, the element for Fatigue of Seafarers(Q3) took precedence over the other two groups. The biggest reason is that the subject of the remote survey is transferred to the seafarers, not the ship surveyors, compared to the conventional on-site ship surveys. In addition, the seafarer's group, like the ship manager group, cited Cybersecurity (Q10) as an element of priority that should be considered more preferentially than the ship surveyors group. The remote survey requires more education and training for seafarers (IACS, 2021a). For seafarers, education and training for the process of the remote survey, including cybersecurity related to the remote survey, may be required. It is understood that the burden on those was also recognized as increased fatigue for seafarers.

5.2 Limitations

First of all, remote ship surveys involve a number of stakeholders. In addition to ship surveyors, ship managers, and seafarers as participant groups in this study, there may be more diverse stakeholders such as flag States, service suppliers, and port States. However, in this study, the questionnaire survey recipients were limited to only

three expert groups: ship surveyors, ship managers and seafarers, that can be classified as the most representative stakeholders of remote ship surveys.

Second, this study has limitations in predicting and comparing the importance of each element of the remote survey and future performance based on the current time. This is because survey respondents have limited experience in performing remote surveys only for force majeure reasons such as COVID-19, and there is no case in which universal and extensive remote surveys have been practically implemented. Therefore, stakeholders' perspectives may change depending on the development of RIT (Remote inspection technique) or the change in the related legal framework according to the future technology development.

Third, in the questionnaire survey for this study, the number of participants for each sample group is not the same. Therefore, in comparing the analysis results amongst groups, it should be cautious about comparing them objectively according to the same weight. This is because there is a possibility that different results could be derived if the same number of sample groups is investigated.

Finally, the questionnaire survey for this study was conducted on stakeholders active in the Republic of Korea with a questionnaire translated into Korean. Therefore, there may be some influence on the direction of the response depending on the respondent's technical and social working environment and experiences.

6. Conclusion

Raising the need for remote ship surveys triggered by the global COVID-19 outbreak is now being discussed as an extended application of remote ship surveys in ordinary situations beyond extraordinary situations such as force majeure. IMO is rushing to develop remote survey guidelines for effective and unified implementation of remote ship surveys. Member States of IMO and IACS present the experience of remote surveys and the expected problems of the remote survey to be implemented in the future and are spurring the development of key elements that must be included in the guidelines to develop more effective and practical remote survey guidelines.

This study was begun to identify the most important elements necessary for the remote survey before developing remote survey guidelines and identifying the priority of improvements required by stakeholders for effective remote surveys in the future. Accordingly, specific elements related to the development of remote survey guidelines have been identified through rules of classification societies and IACS documents, discussions in IMO and literature review on the remote survey. In addition, through a questionnaire survey of major stakeholders group of the remote survey, the gap between the importance of key elements required for the remote survey and predictive performance of future remote surveys were analysed, and identified elements requiring improvement were considered preferentially by each expert group.

Identifying the elements requiring improvement was a very meaningful process in conducting an investigation by dividing major stakeholders group. In particular, the issue of the safety of seafarers performing a remote survey on ships and the issue of

the fatigue of seafarers intensified by the preparation and implementation of the remote survey is all the more meaningful because those are new issues raised apart from the discussion at IMO and rules of classification societies and IACS. Moreover, the safety and fatigue of seafarers due to remote surveys were identified as one of the most important key elements according to this study's analysis of the questionnaire survey results.

Most of the 278 respondents who participated in the questionnaire survey for this study are experts currently performing tasks directly related to remote surveys and have considerable experience and know-how related to ship surveys. Therefore, amongst the elements of remote survey, the key elements in priority identified by analysing the questionnaire survey data of the expert groups need to be treated very carefully and important and prioritised to review on implementation of the remote survey.

Although limitations of this study remain regrettable that the survey was conducted based in the Republic of Korea, with an unequal number of respondents among the expert groups and limited to three expert groups representing interested stakeholders of the remote survey. However, if further research beyond these limitations is conducted in the future, this study will be a sufficiently helpful basis for future research on the effective implementation of the remote survey. In addition, it can be used as valuable data for not only the development of remote survey guidelines but also for the safety and welfare of seafarers related to the implementation of remote ship surveys, technology, economic research, and policy development of remote ship surveys in the future.

References

Bloor, M. J., Pentsov, D., Levi, M., & Horlick-Jones, T. (2004). Problems of global governance of seafarers' health & safety. Cardiff: Seafarers International Research Centre.

Borich, G. D. (1980). A needs assessment model for conducting follow-up studies. Journal of teacher education, 31(3), 39-42.

Bureau Veritas. [BV]. (2021, June 01). NI672 R00 - Guidelines for remote survey. https://marine-offshore.bureauveritas.com/ni672-guidelines-remote-survey

Chae, C. J., Kim, K. H., & Kang, S. Y. (2021). Limiting ship accidents by identifying their causes and determining barriers to application of preventive measures. Journal of Marine Science and Engineering, 9(3), 302.

Chae, C.J.; Kamg, S.K.; Kim, K.H. (2020). A Study on the Need to Improve Response after Marine Accident through IPA. In Proceedings of the Korean Society of Coastal Disaster Prevention, Online, Korea, 54.

China Classification Society. [CCS]. (2022, February 01). Guidelines for remote survey of ships 2022. https://www.ccs.org.cn/ccswzen/file/download?fileid=202203071045015670

Cho, D. Y. (2009). Exploring how to set priority in need analysis with survey. The journal of Research in Education, 35(8), 165-187.

Doumbia-Henry, C. (2020). Shipping and COVID-19: protecting seafarers as frontline workers. WMU Journal of Maritime Affairs, 19(3), 279-293.

Eason, C. (2020, September 29). Are remote ship surveys safe? -. Fathom World - Shipping and Maritime Industry News. Retrieved July 29 , 2022, from https://fathom.world/are-remote-ship-surveys-safe/

International Association of Classification Societies. [IACS]. (2016a, June) Guidelines for Use of Remote Inspection Techniques for Surveys- Rev.2 (IACS Rec 42 Rev.2) Retrieved July 2, 2022, from https://iacs.org.uk/publications/recommendations/41-60/

International Association of Classification Societies. [IACS]. (2020, August) Procedure for the Training and Qualification of Survey and Plan Approval Staff - Rev.3 (IACS PR 7 Rev.3) Retrieved July 4, 2022, from https://iacs.org.uk/download/1441

International Association of Classification Societies. [IACS]. (2022a, March) Remote Classification Surveys. (IACS UR Z29) Retrieved July 2, 2022, from https://iacs.org.uk/download/14078

International Association of Classification Societies. [IACS]. (2021a, February). IACS Information Paper on Remote Survey for Interested Stakeholders. https://iacs.org.uk/media/7738/iacs-remote-surveys-information-paper.pdf

International Association of Classification Societies. [IACS]. (2021b, August) Procedural requirements for service suppliers (IACS UR Z17 Rev.16) Retrieved July 2, 2022, from https://iacs.org.uk/download/4524

International Association of Classification Societies. [IACS]. (2016b, June) On board use and application of computer based systems (IACS UR E22 Rev.2) Retrieved July 4, 2022, from https://iacs.org.uk/download/4054

International Association of Classification Societies. [IACS]. (2022b, April) Recommendation on Cyber Resilience (IACS REC166 New Corr.2) Retrieved July 4, 2022, from https://iacs.org.uk/download/10714

International Maritime Organization (IMO). (1993). Resolution A.772(18). Fatigue Factors in Manning and Safety. London: Author

International Maritime Organization (IMO). (2013). Resolution MSC.349(92). Code for Recognized Organizations (RO Code). London: Author

International Maritime Organization (IMO). (2017). Resolution MSC.428(98). Maritime Cyber Risk Management in Safety Management System (SMS). London: Author

International Maritime Organization (IMO). (2019). MSC.1/Circ.1598. Guidelines on Fatigue. London: Author

International Maritime Organization (IMO). (2021d). MSC-FAL.1/Circ.3/Rev.1. Guidelines on Maritime Cyber Risk Management. London: Author

International Maritime Organization (IMO). (2021h, December 15). Resolution A. 1156(32). Survey Guidelines under the Harmonized System of Survey and Certification (HSSC), 2021. London: Author

International Maritime Organization. [IMO]. (2020a, November 30). Report of the maritime safety committee on its 102nd session: Submitted by Secretariat (MSC 102/24). London: Author

International Maritime Organization. [IMO]. (2020b, October 20). Proposal to develop guidance on remote surveys in response to increase in their use during the COVID-19 pandemic: Submitted by Republic of Korea (MSC 102/22/11). London: Author

International Maritime Organization. [IMO]. (2021a, June 30). Proposal for developing guidance on the remote surveys: Submitted by Republic of Korea (MSC 104/15/3). London: Author

International Maritime Organization. [IMO]. (2021b, June 30). Proposal for regulating remote survey and audit: Submitted by Austria et al. (MSC 104/15/6). London: Author

International Maritime Organization. [IMO]. (2021c, May 26) Coronavirus (COVID-19) – Guidance for flag States regarding surveys and renewals of certificates during the COVID-19 pandemic (IMO Circular Letter No.4204/Add.19/Rev.3). London: Author

International Maritime Organization. [IMO]. (2021e, October 19). Report of the Maritime Safety Committee on its 104th Session: Submitted by Secretariat (MSC 104/18). London: Author

International Maritime Organization. [IMO]. (2021f, June 30). Proposal for a new output on guidelines for remote inspections and verifications in the field of maritime security: Submitted by Austria et al. (MSC 104/15/12). London: Author

International Maritime Organization. [IMO]. (2021g, July 2). Proposal for a new output on undertaking a scoping exercise of the framework and developing technical requirements for remote surveys: Submitted by China (MSC 104/15/24). London: Author

International Maritime Organization. [IMO]. (2022a, April 27). Proposal for amendments to the Survey Guidelines under the Harmonized System of Survey and Certification and to the Revised Guidelines on the implementation of the International Safety management (ISM) Code by Administrations and Proposal for Principles of the Guidelines on remote surveys, ISM Code audits and ISPS Code verifications: Submitted by Austria et al. (III 8/12/1). London: Author

International Maritime Organization. [IMO]. (2022b, May 20). DEVELOPMENT OF GUIDANCE ON ASSESSMENTS AND APPLICATIONS OF REMOTE SURVEYS, ISM CODE AUDITS AND ISPS CODE VERIFICATIONS AND INSPECTIONS: Submitted by China. (III 8/12/2). London: Author

International Maritime Organization. [IMO]. (2022b, May 20). Proposed draft guidance on remote surveys: Submitted by China. (III 8/12/2). London: Author

International Maritime Organization. [IMO]. (2022c, June 3). DEVELOPMENT OF GUIDANCE ON ASSESSMENTS AND APPLICATIONS OF REMOTE SURVEYS, ISM CODE AUDITS AND ISPS CODE VERIFICATIONS AND INSPECTIONS: Submitted by Turkey. (III 8/12/3). London: Author

International Maritime Organization. [IMO]. (n.d.). Fatigue. Retrieved July 30, 2022, from https://www.imo.org/en/OurWork/HumanElement/Pages/Fatigue.aspx

Jeong, S. J., & Kim, I. S. (2015). A Study on Analysis of Personal Information Risk Using Importance-Performance Analysis. The Journal of the Institute of Internet, Broadcasting and Communication, 15(6), 267-273.

Jones, K. D., Tam, K., & Papadaki, M. (2016). Threats and impacts in maritime cyber security. *Engineering & Technology Reference*. IET. http://hdl.handle.net/10026.1/4387

Korean Register. [KR]. (2021, May 01). Guidance for Remote Survey, GC-38-E. http://krs.westus.cloudapp.azure.com/Files/KRRules/KRRules2022/data/data_other/ENGLISH/gc38e000.pdf

Martilla, J. A., & James, J. C. (1977). Importance-performance analysis. Journal of marketing, 41(1), 77-79.

McCabe, B. (2020, May 11). Time to take advantage of remote surveys? - superyachtnews. Superyacht News. Retrieved August 01, 2022, from https://www.superyachtnews.com/technology/time-to-take-advantage-of-remote-surveys

Mink, O. G., Shultz, J. M., & Mink, B. P. (1991). Developing and Managing Open Organizations: A Model and Method for Maximizing Organizational Potential; Somerset Consulting Group. Inc.: Austin, TX, USA.

Nam, D., & Kim, M. (2021). Implication of COVID-19 outbreak on ship survey and certification. Marine Policy, 131, 104615.

Nippon Kaiji Kyokai (ClassNK). [NK]. (2021, December 01). Guidelines for Remote Survey – Ver.3.0 – English.

https://www.classnk.or.jp/account/ko/Rules_Guidance/ssl/download.aspx?type=pdf&path=guidelines/&file_name=gl_remotesurvey_202112e

Oh, H. (2001). Revisiting importance–performance analysis. Tourism management, 22(6), 617-627.

Poggi, L., Gaggero, T., Gaiotti, M., Ravina, E., & Rizzo, C. M. (2020). Recent developments in remote inspections of ship structures. International Journal of Naval Architecture and Ocean Engineering, 12, 881-891.

Redouane Assad (n.d.). Reexamining remote surveys through expert eyes. Marine & Offshore. Retrieved August 01, 2022, from https://marine-offshore.bureauveritas.com/reexamining-remote-surveys-through-expert-eyes

Safety4sea editorial team. (2020, June 10) Remote surveys on the rise: Pros and cons. SAFETY4SEA. Retrieved August 01, 2022, from https://safety4sea.com/cm-remote-surveys-on-the-rise-pros-and-cons/

Safety4sea editorial team. (2021, April 16) Key elements for remote surveys onboard ships. SAFETY4SEA. Retrieved August 01, 2022, from https://safety4sea.com/key-elements-for-remote-surveys-onboard-ships/

Jones, K. D., Tam, K., & Papadaki, M. (2016). Threats and impacts in maritime cyber security. Engineering & Technology Reference. IET. http://hdl.handle.net/10026.1/4387

Appendix 1

Survey Questionnaire

Dear Survey Participants

Thank you very much for participating in this survey.

My name is Lee Ji Heon, working for Korean Register. Currently, I am completing a M.Sc. program in “Maritime Safety and Environmental Administration” at World Maritime University in Malmo, Sweden.

I am currently preparing a research paper on “Effective Implementation of Ship Remote survey”. In the course of this research, your valuable opinions regarding ship remote survey will be used as invaluable data in analysing the hypothesis of my research and deriving the results. Unfortunately, we would like to inform you in advance that it is difficult to provide compensation or payment for the survey. However, your valuable comments will be of great help to the implementation and development of ship remote survey in the future, contributing to the shipping industry. Of course, I will always cherish my gratitude as a precious relationship with all of you who answered the questionnaire.

This survey will not be used for any purpose other than research purposes, and your personal information will be thoroughly protected. In addition, even when research papers are published, your personal information or personal opinions will not be disclosed at all. The data collected and analysed through this anonymous survey will be stored on a virtual drive connected to World Maritime University for the time being, but will be deleted as soon as I complete my degree. Thank you once again for taking your precious time and deciding to participate in the survey.

---------- **Researcher Information** ----------

Name: Lee Ji-heon

Major : Maritime Safety and Environmental Administration

Email : w1010763@wmu.se

Consent Confirmation

I agree to participate in this survey and confirm that I have understood all matters regarding the use of opinions and information related to the survey.

☐ I Agree *** Kindly make sure to click the “I Agree” checkbox above.**

Survey Overview

Due to COVID-19, port closures have led to difficulties for surveyors to access ships, and many international shipping vessels have experienced serious difficulties in smooth operation due to the inability to renew and endorse ship’s certificates. Therefore, the need for remote survey has been raised in earnest. In addition, various remote survey technologies, including information and communication, are expected to expand further in the future, so IMO recognizes the urgent need to prepare international guidelines for remote survey and is actively discussing.

