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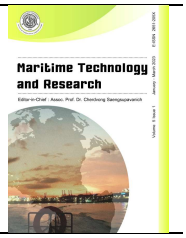

Research Article

Analyzing risks in Naval Operations: The case of visit, board, search and seizure operations in the Côte D'Ivoire Navy

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Abstract

Visit, Board, Search and Seizure (VBSS) operations, which are the preferred *modus operandi* to deliver law enforcement at sea, have always been, and remain, a risky endeavor. Because this type of operation holds a pivotal role in maritime law enforcement, safe execution is vital to protect involved staff and assets. Hence, this paper analyzes risks associated with VBSS operations; its main aim is to improve the overall level of safety and bring the identified risks under control, by developing associated mitigation measures. First, the risks under discussion were assessed, based on the professional judgment and experience of the naval personnel involved in these operations. Their inputs were introduced in a conceptual framework and the associated results were scored, compared, and benchmarked. It is true that there is an inherent level of risk built in the execution of VBSS operations; although the occurrence of negative incidents/mishaps can be considered marginal for the vast majority of the time, events like these are most often associated with serious consequences. The results of this research effort acknowledged that risk management practices can be useful and have variable performance in bringing risks to as low as reasonably practicable. In this aspect, risk mitigation can be more effective by implementing a systems approach of physical and administrative barriers with four distinct pillars: "Training", "Equipment", "Organizational Culture", and "Procedures".

1. Introduction

During the first two decades of the 21st century, the surge in piracy and terrorist activities in Africa, as well as certain inter-state tensions, brought maritime security to the forefront of international attention (Bueger, 2015; Dalaklis, 2012), often under the burden of limited capabilities in relation to effective maritime law enforcement; the concerned countries also faced a complex and quite diversified portfolio of security threats (Krause & Bruns, 2016). It is more than clear that, since the early 2000s, the exploitation of natural resources in the Gulf of Guinea (GoG) and insufficient law enforcement capabilities have clearly attracted groups engaged in transnational organized crimes (TOCs). Consequently, the West African region has become a world hotspot for piracy and armed robbery at sea (Okafor-Yarwood et al., 2020). To coordinate their efforts, the countries of that region adopted the Yaounde Code of Conduct, to enhance the repression of piracy,

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armed robbery against ships, and illicit maritime activity in West and Central Africa (Judith & Dalaklis, 2017).

In order to fulfil their objectives, these countries established an architecture requiring the development of intervention capabilities and significant improvements in relation to Maritime Domain Awareness (MDA); they also devoted a lot of resources and capacities to their navies and/or coast guards. From a military perspective, getting involved with maritime law enforcement should be viewed as an opportunity to build a better understanding of events, activities, and circumstances within and related to the maritime environment and, therefore, enhance Maritime Situational Awareness (MSA) (Dalaklis, 2019). Furthermore, effectively dealing with transnational organized crimes requires the enhancement of maritime surveillance capabilities and, at the same time, the availability of interception assets at sea, preferably nearby the locations where illicit activities are taking place (Dalaklis, 2017a).

In order to clarify certain terms used within this research effort, Hughes (2012) defined naval operations as the tasks performed by navies on the seas to ensure the safety and delivery of goods and services and to deny the safety and delivery of enemy goods and services. In any case, as part of their wider framework of operations, navies conduct multiple Visit, Board, Search and Seizure (VBSS) (quite often abbreviated simply as "boarding") operations to intercept targets into or out of a state jurisdiction or on the high seas (NATO, 2005). An indicative example is the Côte D'Ivoire Navy's assets, which covered 132 days of operations at sea in 2020, according to the 2020 Review of operational activities delivered by the Marine Operational Centre (MOC) Abidjan. According to the authors' knowledge, very few literature items have discussed/addressed the risks related to VBSS operations until this point of time. This is a gap that the current paper aims to cover, by analyzing the risks related to boarding operations and highlighting relevant mitigation measures. The following research questions drove the itinerary process of this research:

- What are the hazards and the threats in VBSS Operations in Côte D'Ivoire?
- What are the risk acceptance criteria and levels?
- How can these risks be managed and communicated effectively?

This paper is structured over six sections. Following this introductory section, section 2 reviews the relevant works in the literature addressing risk analysis and VBSS operations, respectively. Section 3 presents the conceptual framework used for the research. Then, the findings are presented and discussed in section 4. Finally, section 5 provides concluding remarks and recommendations.