Remote survey refers to an survey performed without the presence of an surveyor on the ship. The remote survey will be conducted by the ship's designated "remote survey supporter" using video and audio equipment to provide visual, auditory data, as well as various data related to the survey. The surveyor will conduct the survey remotely from ship at the on-shore office, by collecting real-time delivery information, pre-submitted information, and data from the service supplier such as for life saving appliances, fire protection equipment, thickness measurement, underwater inspection services. If there is no abnormality as a result, the survey will be completed by issuing/renewal/endorsement the ship certificate via the electronic certification system. However, if any abnormality is found during the survey or if the surveyor needs to check it in person, the surveyor may visit the vessel again to proceed with the survey on scene.

This questionnaire consists of questions to measure the importance, efficiency, and expected effectiveness of remote survey to be implemented in the future. It consists of 26 questions in total, but it can be more effective if you answer according to your own intuitive judgment rather than very deep consideration. I think about 10 minutes will be enough. In addition, if you have an individual's subjective opinion, please simply write it in the box located at the bottom of each question and it will be very helpful for the study.

Then, let’s start the survey. Please click only one answer for each question.

SURVEY QUESTIONS

What is your occupation?

① Seafarer ② Ship Manager (Superintendent) ③ Ship Surveyor

What is your position (Rank) ?

1) In case of Seafarer ; ① Junior officer ② Senior officer including Master & Chief Engineer

2) In case of Ship Manager ; ① Junior Manager ② Senior Manager

3) In case of Ship Surveyor ; ① Junior Surveyor ② Senior Surveyor

How many years of experience do you have? (Including your current job, combined experience in shipbuilding or shipping)

① Less than 3 Years ② 3 ~ Less than 5 Years ③ 5 ~ Less than 10 Years

④ 10 ~ Less than 20 Years ⑤ 20 years or more

Possibility of expanding remote survey for ships

Q. Do you think remote survey for ships will be further expanded in the future?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

Q. Do you think that if remote survey is expanded in the future, the quality of survey of ships (securing the safety of ships and marine environment protection) will be more improved compared to current survey with attendance of surveyor ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

1. Time and cost efficiency of remote survey

Note: Comprehensive consideration is given to surveyor's travel time/cost, Ship's survey preparation time/cost, survey progress time/cost, etc.

Q 1-1 Do you think the time/cost of remote survey is an important factor to be considered in conducting remote survey ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

Q 1-2 Do you think remote survey will be more efficient than on-site survey by surveyor in terms of time/cost?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

2. Safety of seafarers during remote survey

Q 2-1 How important do you think the safety of seafarers who support/cooperate with the survey during remote survey ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

Q 2-2 Do you think that the safety of seafarers who support/cooperate with the survey during remote survey can be at an equal level or higher than the on-site survey?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

3. Fatigue of seafarers by the remote survey

Q 3-1 Do you think fatigue of seafarers is an important factor to be considered in the implementation of remote survey ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

Q 3-2 Do you think that the fatigue of seafarers during remote survey can be improved compared to the on-site survey ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

4. Hardware used for remote survey

Note: Hardware refers to smartphones, tablet PCs, video equipment, audio equipment, etc. used for remote survey.

Q 4-1 Do you think the hardware used for remote survey plays an important role in the efficiency of remote survey ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

Q 4-2 Do you think the hardware used for remote survey can play a sufficient role in performing effective remote survey compared to the on-site survey ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

5. Software used for remote survey

Note: Software refers to applications, communication programs, etc. that enable smooth communication between ships and surveyor through the hardware used for remote survey.

Q 5-1 Do you think the software used for remote survey plays an important role in the efficiency of remote survey ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

Q 5-2 Do you think the software used for remote survey can play a sufficient role in effective survey compared to the on-site survey ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

6. Competency and Reliability of Remote survey supporter on-board

Note: Remote survey supporter means a person who supports remote survey of the ship. Generally, it refers to a person who is responsible for the relevant work of the ship and provides remote survey data to the surveyor by directly operating the hardware and software for remote survey. (e.g. ; C/O, C/E etc.)

Q 6-1 Do you think the competence and reliability of the remote survey supporter are important for effective remote survey ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

Q 6-2 Do you think that the competence and reliability of remote survey

supporter during remote survey can be guaranteed at the same level as survey directly witnessed by surveyor ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

7. Competency and Reliability of service suppliers during remote survey

Note: Service supplier means a who provides inspection services as a third party of survey such as life-saving equipment (L/Boat, L/Raft, etc.), fire extinguishing equpment, Radio equipment, thickness measurement, and underwater inspection, etc.

Q 7-1 Do you think the qualification, competency and reliability of a service supplier are important for remote survey ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

Q 7-2 Do you think that the qualification, competence and reliability of a service supplier during remote survey can be guaranteed at the same level as survey directly witnessed by surveyor ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

8. Competency of the surveyor in charge of remote survey

Note: The surveyor responsible for conducting the remote survey must be able to review the information collected remotely and have a competency to determine the survey results.

Q 8-1 Do you think that the competency of the surveyor in charge of remote survey will become more important than that of the on-site survey ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

Q 8-2 Do you think the competency of the surveyor responsible for remote survey can be sufficiently effective compared to the on-site survey ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

9. Reporting and Record keeping related to remote survey

Q 9-1 Do you think that the functions associated with keeping and reporting

records related to remote survey will become more important than the on-site survey ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

Q 9-2 Do you think the reporting and record keeping related to remote survey will function more effectively than the on-site survey ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

10. Cyber-security of Remote survey

Q 10-1 Do you think cyber-security will become more important if remote survey is carried out ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

Q 10-2 Do you think cyber-security is sufficiently secure if remote survey is carried out ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

11. Restriction of ships for remote survey

Note: It means to limit the ship for remote survey according to the results of pre-reviewing the ISM / PSC performance along with the safety of the vessel considering the type and age of the ship.

Q 11-1 Do you think it is necessary to limit vessels capable of remote survey according to the above criteria?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

Q 11-2 Do you think a more efficient remote survey system can be obtained by limiting the vessel subject to remote survey to the above criteria?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

12. Restrictions on types & scope of remote survey

Note: In conducting remote survey, it means limiting the possibility of remote survey by type and scope of ship survey. For example, surveys that are less difficult

and less important to the attendance of surveyors, such as occasional survey, make remote surveys possible, and surveys that are more difficult to survey and increase the importance of surveyor's attendance, such as special surveys, are restricted to carry out the remote survey.

Q 12-1 Do you think it is necessary to restrict the type and scope of survey when conducting remote survey ?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

Q 12-2 Do you think that limiting the type and scope of remote survey can secure a more efficient remote survey system?

① Strongly Disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly Agree

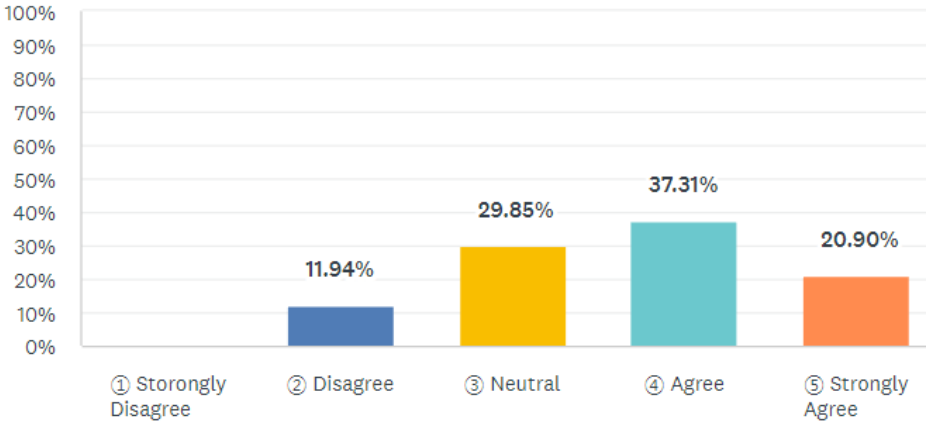
[END]

Appendix 2

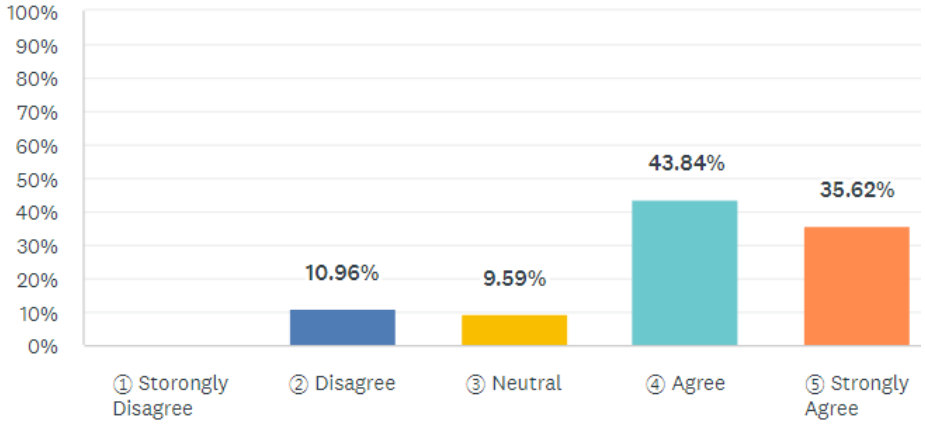
Questionnaire Survey Results

Possibility of remote ship survey

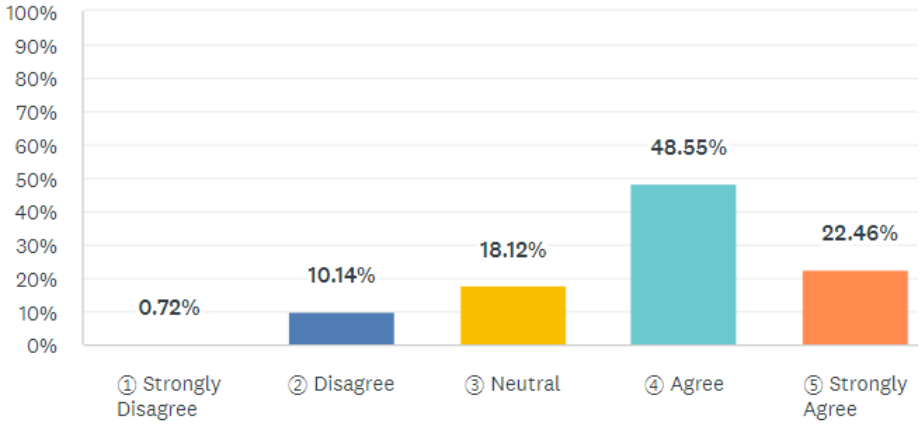
PQ-1 Expansion of Remote Survey



(a) Ship Surveyors

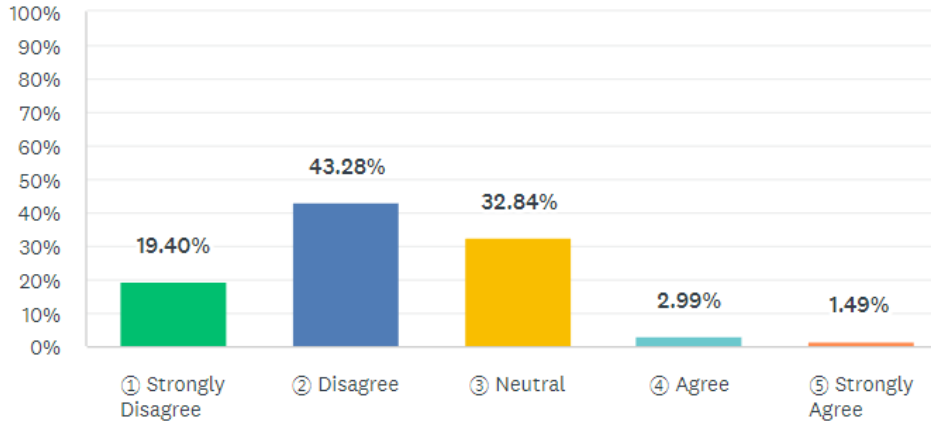


(b) Ship Managers

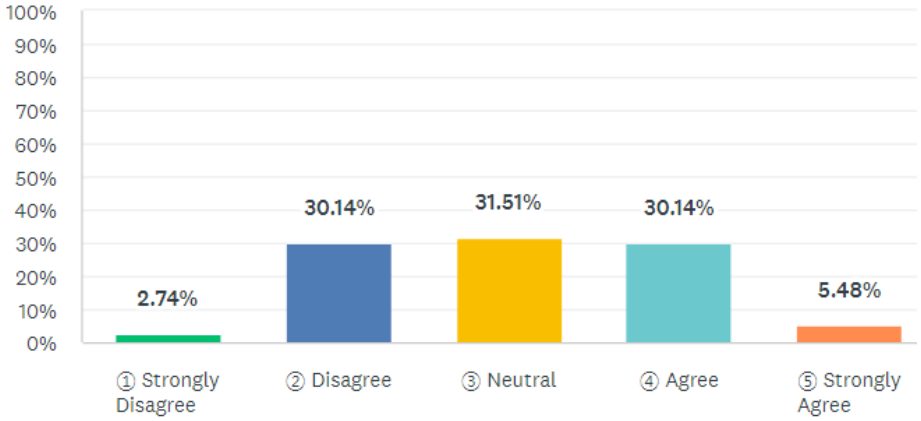


(c) Seafarers

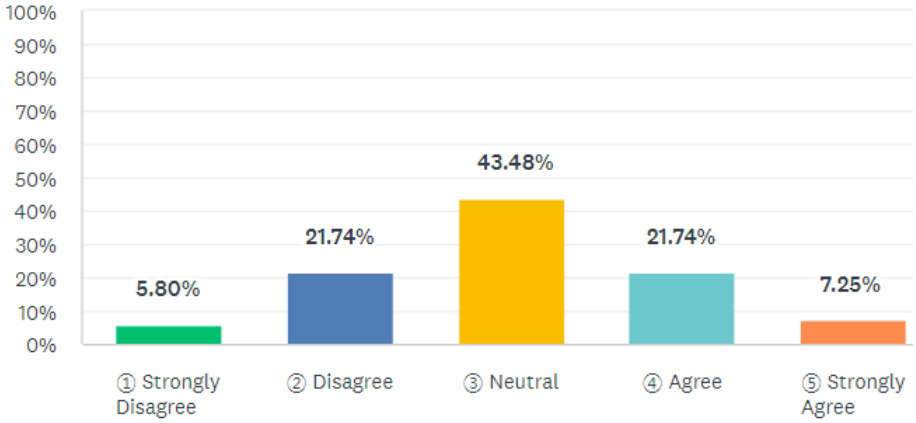
PQ-2 Effectiveness of Remote Survey



(a) Ship Surveyors



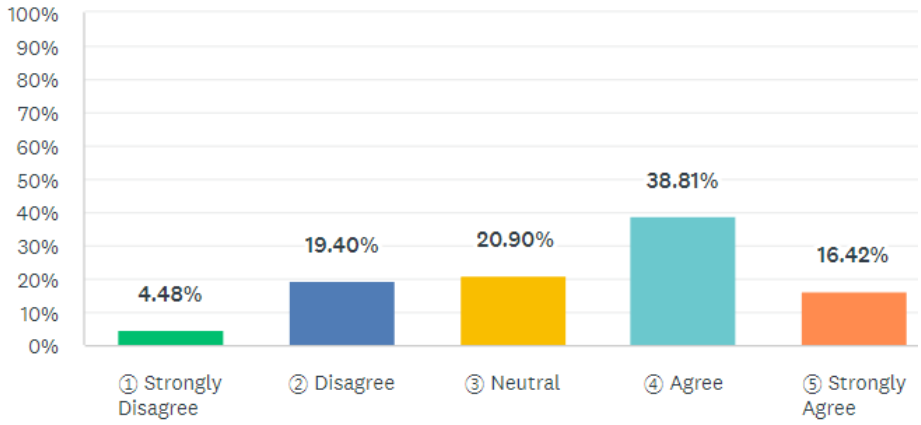
(b) Ship Managers



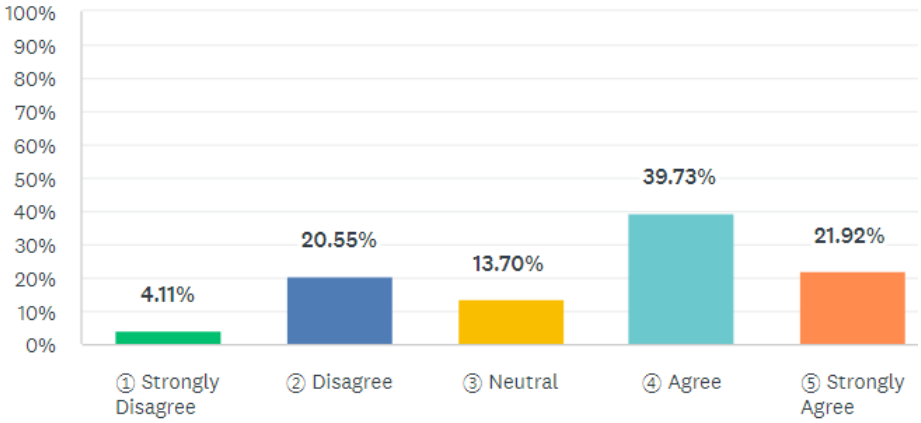
(c) Seafarers

1. Time and cost efficiency of remote survey

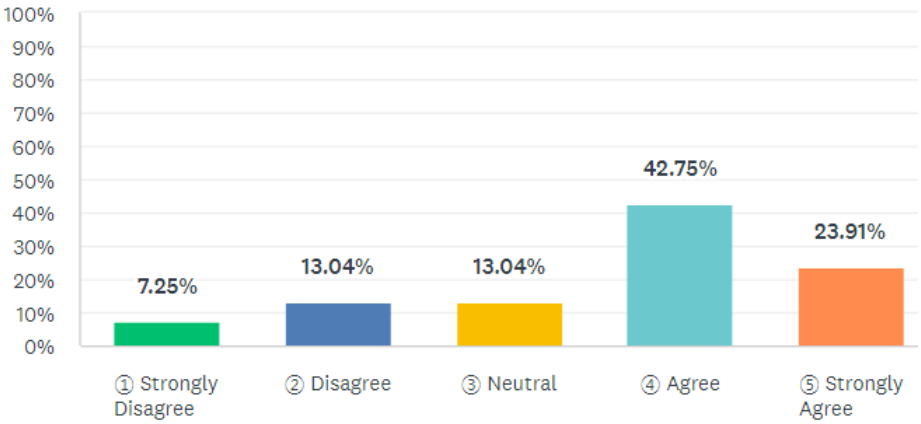
Q 1-1



(a) Ship Surveyors

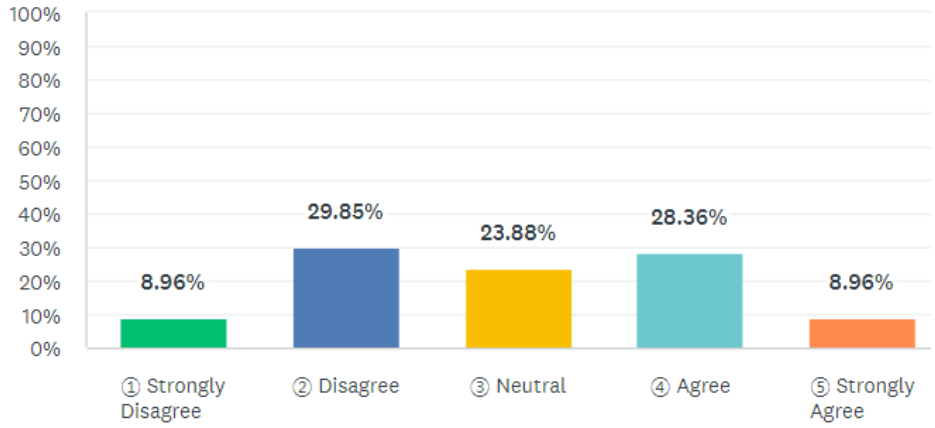


(b) Ship Managers

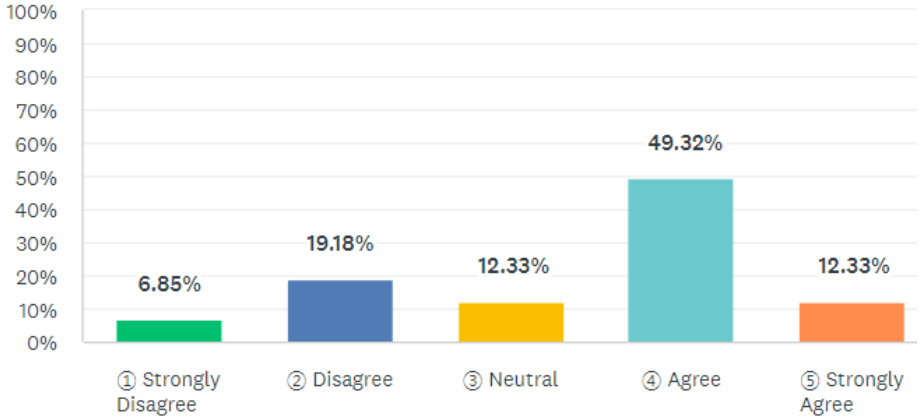


(c) Seafarers

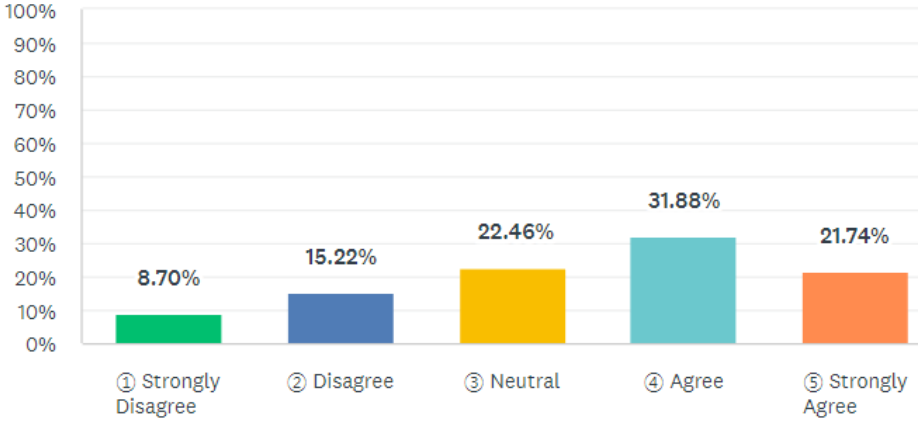
Q 1-2



(a) Ship Surveyors



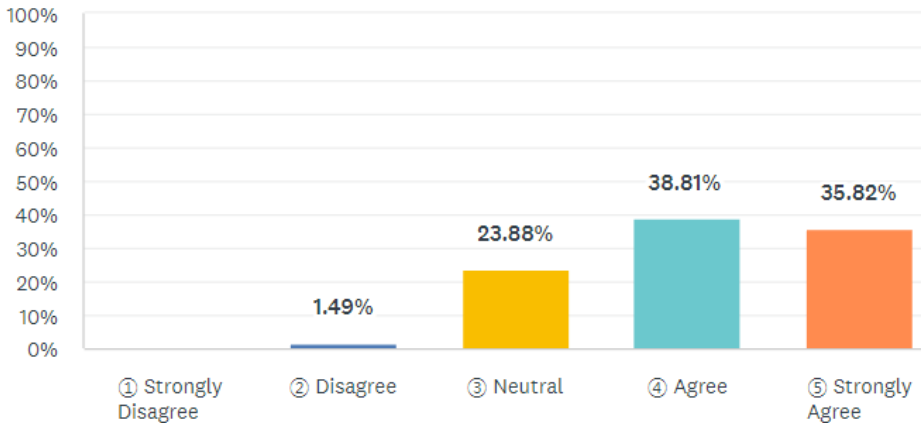
(b) Ship Managers