2. Literature review

2.1 Risk analysis

The aim of a risk analysis is to inform a decision, facilitating the mitigation of risks by balancing costs and benefits (Aven & Zio, 2014; Cox, 2009; Goerlandt & Montewka, 2015; Ozbas, 2013; Yoe, 2019). It is true that the scientific community has discussed extensively the concept of risk analysis. For example, Bennett (2018), in his book, defined the term risk as "an act or condition posing a source of potential danger or adverse condition" (p. 215). Goerlandt and Montewka (2015) classified risk definitions in nine categories based on the relevant application area; in general, risk can be viewed as a function of one or more factors, such as (among others) probability, event, consequence of event, and uncertainty. This notion provides the basis of risk quantification (Bennet, 2018; Kaplan, 1997; Kaplan & Garrick, 1981). It is also useful to note that Aven (2012) considers that the simplistic equation "Risk = C & U" is the most appropriate type of risk definition, where C represents the associated consequences and U the uncertainty of an event happening.

Based on the definitions of maritime safety and (maritime) security provided by Del Pozo et al. (2010) and Klein (2011), "Safety" primarily refers to those dangers emanating from an unwanted event, like an accident or a natural disaster; in contrast, "Security" deals with the threats derived from a clear human motivation to do harm. Whether it is from a Security or a Safety perspective,

the first step in any risk analysis process is to identify the associated dangers. This identification and acceptance review require experts' participation and/or the use of statistical data (if available) (Apostolakis, 1990; Merrick & Van Dorp, 2001; Ozbas, 2013; Ulusçu et al., 2009). The available literature points towards the prioritization of the hazards being achievable by using a generic risk matrix, combining the Frequency and the Severity or Consequence, while acknowledging their limits and the need for continuous review (Cox, 2008b; Kontovas, 2005).

The literature also acknowledges the fact that risk assessment can be either quantitative, qualitative, or via mixed methods. Although the International Maritime Organization (IMO) promotes the use of quantitative data, some scholars support qualitative risk assessment (Hermanski & Daley, 2010; Kontovas & Psaraftis, 2009; Rosqvist & Tuominen, 2004; Wang, 2001), and acknowledge the relevant limits (Cox et al., 2005). In the maritime sector, the base for quantitative risk analysis can be found in data on accidents, like the number of fatalities, the frequency of accidents, or the severity of their consequences. Soares and Teixeira (2001) stated that individual risk criteria, including occupational risk, are measured in Fatal Accident Rate and societal risk criteria. After being assessed, risks are usually ranked as negligible, tolerable, and intolerable. The risks classified as tolerable are meant to be As Low As Reasonably Practicable (ALARP) (Joseph & Dalaklis, 2021; Wang, 2001).

It is a rather common task for researchers to explore the scientific nature of risk analysis in complex environments (Goerlandt & Montewka, 2015). As an indicative example, Goerlandt (2015) suggests the deployment of the Formal Safety Assessment (FSA) approach, under the precondition, of course, of a rigid framework and by factoring in the appropriate risk indicators. After assessment and prioritization, Risk Control Measures (RCMs) are developed to address the risks and their underlying causes to reach acceptable or tolerable levels (IMO, 2002; Yoe, 2019). However, Cox (2009) also put forward the notion that risk-mitigating measures based on risk scoring systems do not consider the correlation between risks, and called for the use of optimization models which consider those dependencies.

2.2 The concept of Visit, Board, Search and Seizure operations

2.2.1 Legal framework

VBSS operations are most commonly the responsibilities of navies. However, a boarding is not the sole privilege of navies. Indeed, law enforcement authorities of a country, like coast guards, police, or maritime inspectors, may board a ship flying its flag. As the concept of maritime security evolves, coast guard and naval activities overlap, and the main difference concerns the legal implications depending on the maritime zones in which a boarding takes place (Guilfoyle, 2017). In the literature, the right of visit is thought to emanate from the historical controversy around the legal principles of Mare Clausum, which claims sovereignty and jurisdiction over the seas, versus Mare Liberum, namely, the principle of freedoms of the seas. Mare Clausum is thought to be the rationale behind this interference on the high seas (Papastravridis, 2011).