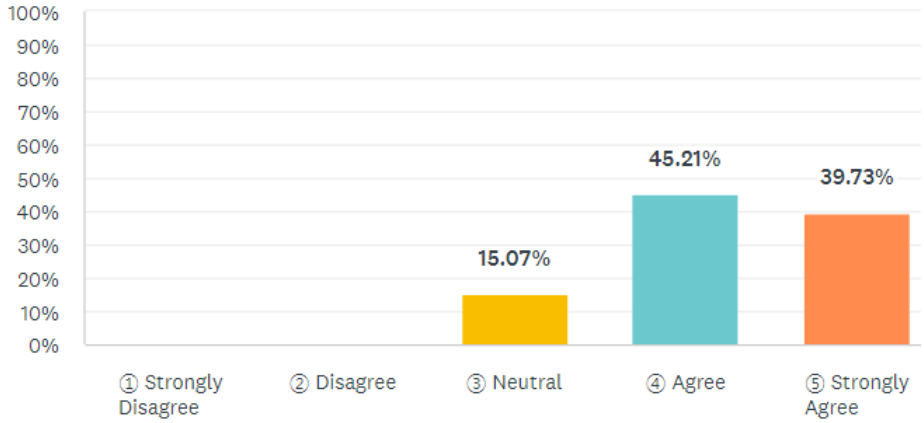
(c) Seafarers

2. Safety of seafarers during remote survey

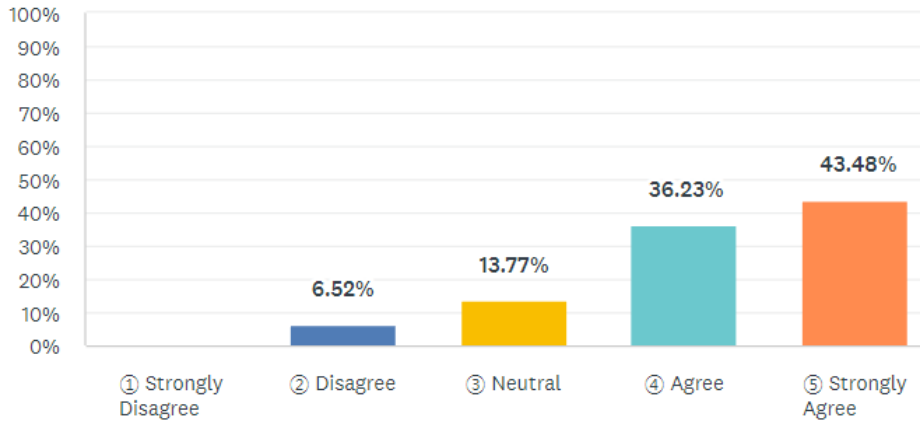
Q 2-1



(a) Ship Surveyors

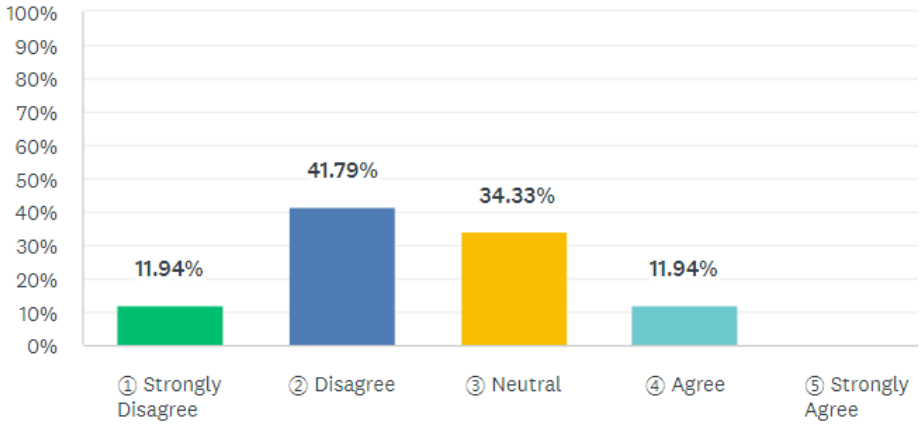


(b) Ship Managers

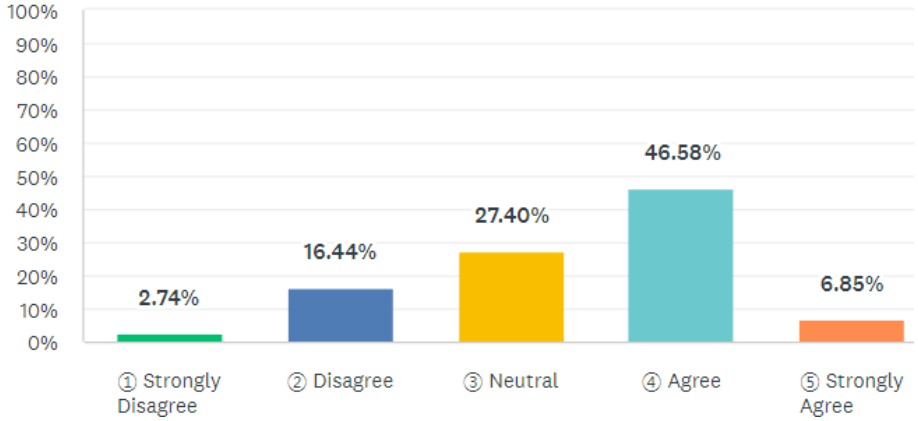


(c) Seafarers

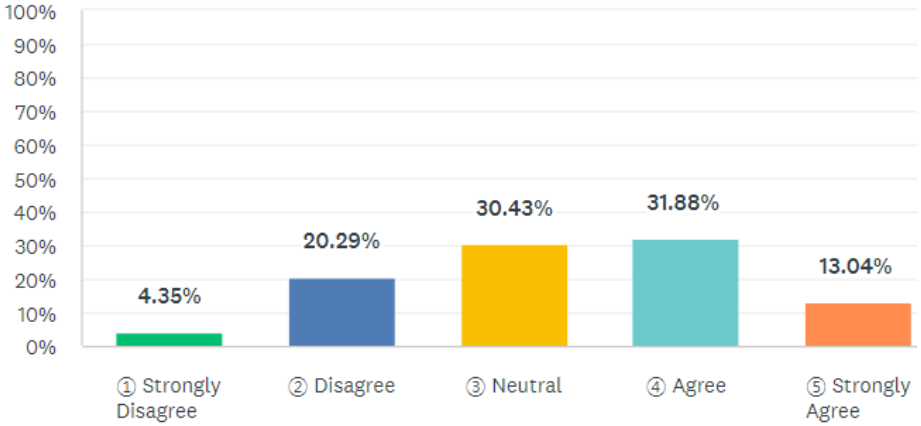
Q 2-2



(a) Ship Surveyors



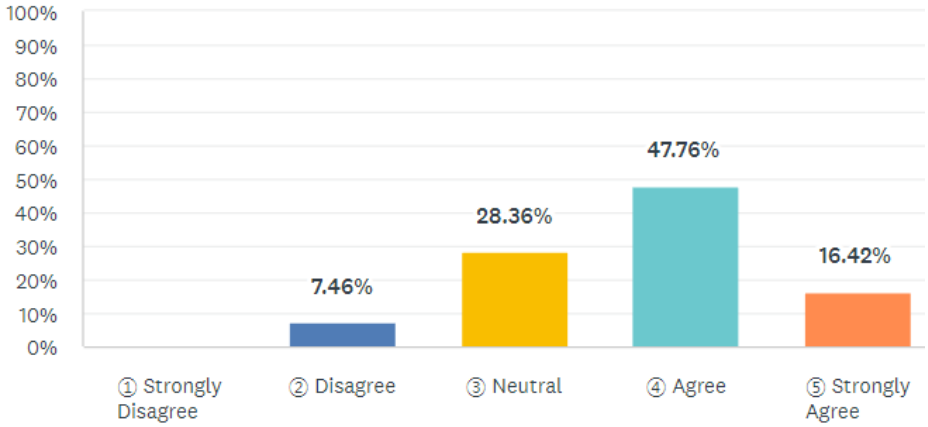
(b) Ship Managers



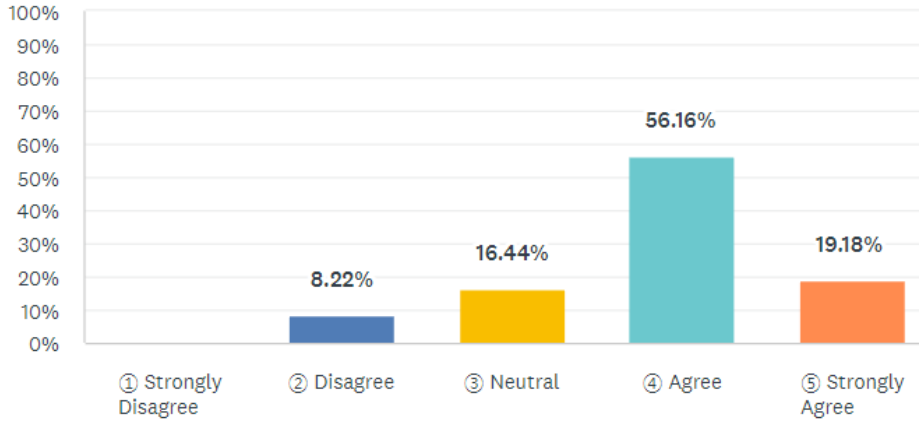
(c) Seafarers

3. Fatigue of seafarers by the remote survey

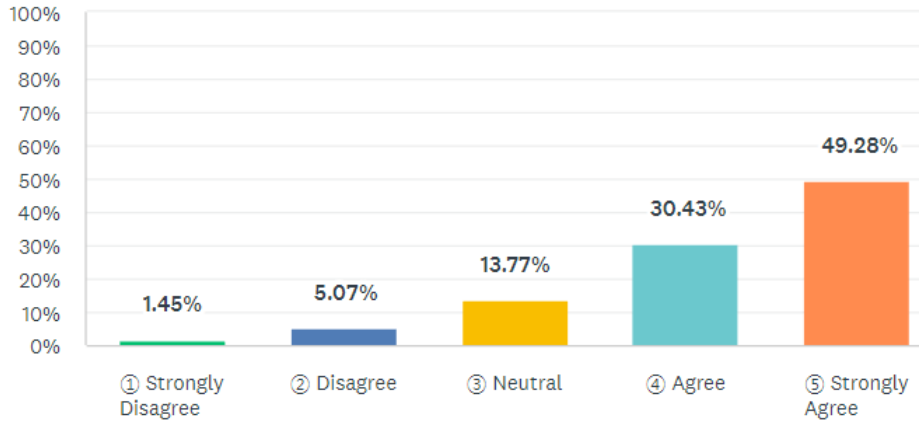
Q 3-1



(a) Ship Surveyors

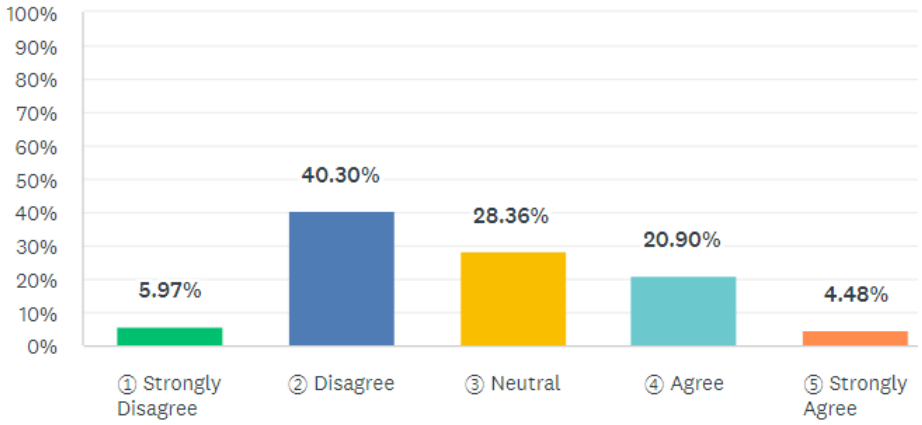


(b) Ship Managers

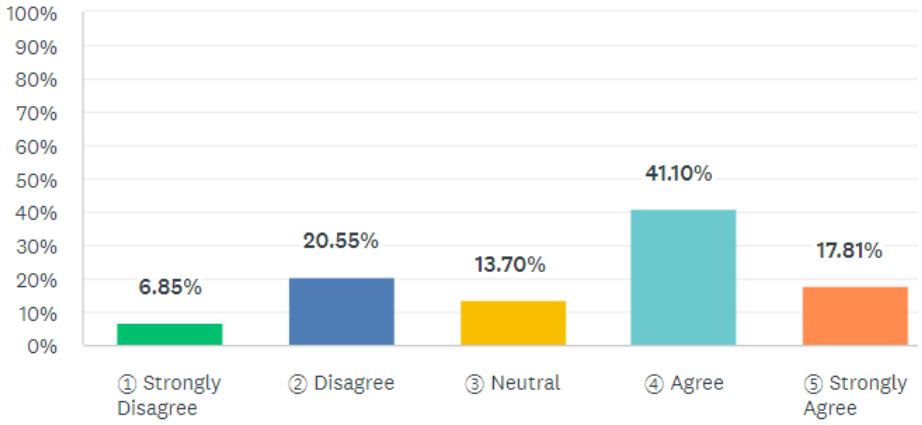


(c) Seafarers

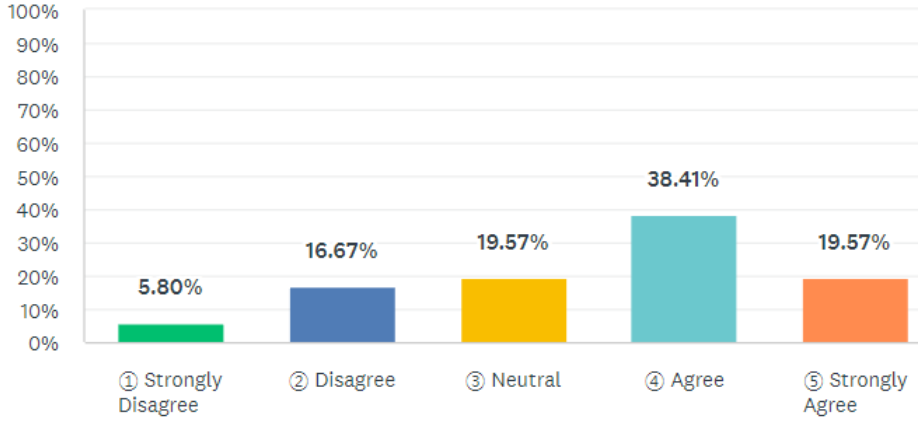
Q 3-2



(a) Ship Surveyors



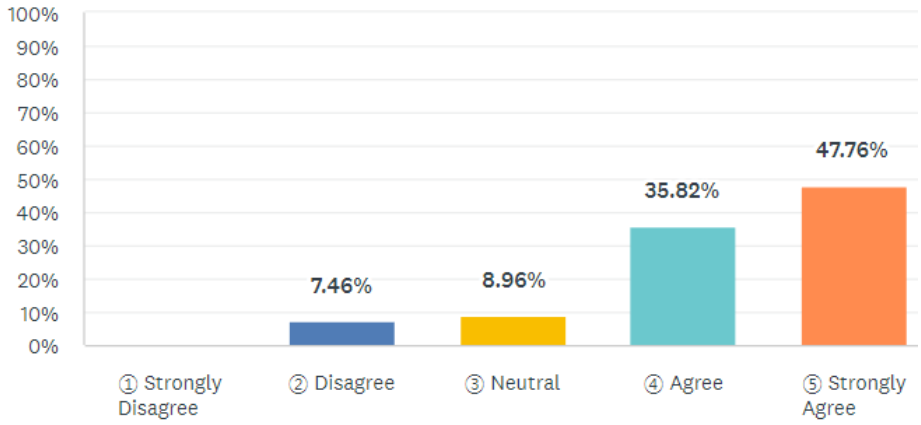
(b) Ship Managers



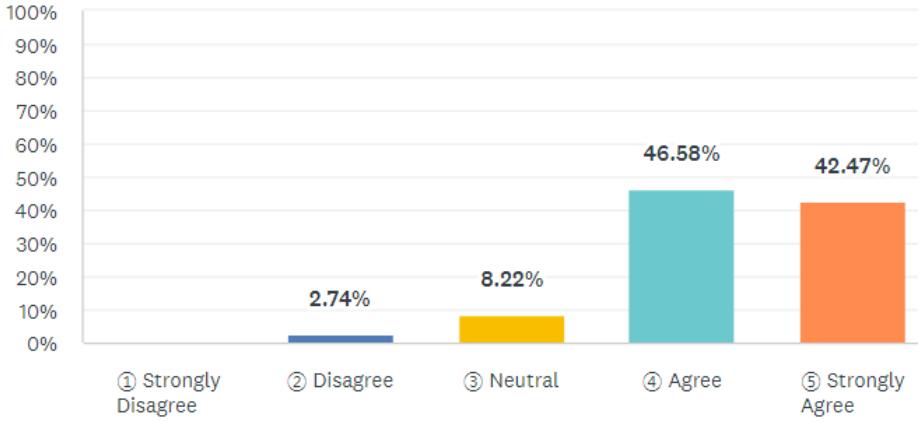
(c) Seafarers

4. Hardware used for remote survey