The UNCLOS, also widely known as the "Constitution of the Seas", was the first international maritime convention to enshrine the last lasting maritime principle of the right of visit. The conduct of VBSS operations represents a direct correlative of this right. Article 110 of UNCLOS justifies a boarding in the high seas if there is reasonable ground that the suspected ship is engaged in piracy, in the slave trade, or in unauthorized broadcasting, and the flag state of the warship has jurisdiction, or the ship is without nationality or, through flying a foreign flag or refusing to show its flag, the ship is, in reality, of the same nationality as the warship.

This right, which can be viewed as a reflection of customary international law, stands as an exception to the exclusive jurisdiction of the flag state over ships flying their flags, defined in Article 92 of UNCLOS, which is concomitant with the principle of the freedom of the high seas in Article 87. However, the principle of "further examination" in Article 110(2), if suspicion remains after examining the ship's papers, has different interpretations in the literature. Some have argued

that it should not be used for purposes other than those warranted for stopping the vessel (Norquist et al., 1985). Guilfoyle (2017) estimated that this right is a general one, and nothing should prevent the conduct of a search with ulterior motive if it can feed back to the flag state information concerning illegal activities.

In waters under the jurisdiction of a state, UN instruments have defined limitations to VBSS operations. In fact, the right of visit is, in most cases, related to criminal jurisdiction in the waters of a coastal state. The UNCLOS and the Geneva convention on the territorial sea exclude the exercise of criminal jurisdiction over a foreign ship unless the conditions of innocent passage are not met. Guilfoyle (2017) stated that, although the right of innocent passage in territorial seas can be considered an immunity from VBSS operations, in reality, the only exceptions to conduct law enforcement activities are for sovereign immune ships and for crimes committed before the vessel entered the territorial sea and is simply transiting without entering internal waters (UNCLOS Article 21 and Article 27(5)). Concerning the contiguous zone, Article 33(1) of UNCLOS may provide grounds for boarding in the case of infringements of customs or fiscal, sanitary, and immigration laws within a coastal state's territory or territorial sea. However, Shearer (1986) argued that the powers of the coastal state are limited to inspections and warnings, rather than for arresting vessels.

Furthermore, under Article 73 of UNCLOS, a coastal state can conduct a boarding to enforce its privileges, pertaining to the natural resources in the Exclusive Economic Zone (EEZ), in accordance with Article 56 of the same convention. Additionally, Articles 211(5), 220(5), and 220(6) contain provisions which may grant a coastal state the right to conduct control in its EEZ in cases where activities which jeopardize the marine and coastal environment are clearly identified. Regarding a master's authority over his/her vessel, recognized also in customary law, UNCLOS Article 27(3) defines specific conditions where a master's consent might authorize a boarding in waters under the jurisdiction of a coastal state for criminal activities. Because the aforementioned provisions are less subject to interpretation, VBSS operations are primarily backed up by the framework of the United Nations, particularly for foreign-flagged vessels in the high seas.

Steering the discussion back to the Côte D'Ivoire, legislation for VBSS operations originated essentially from the National Strategy for the State's Action at sea (SNAEM), and is centered around maritime law enforcement. This latter document describes the Côte D'Ivoire Navy as the centerpiece of the coast guard function; in other words, the surveillance and the control of activities in waters under the country's jurisdiction. This strategy devotes to the Navy the missions of sovereignty and the protection of national interests (RCI, 2014). In addition, the law organizing defense and the armed forces, in its Article 14, stipulates that the Navy participates in actions for peace and international law. Its Article 26 acknowledges the duties described in the SNAEM, and adds the defense of maritime zones (RCI, 2016a). Although these 2 documents do not embody any explicit mention of VBSS operations, they imply that the Navy has the right and the duty to execute them in accordance with international conventions which Côte D'Ivoire is party to.

Finally, the country's regulations of fisheries are more precise concerning the authorization for boarding operations. First, in Articles 983 and 985 of the maritime code, any fishing vessel in Ivorian waters is subject to controls, and officers in command of a Navy ship have the right to search for and to ascertain infractions (RCI, 2017). Second, the fishing and aquaculture law authorizes the conducting of visiting and searching without special mandate in its Article 70. Last, but not least, this law, in its Article 80, bestows to the Navy the operational coordination of monitoring, control, and surveillance activities of foreign-flagged vessels, which requires joint teams of Maritime Administration (MARAD), Navy, fisheries and/or customs personnel (RCI, 2016b). In this respect, the country concluded an agreement with the European Union (EU) for the control of its vessels operating in Côte D'Ivoire waters (EU, 2018). Thus, boarding operations for fisheries control relies on clear national provisions.

2.2.2 Principles and dynamics

VBSS operations represent the epicenter of the broad concept of Maritime Interdiction Operations (MIOs), and are commonly an important responsibility for navies on the high seas (Guilfoyle, 2017), as well as for coast guard and maritime police forces in coastal areas. In general, commercial vessels are boarded to ensure compliance with international law or to conform UN resolutions but also, to some extent, to gather intelligence (Guilfoyle, 2017). The different types of MIOs are embargo operations, drug interdictions, the locating of suspected vessel, environmental patrols, fishery patrols, and refugee recovery.

The composition of the relevant command structure varies up to a certain degree, depending on factors like the wider area of operations, goals, or command intents. On naval vessels, the On-Scene Commander (OSC) is the commanding officer (CO) of the boarding ship that is providing the boarding team. The boarding party is under the control of the Boarding Officer (BO), who in turn is responsible for visiting and searching the vessel. However, it is necessary to clearly highlight that the overall control of the operation remains with the OSC. The total number/composition of the boarding party varies depending on the prevailing situation and established practices in place. **Figure 1** demonstrates a typical command and control structure.

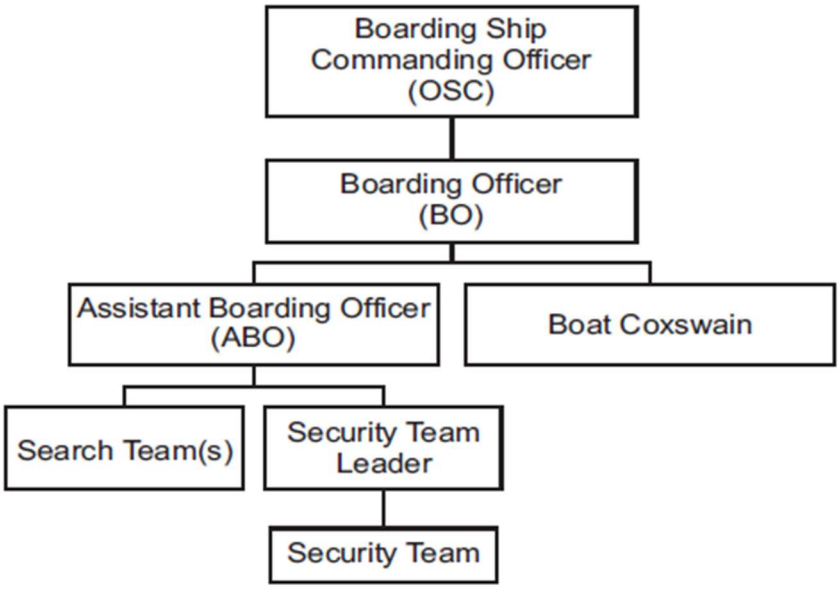

Figure 1 Boarding party command and control (NATO, 2005).

The execution course of MIOs can be divided into four main phases: the “detection and surveillance” phase, the “interrogation, approach and stopping” phase, the “boarding and searching” phase, and (if needed) the “diversion” phase. Boarding operations require a party to board another vessel in order to carry out specific tasks related to law enforcement. The personnel involved are expected to carry weapons and equipment for their own protection. In the maritime industry, boarding ships is a common practice in any pilotage operations or *ad hoc* inspections (e.g., pre-transit inspection in the Panama Canal). Therefore, cargo ships are appropriately equipped to facilitate boarding. By being in parallel with routine boarding, occupational health and safety issues could be better understood and addressed.

It is necessary to note that the Côte D’Ivoire Navy conducts patrols, to ensure the safety of navigation and to secure the marine resources in the EEZ of the country, relatively close to the coast. Oil and fish are the main concerns among those resources. Indeed, they are threatened by illegal activities, principally IUU fishing, as well as piracy and armed robbery at sea. The country also faces a number of illegal trafficking activities, especially via the use of small craft (Mieu,

2020). This situation could have been exacerbated by the "grey" zone which prevailed during the settlement of the maritime borders dispute between the country and Ghana, since the jurisdiction over the disputed area could not be clearly defined (Ioannides, 2017). The recent discoveries of offshore oil reservoirs could also awaken the intentions of criminals in the country. Furthermore, as Côte D'Ivoire expects to fulfil its regional and international commitments for security in the Gulf of Guinea, VBSS operations will be required more and more. Consequently, the strategic importance of these operations for the stability of the country requires them to be effective and safe.