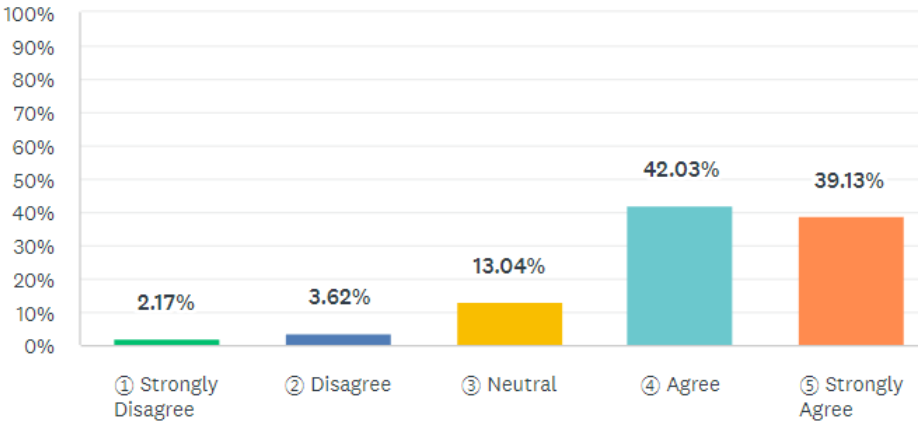
Q 4-1



(a) Ship Surveyors

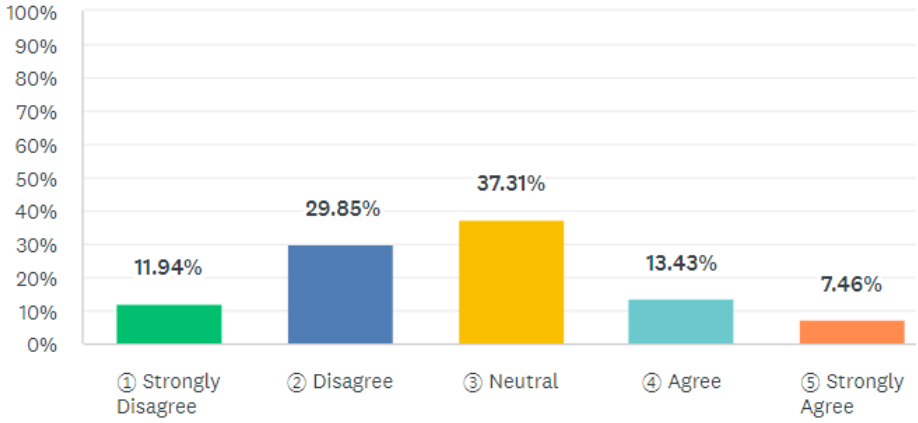


(b) Ship Managers

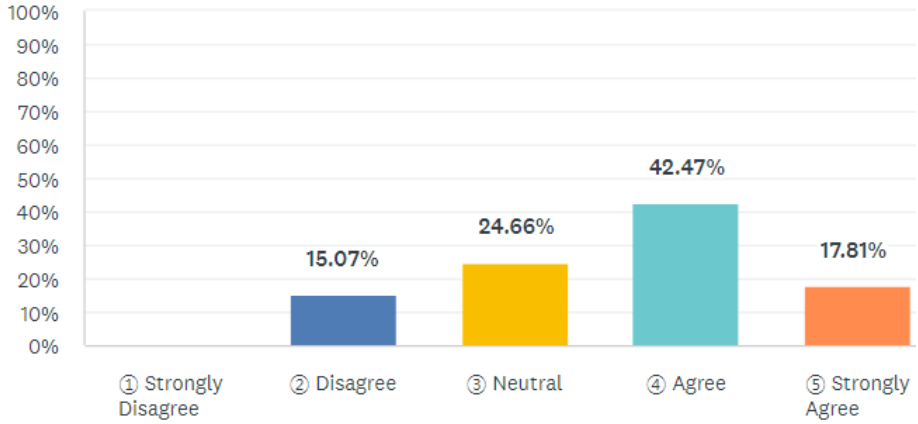


(c) Seafarers

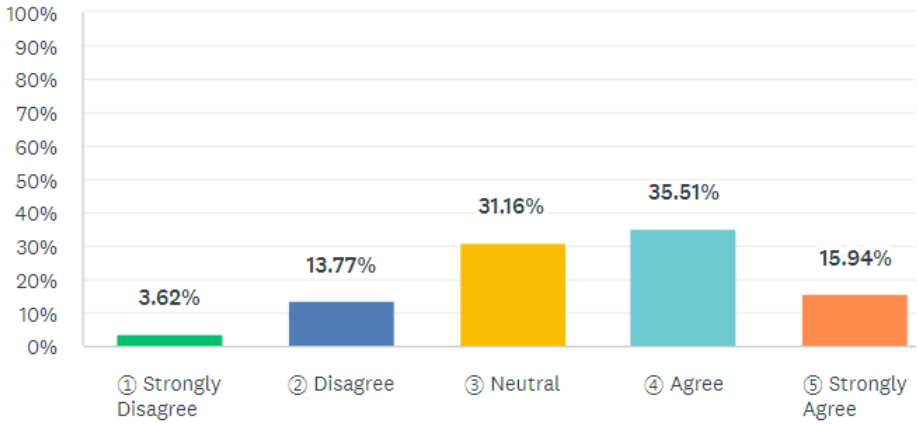
Q 4-2



(a) Ship Surveyors



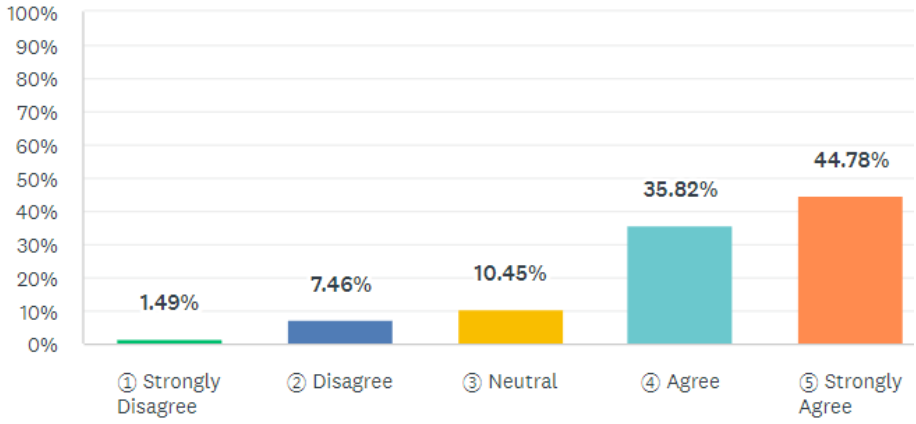
(b) Ship Managers



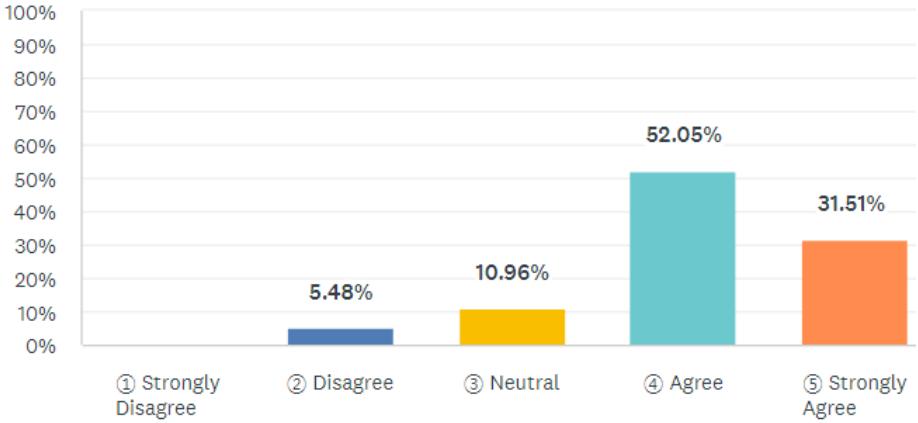
(c) Seafarers

5. Software used for remote survey

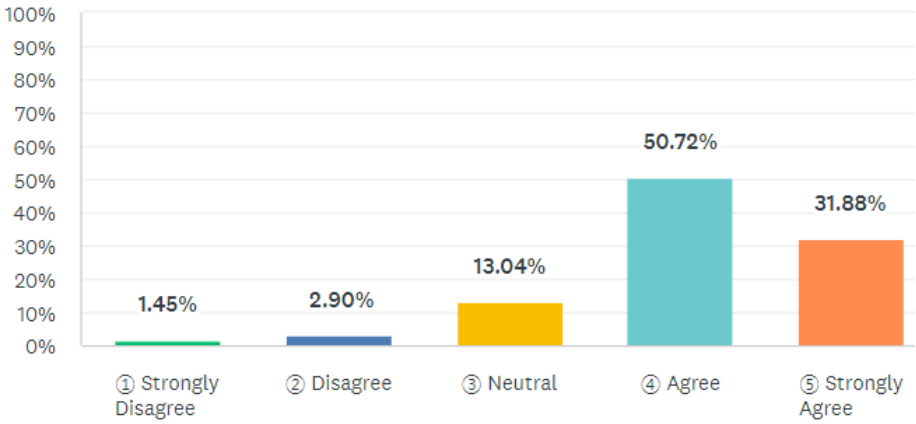
Q 5-1



(a) Ship Surveyors

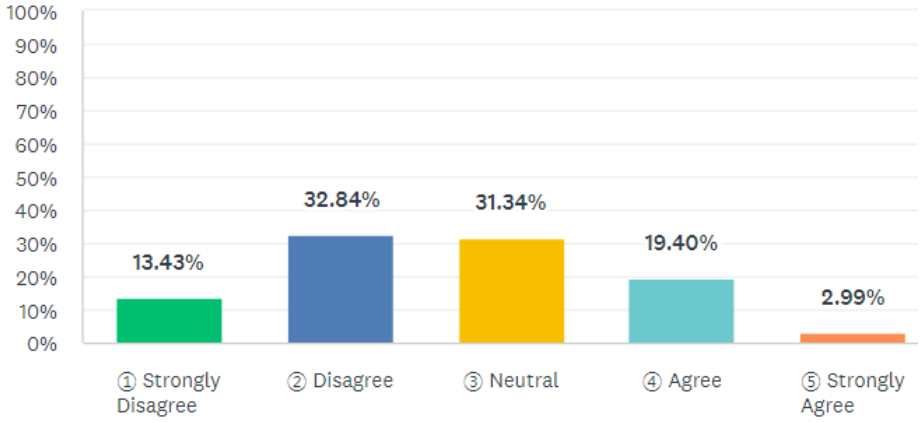


(b) Ship Managers

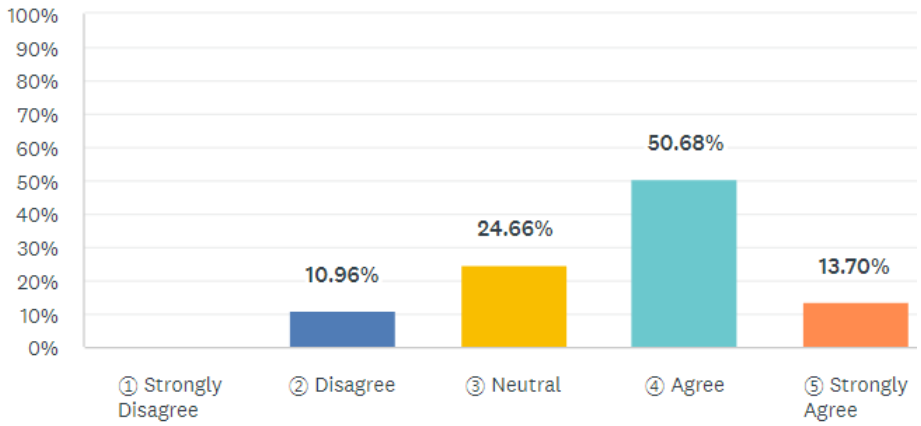


(c) Seafarers

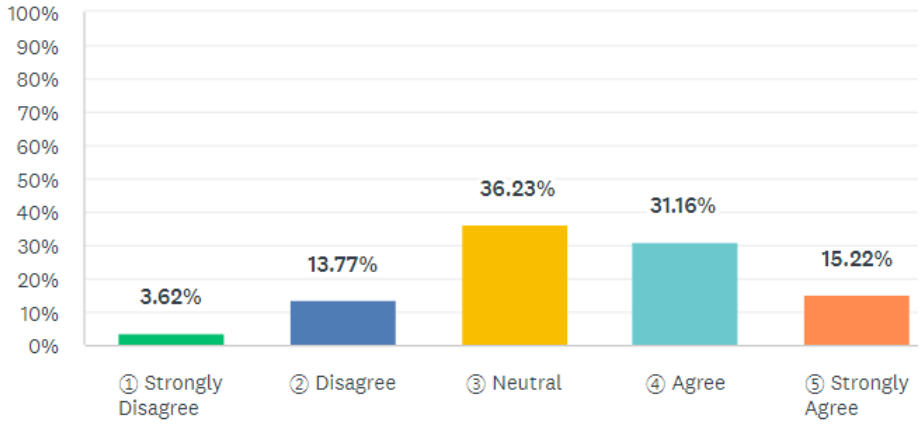
Q 5-2



(a) Ship Surveyors



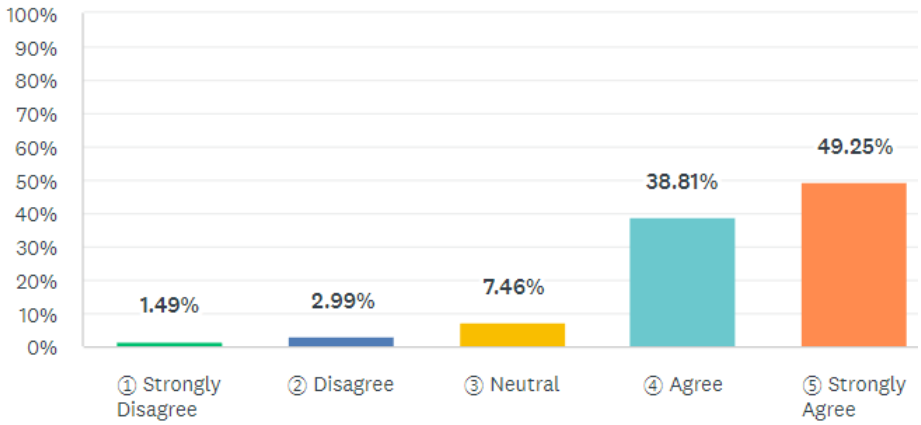
(b) Ship Managers



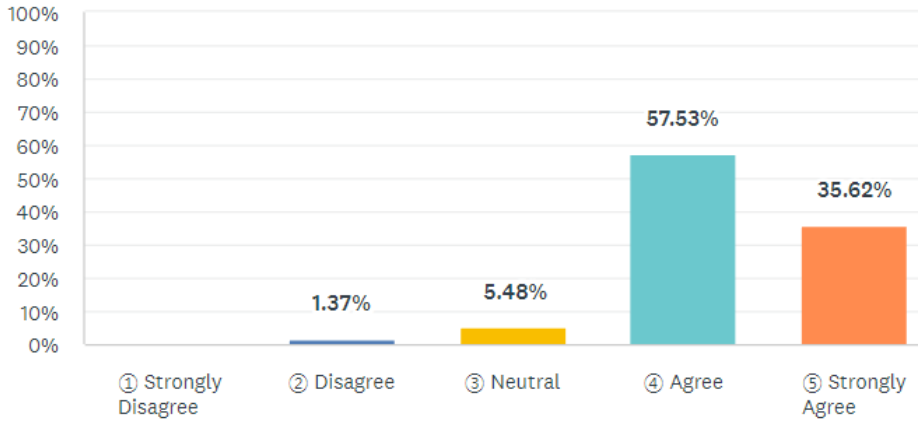
(c) Seafarers

6. Competency and Reliability of Remote survey supporter

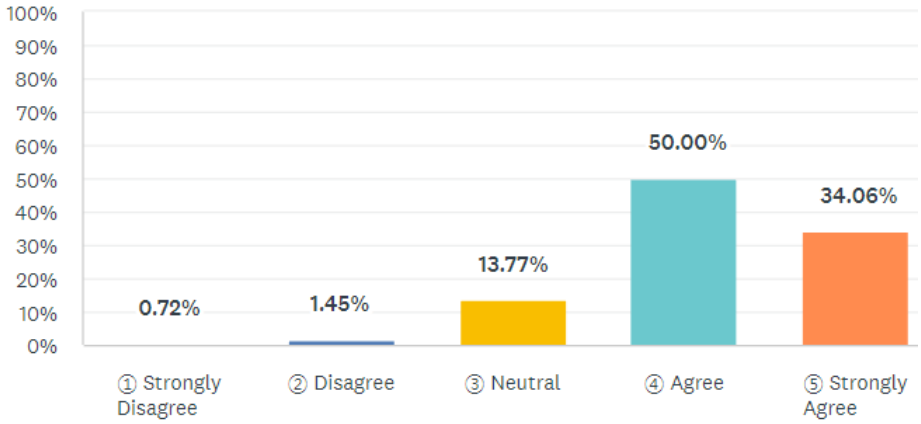
Q 6-1



(a) Ship Surveyors