In Côte D'Ivoire, VBSS operations are carried out by naval personnel using designated vessels and small crafts. These patrol vessels house a rigid hull inflatable boat at their stern, for the safe transfer of the boarding party on the "visited" vessel. One issue of interest is that the boarding party consists of pre-arranged teams, specially trained for that purpose, and originate from a standing group of marine commandos. It is also highlighted here that the small craft's crew is most commonly part of the "hosting" naval vessel crew. However, inspectors from fisheries, maritime administrations, or customs could be integrated in the boarding party in certain specific missions in order to benefit from their expertise, in accordance with the pooling of resources called for by the country's national maritime strategy (RCI, 2014). On a few occasions, the boarding can take place inside or in the vicinity of the ports, by using small crafts or special utility boats only.

2.2.3 Challenges

The first challenge associated with this type of operation is the comprehension and interpretation of the law of maritime interdiction. MIOs reveal the difficult balance between the protection of security interests and legal principles (Fink, 2010). Moreover, the current MIOs are very similar to law enforcement operations; thus, the law of maritime interdiction should also include legal considerations as human rights and criminal laws (Fink, 2010). It is, therefore, not a coincidence that Guilfoyle (2016) added that consent (by shipmasters and flag states) for visiting and searching does not generally mean consent for arrest and prosecution. Also, Fink (2010) estimated that, due to new political settings and the changing nature of maritime threats, the scope of the right of visit has been broadened. Therefore, from a legal perspective, all aspects of international and domestic law should be specifically reinforced in MIOs to make them effective (Hodgkinson et al., 2007).

It is also useful to note that boarding operations are clearly dangerous, and often rather unpredictable. For instance, the boarding and search phase is most commonly considered as the most hazardous, because the concerned vessels have to maneuver in very close proximity. Additionally, boarding on and off from the suspected vessel with a small craft or a helicopter is a high-risk operation, particularly in rough seas or swell (NATO, 2005). Even if it is recognized that, in most cases, the crew or passengers do not pose a serious threat to the boarding party, hostile acts can never be totally excluded (NATO, 2005). This is why Guilfoyle (2016) concluded that "apart from the legal restrictions, the hazard and expense of maritime interdiction operations tends to ensure that they are an exceptional measure" (p. 265).

As a result, pre-operation risks need clear hazard and threat assessments to ensure safe and secure operations. NATO (2005) provided a wide list of guidance and equipment to ensure the safe conduct of such an operation. Although certain dangers are mentioned in that document, it does not provide an objective method to assess and/or to prioritize them. Interestingly, it advises mostly to rely on intelligence to evaluate and to address the risks based on the experience of persons. The multinational character of the organization, which has different countries with different capabilities and regulations, may probably be the reason for this flexibility (Feldt, 2016). At the same time, the United States Coast Guard (USCG) General Assessment of Risk (GAR) tool model provides a generic framework to analyze situations and to help converting the judgement of persons in numerical scores when assessing and accepting risks. Despite being broad and intentionally subjective, such a tool may be used to lower risk exposure (USCG, 2018).

3. Research methodology

The novelty of the topic under investigation drove the work towards the utilization of different methods of risk assessment in order to collect sufficient data to conduct a fair analysis. In this paper, "hazards" designate dangers related to safety, and "threats" dangers related to security. The methodology of the research was framed by separating the risk analysis process into risk assessment, risk management, and risk communication (Yoe, 2019). The risk management and the risk communication components were achieved through the development of Risk Control Options (RCOs) (outputs) based on the results of the risk assessment (inputs). Regarding the dynamic and data-scarce nature of these operations, this paper adapted a combination of risk analysis frameworks (Merrick & Van Dorp, 2006). The use of a quantitative method helped to obtain numeral data about risks in order to combine them with the results of a qualitative method: as this study relied on experts' judgment, this methodology aimed at reducing subjectivity in the analysis by obtaining an adequate pool of relevant figures. **Figure 2** summarizes the structure of the methodology framework.

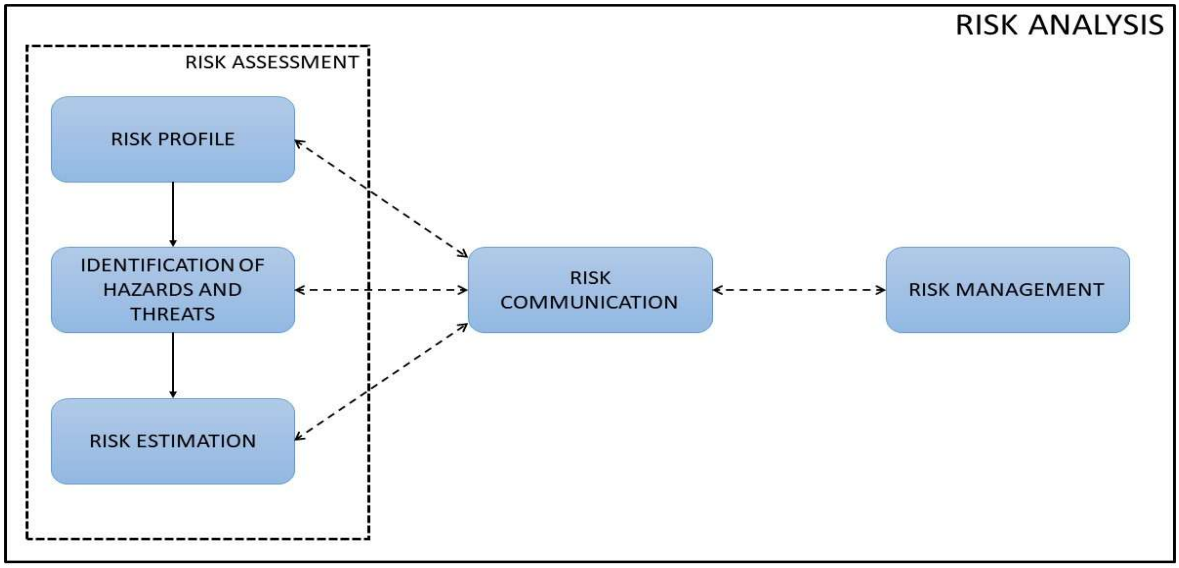

Figure 2 Research Conceptual Framework (Authors).

3.1 Data collection

Data used in this research was collected with the help of two survey questionnaires and semi-structured interviews with boarding operations stakeholders from the Côte D'Ivoire Navy and the Abidjan Autonomous Port; at the same time, input from the Senegal and the Nigerian Navies was also used for the purposes of benchmarking. The time constraints and restrictions of travel led to the use of a more purposive sampling technique, more precisely, a convenience sampling. The sample of participants encompassed all categories of naval personnel without any distinction of ranks and position, chosen based on their professional experience in boarding operations and their positions. It must be noted here that the Senegal Navy shares similar structures and interception capabilities with the Côte D'Ivoire Navy; in contrast, the Nigerian Navy is better equipped, and has more experience in these operations, so they could represent a broad field of experts. This research was conducted in partial fulfilment of the requirements for the degree of Master of Science for the lead author; the data collection framework was assessed and approved by the Research Ethics Committee (REC) of the parent organization covering the research, namely, the World Maritime University (WMU), with data collection taking place between June and October 2021. According to that organization's policies, all data were collected with the full consent of the participants, and were deleted after the degree was awarded.

- Questionnaire for risk profile

The structure for risk profile described by Yoe (2019) was the basis for this questionnaire. The purpose was to conduct a preliminary identification of risks and to evaluate the current state of knowledge about those risks. In total, 18 respondents provided their inputs. Eight out of them held a top management level position. All of them were naval personnel, but from different organizations: 14 naval personnel from the Côte D'Ivoire Navy, 1 officer from the Senegalese Navy, 1 officer from the Nigerian Navy, 1 officer from the Côte D'Ivoire's Permanent Secretary of the Interministerial Committee for the State's Action at Sea, and 1 officer from the regional Maritime Security Centre of West Africa.

- Questionnaire for risk assessment

This questionnaire intended to collect information in order to answer the informal questions of risk analysis (Kaplan & Garrick, 1981). It was a combination of risk assessment frameworks and was intended to assess safety hazards and security threats in the same questionnaire. The results of 28 respondents were processed. Among them, 86 % were directly involved in boarding at sea, and the remaining held positions in supporting infrastructure on shore. The sample was composed of 6 commanding officers, 5 executive officers, 2 staff officers, 2 boarding officers, 2 MOC officers, 10 boarding team members, and 1 small craft crew member.