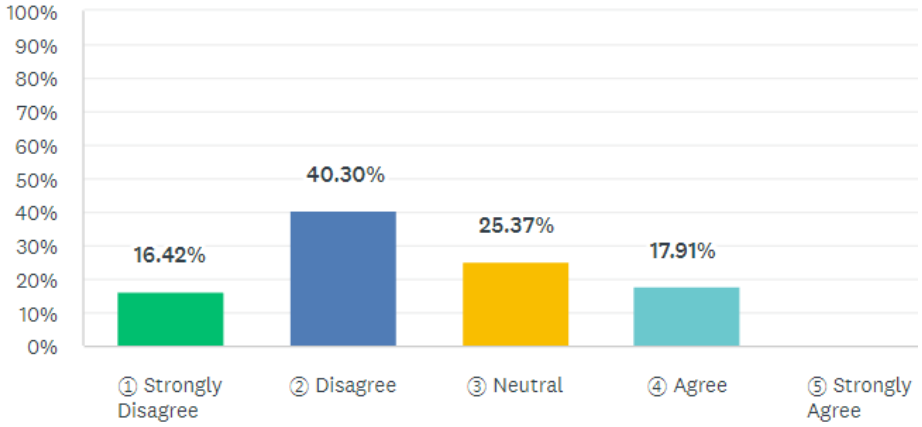


(b) Ship Managers

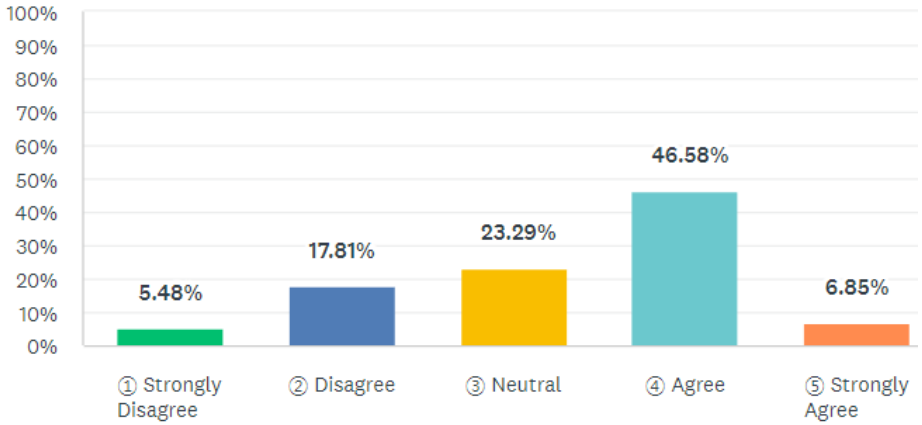


(c) Seafarers

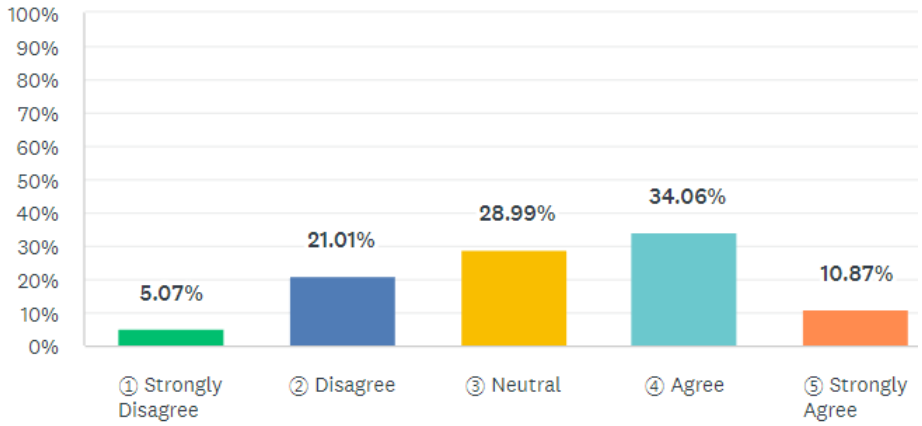
Q 6-2



(a) Ship Surveyors



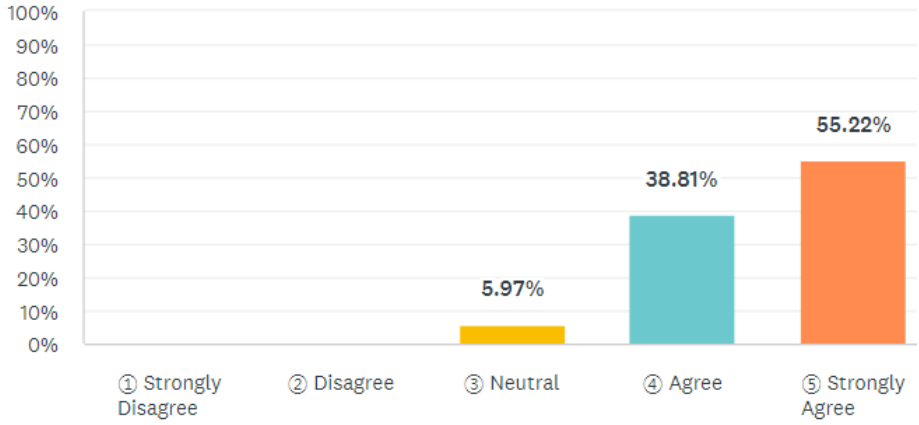
(b) Ship Managers



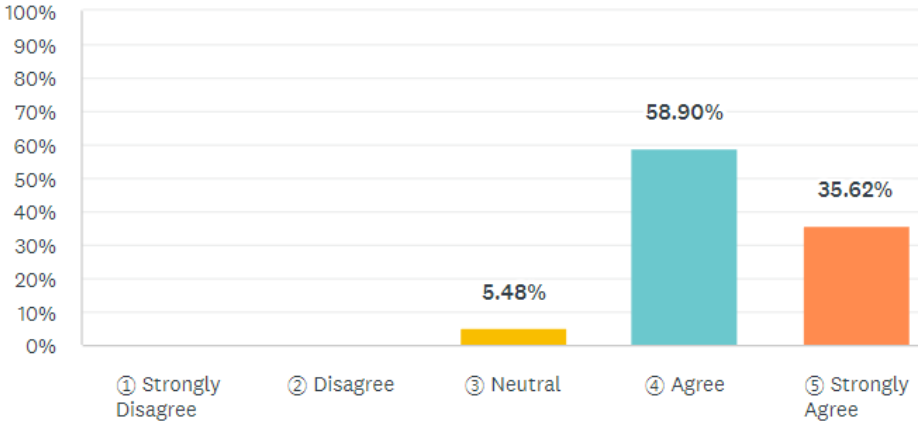
(c) Seafarers

7. Competency and Reliability of service suppliers

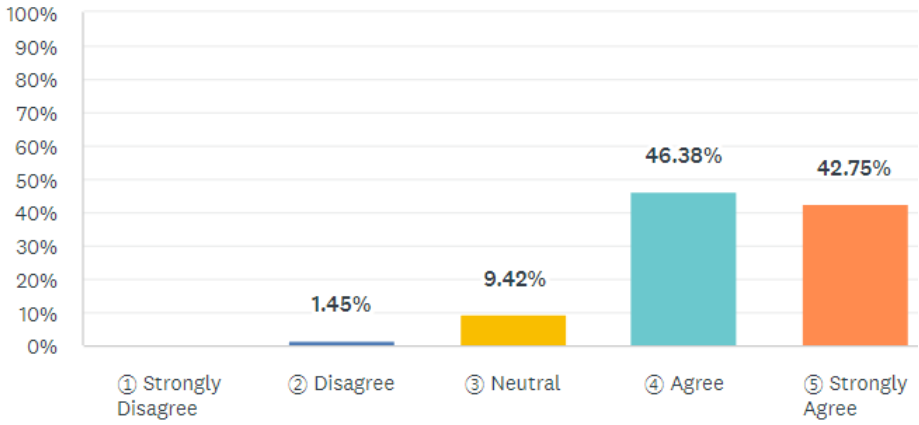
Q 7-1



(a) Ship Surveyors

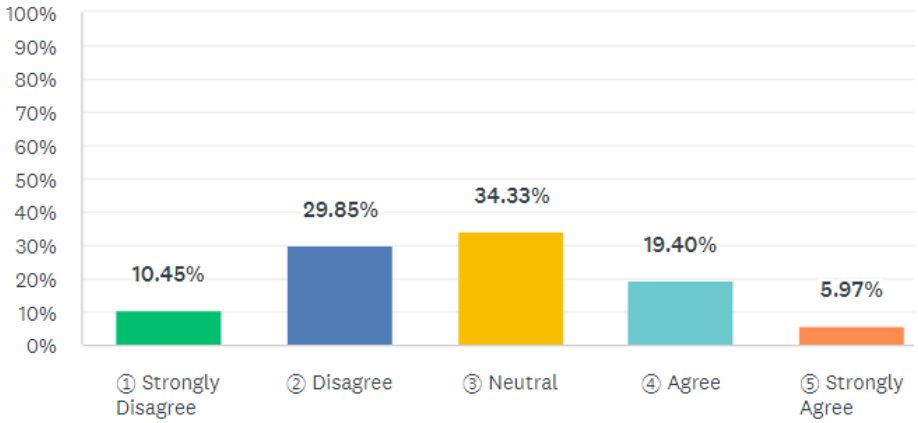


(b) Ship Managers

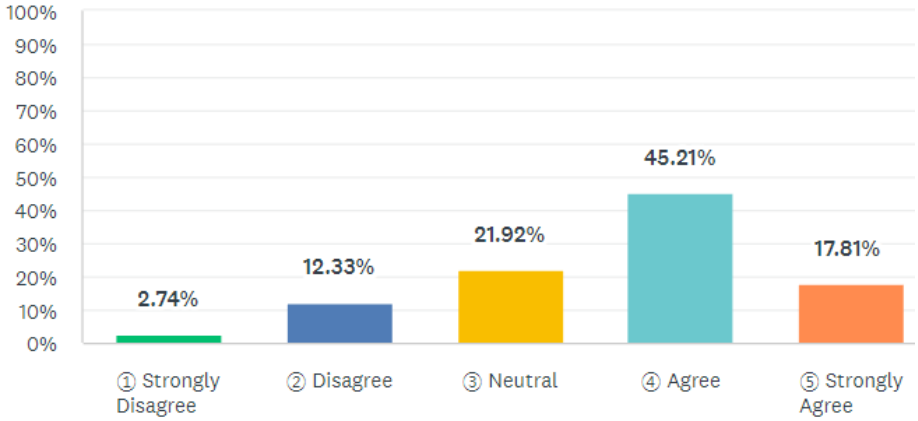


(c) Seafarers

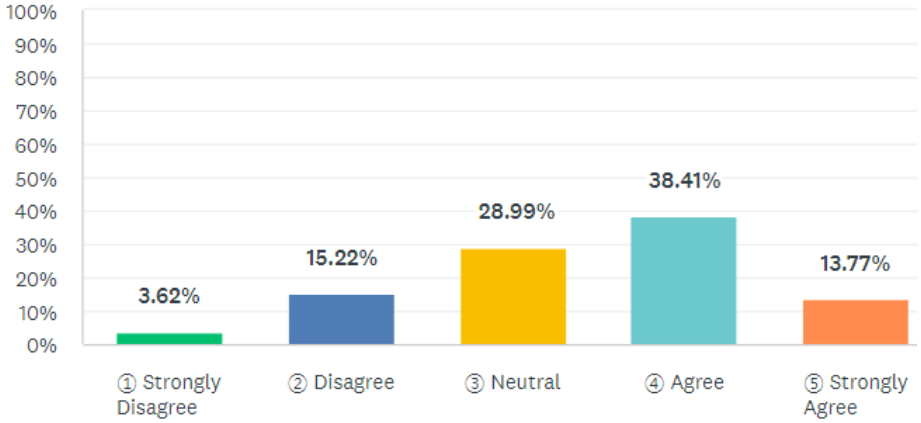
Q 7-2



(a) Ship Surveyors



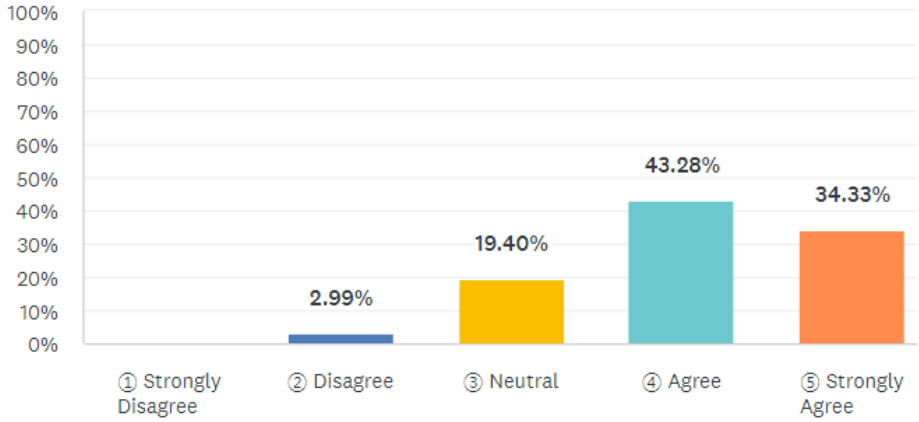
(b) Ship Managers



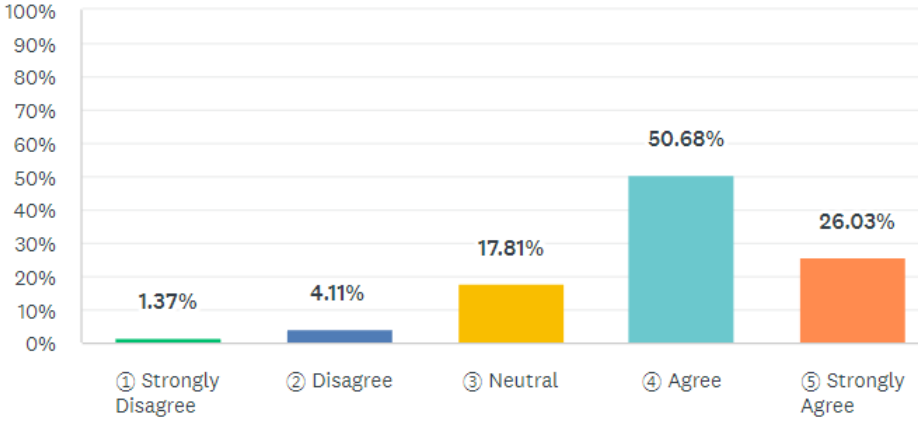
(c) Seafarers

8. Competency of the surveyor in charge of remote survey

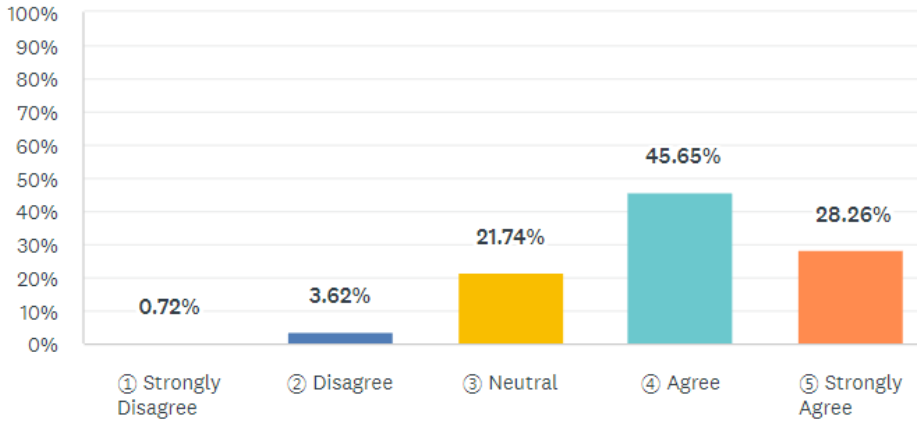
Q 8-1



(a) Ship Surveyors

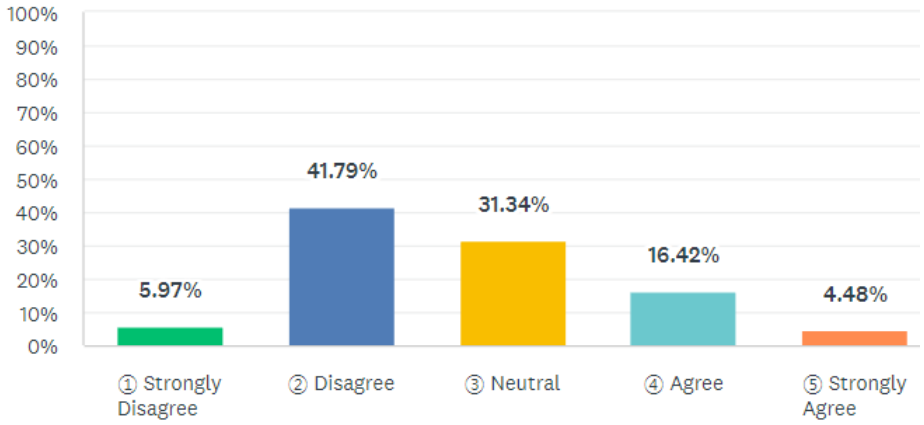


(b) Ship Managers

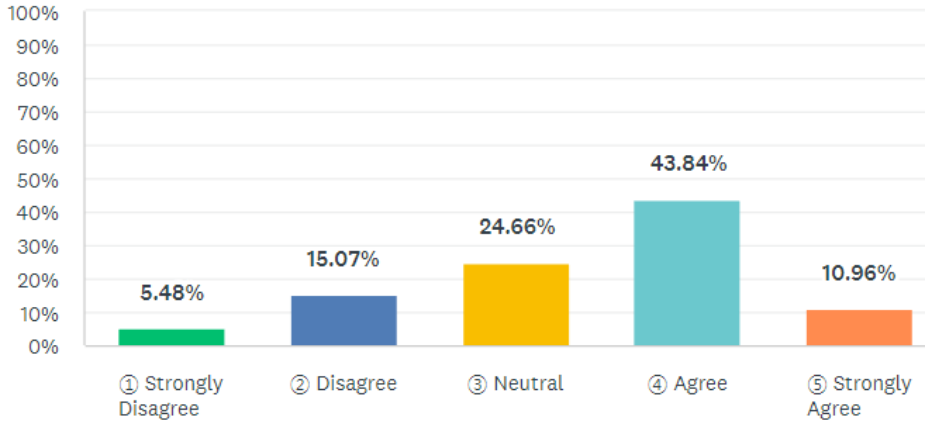


(c) Seafarers

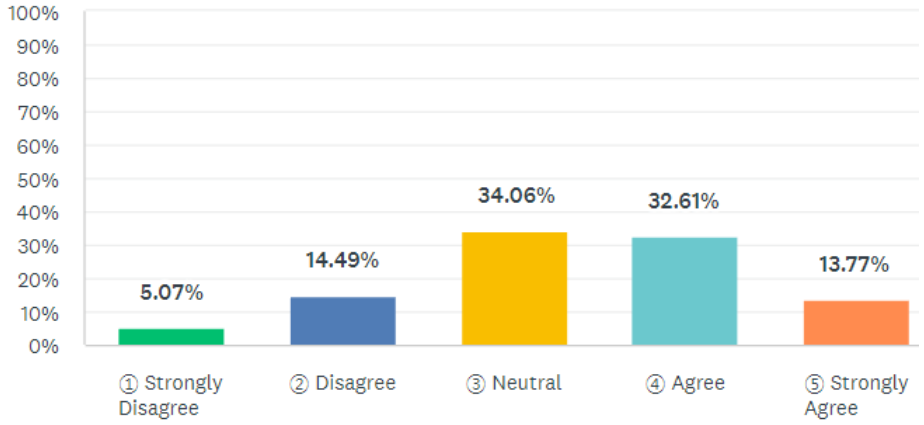
Q 8-2



(a) Ship Surveyors



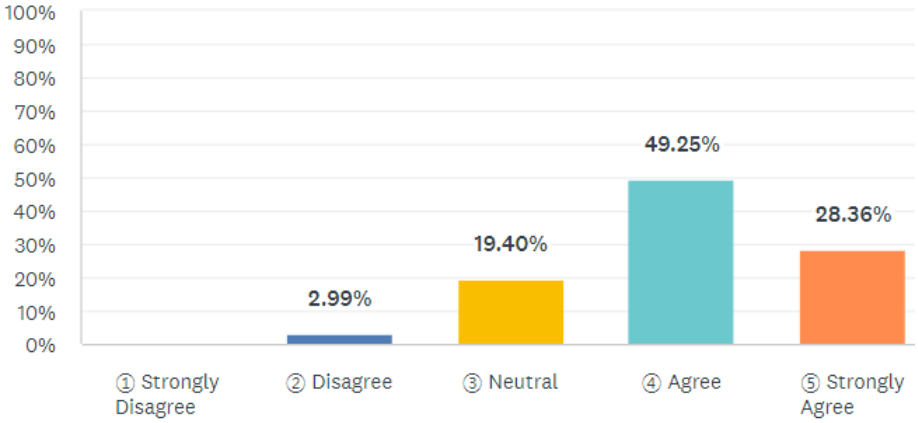
(b) Ship Managers



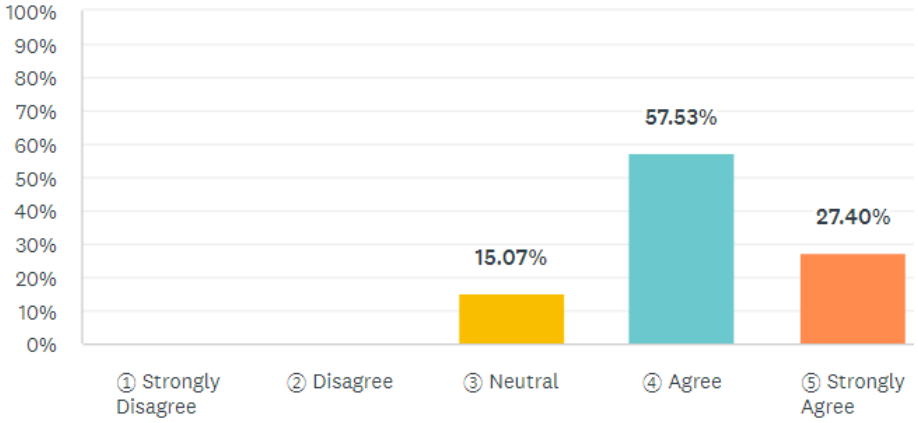
(c) Seafarers

9. Reporting and Record keeping related to remote survey

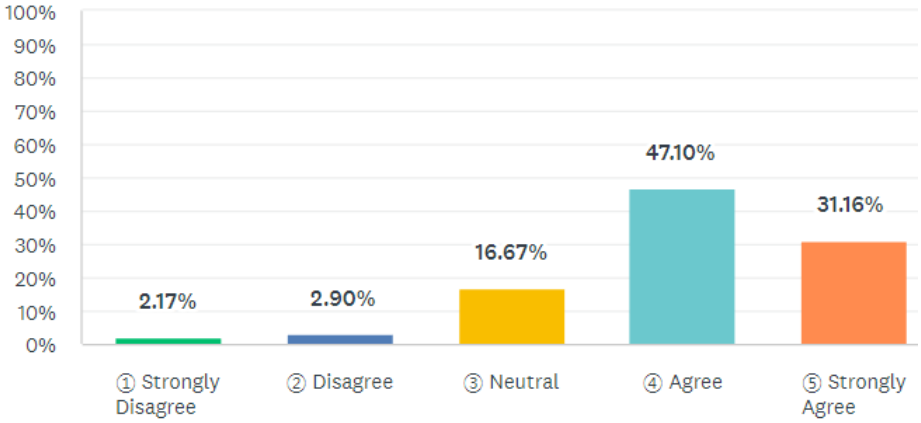
Q 9-1



(a) Ship Surveyors

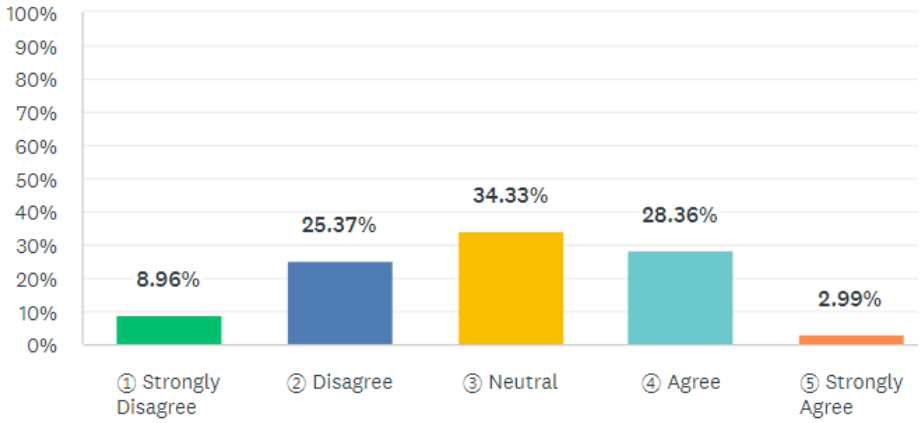


(b) Ship Managers

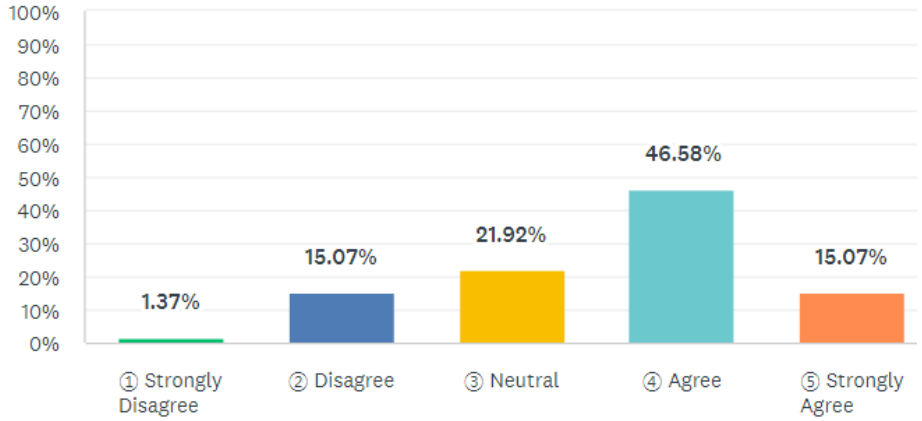


(c) Seafarers

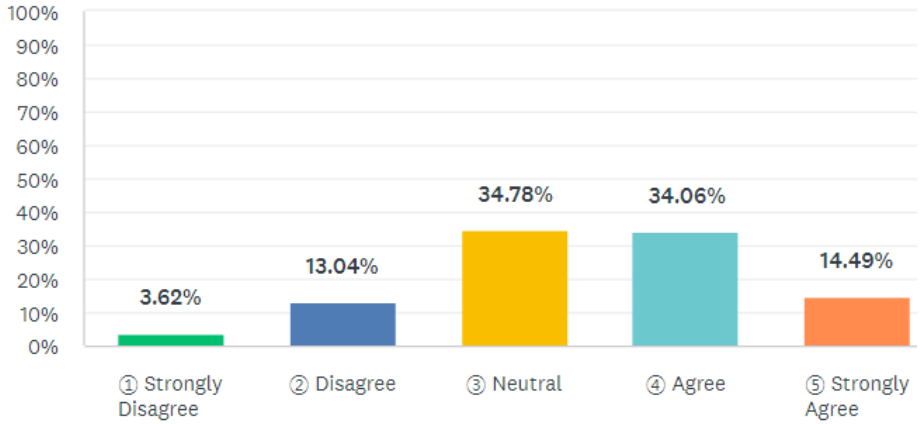
Q 9-2



(a) Ship Surveyors



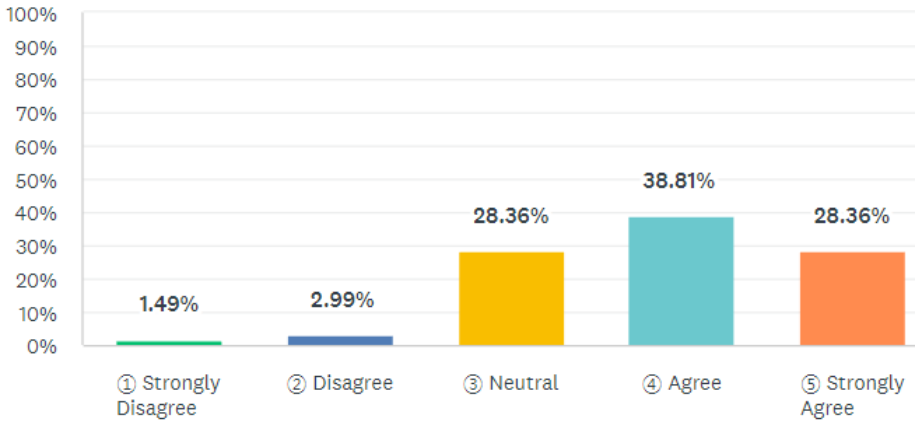
(b) Ship Managers



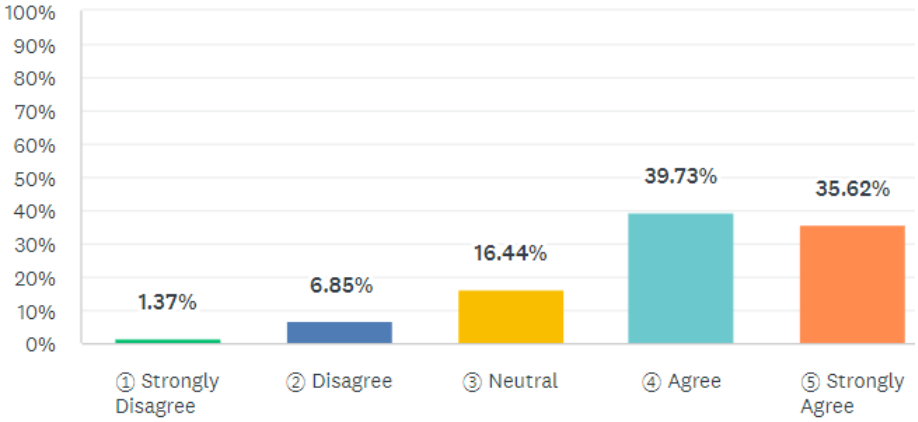
(c) Seafarers

10. Cyber-security of Remote survey

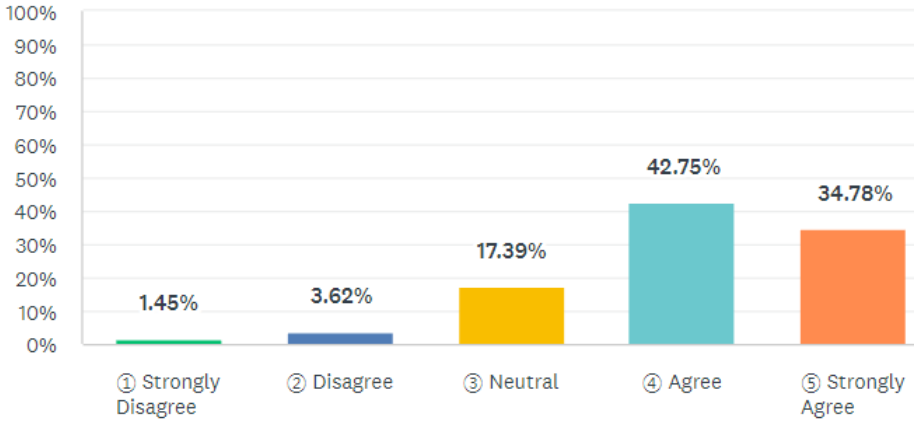
Q 10-1



(a) Ship Surveyors

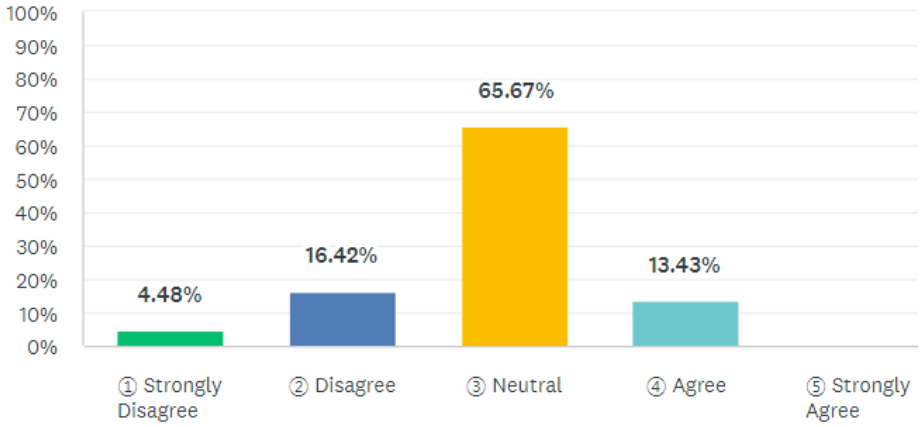


(b) Ship Managers

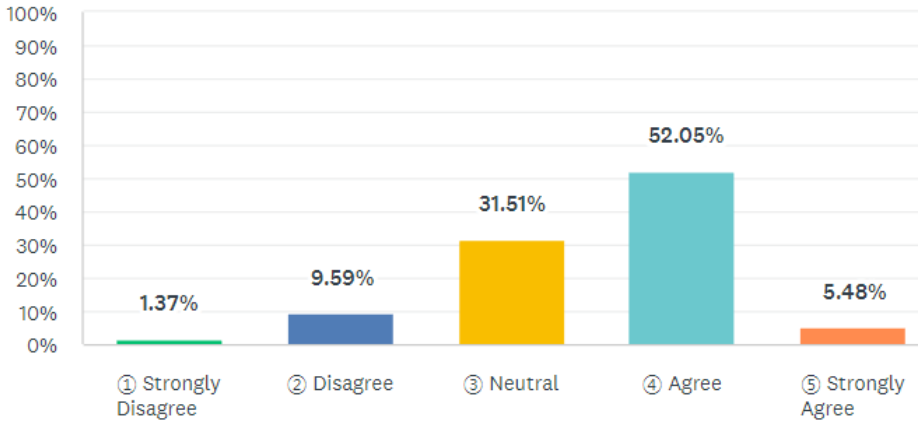


(c) Seafarers

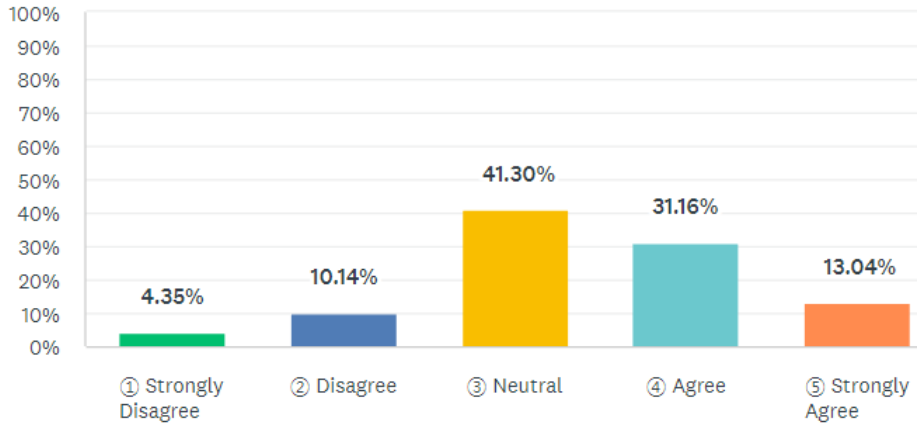
Q 10-2



(a) Ship Surveyors



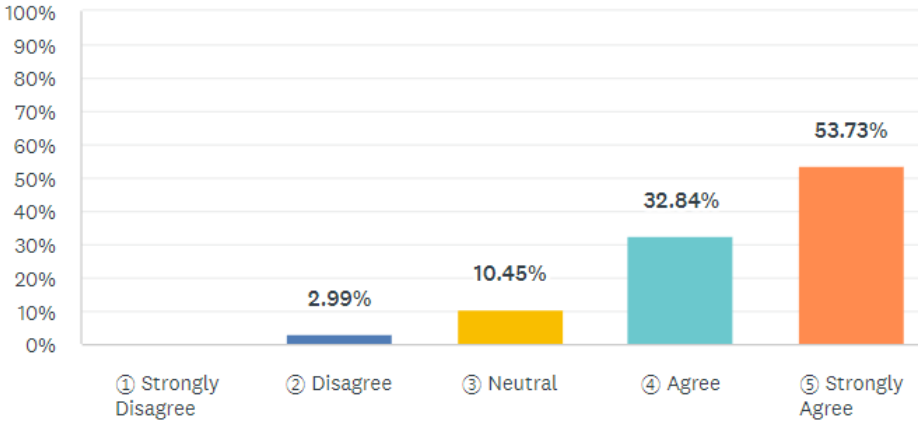
(b) Ship Managers



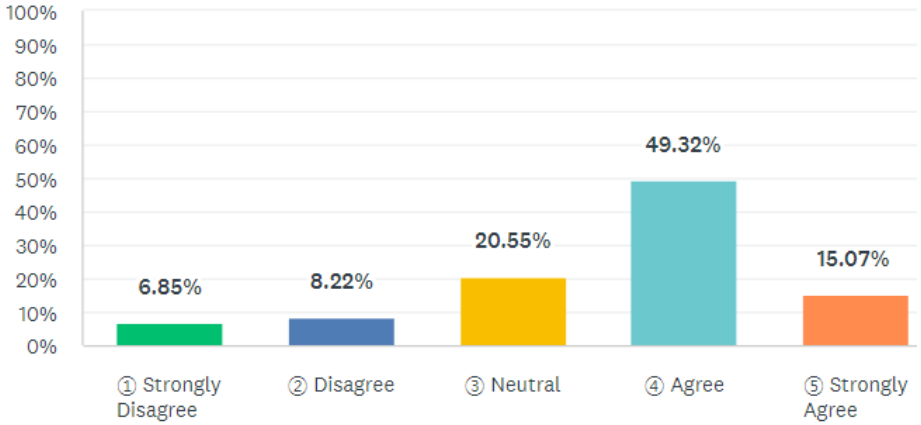
(c) Seafarers

11. Restriction of ships for remote survey

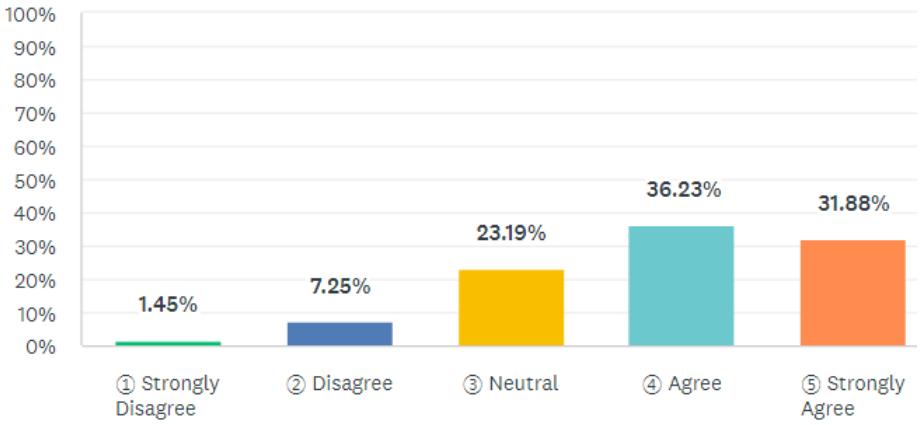
Q 11-1



(a) Ship Surveyors

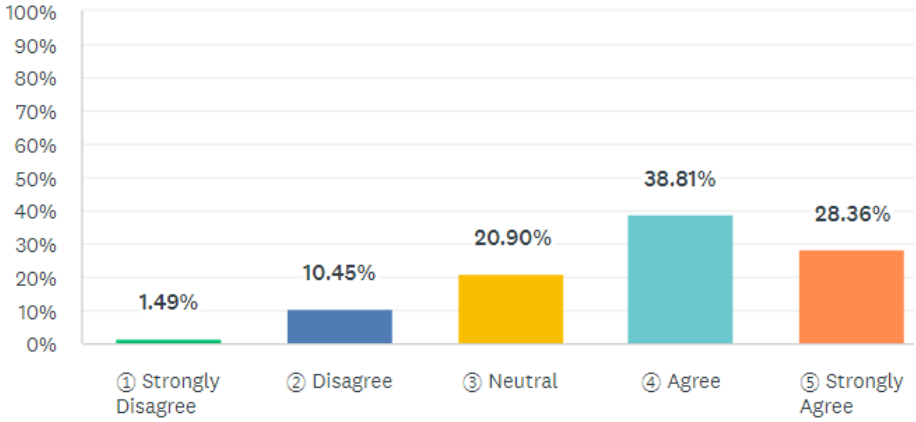


(b) Ship Managers

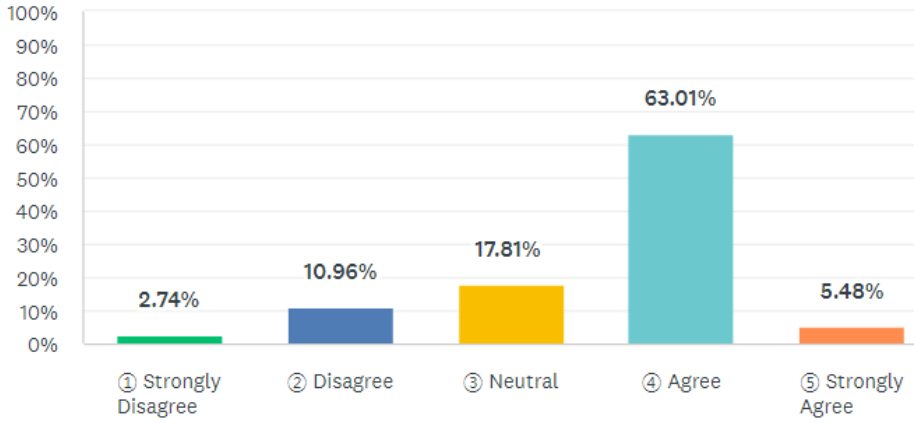


(c) Seafarers

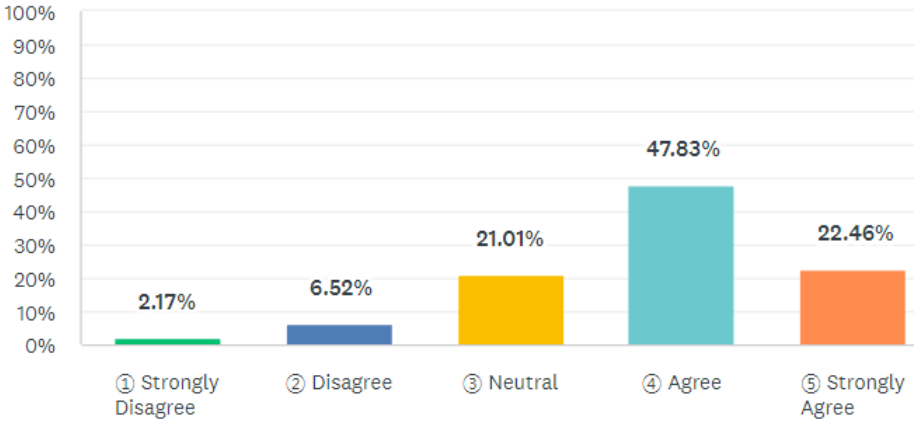
Q 11-2



(a) Ship Surveyors



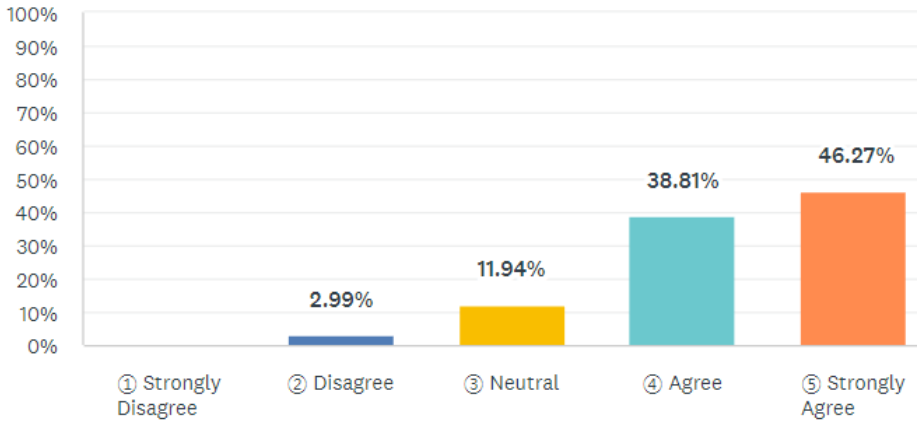
(b) Ship Managers



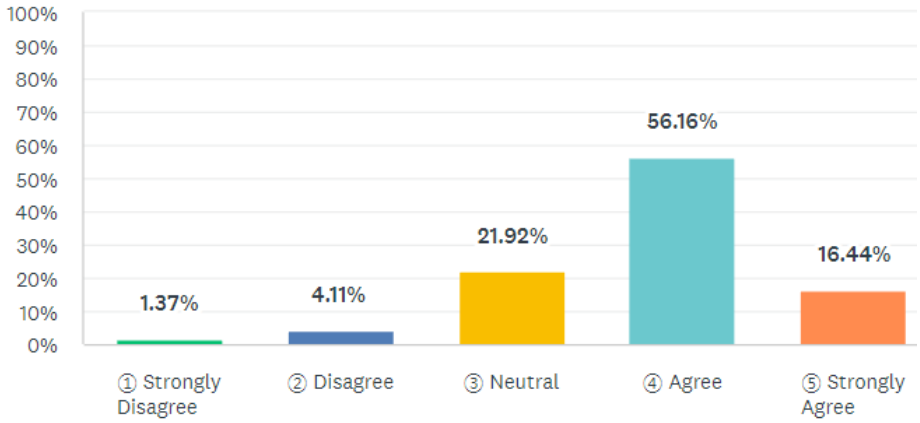
(c) Seafarers

12. Restrictions on types & scope of remote survey

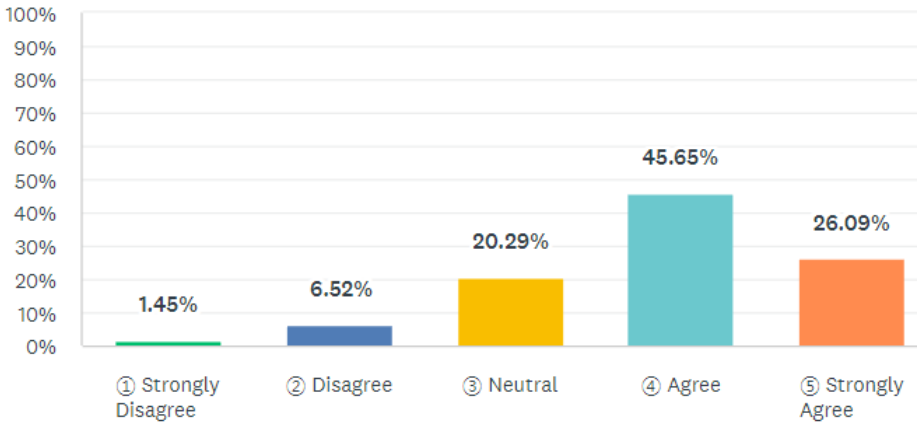
Q 12-1



(a) Ship Surveyors

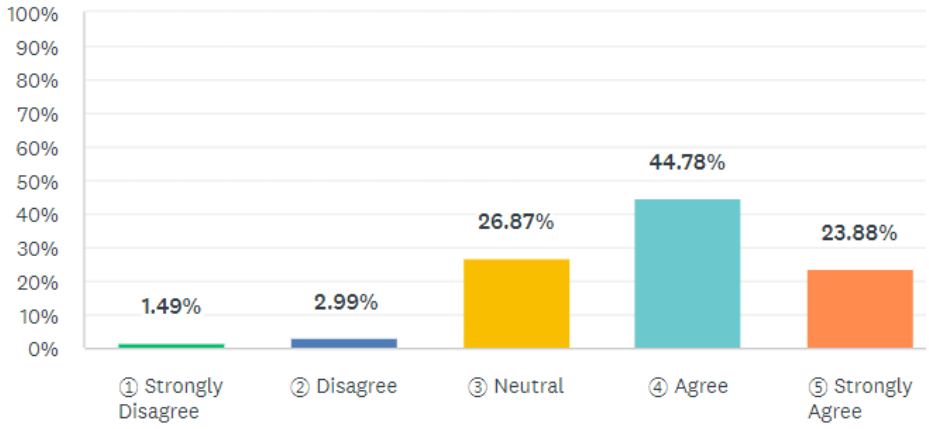


(b) Ship Managers

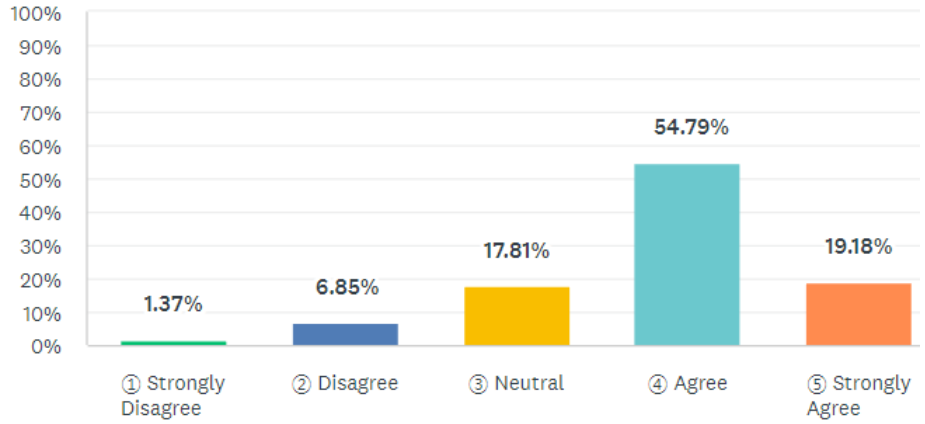


(c) Seafarers

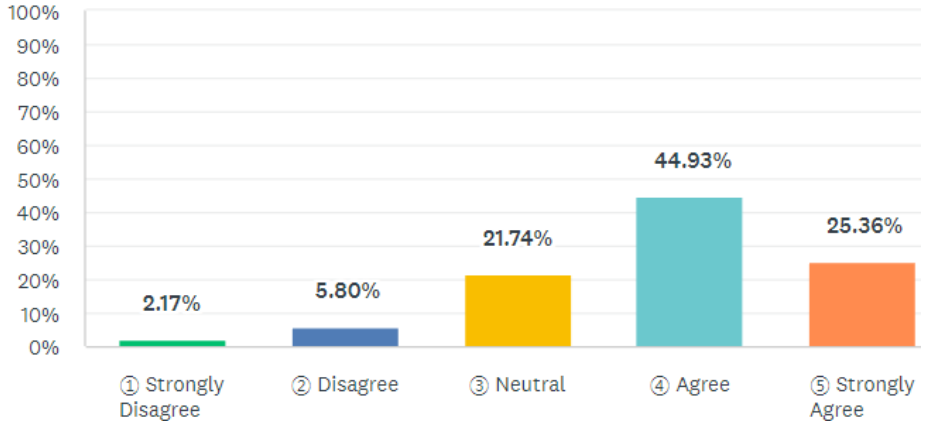
Q 12-2



(a) Ship Surveyors



(b) Ship Managers



(c) Seafarers