- Interviews

The interviews targeted experienced professionals in their field of activity. Semi-structured interviews were used to keep the discussions focused on risks of interest and to calibrate inputs on RCOs. The questions were inspired from the four informal questions of risk analysis defined by Kaplan and Garrick (1981), with additional themes to explore RCMs. The interviews were conducted online (via the Zoom online platform) and lasted approximatively 1 hours. In total, 3 interviewees gave their inputs: 1 navy chief of operations, 1 pilot of Abidjan Port, and 1 commanding officer of a patrol vessel.

3.2 Data analysis

The data collected through the questionnaires was matched together to obtain the possible risk scenarios related to safety and security matters separately.

- Risk marking system

The identification of risks of interest was achieved by attributing a numerical value or index to the dangers in risk matrices. The indexes were on a logarithmic scale in order to facilitate the calculation of risk equations (IMO, 2002). The average of the index per the responses determined the index for each danger:

$$\textit{Avg INDEX} = [\textit{Sum}\ (n_i \times \textit{INDEX}_i)] / N$$

N : *total number of responses* = *Sum* (n_i)
n_i : *number of responses for the item i*
$\textit{INDEX}_i$: *corresponding index to item i*

The risk estimation was not meant to categorically rank the risk scenarios, but to identify risks which need mitigation. Safety hazards were identified by quantifying the risk using the formula **(1)** to form a matrix. The severity represented the index attributed to the consequence of a scenario. The frequency was the number of occurrences per unit of boarding. Risk mitigation considered scenarios with a risk index superior to or equal to 6 using the formula **(1)**.

$$Risk\ (hazards) = severity * frequency \quad (1)$$

$$RI\ (hazards) = SI + FI \quad \textbf{formula (1)}$$

Risks posed by security threats were calculated by multiplying the vulnerability of the asset, the level of threat, the frequency, and the severity of an attack. This definition was adapted from one used in risk assessment in terrorist attacks (Cox, 2008a). The risk was estimated using the formula **(2)**. The vulnerability provided a numerical value for the level of protection of the asset against possible threats. The risk scenarios where an index was calculated as greater than 14, using the formula **(2)**, were considered problematic and in need of specific attention.

$$Risk\ (threats) = vulnerability * threat * severity * frequency \quad (2)$$

$$RI\ (threats) = VI + TI + SI + FI \quad \textbf{formula (2)}$$

- Risk management Likert scale

A value was given to the responses on a Likert scale, where 5 was the answer "strongly agree" and 1 "strongly disagree". A score higher than 4 meant that the risk management aspect which was assessed is well implemented. Only questions with an average score of 3 or lower were considered to require improvements.

4. Results and discussions

4.1 Results

- Risk profile

The results suggested that boarding operations have a strategic importance for the country under discussion. Indeed, they are a prime mean used for maritime law enforcement to ensure legal order at sea. The fleet commander stated this point when describing the goal of these operations as follows: "*to ensure compliance with regulations in the context of public service missions or missions aimed at carrying out checks or interceptions […]*". Four other respondents also confirmed that boarding operations could cover many areas, such as "the fight against IUU fishing, Narcotics or Piracy". It is interesting to note that, according to the respondents' views, VBSS operations require assets such as "a warship, a small craft (rigid-hulled), qualified personnel (marine commandos, sailors with boarding skills prerequisites), security equipment (firearms, ammunitions, etc.), safety equipment (lifejackets, gloves, etc.) and logistics (healthcare, food, fuel, etc.)". Others, like an executive officer, noticed the need of "specialists", like "fisheries or customs inspectors", to address specific missions.

The results list the hazards of boarding operations: "man overboard", "hostile acts from visited ship's crewmembers", "injury", "loss of equipment", "sea state", "engine failure", "shooting", "slip", "toxic products", "disease-related contamination", "ladder accident", "hostage-taking", "capsizing", "collision", "fire", "drowning", or "death". Correspondingly, the inputs suggested that capsizing, man overboard, injury, slip and fall, loss of equipment, or collision could be more recurrent during maneuvers. Furthermore, 84 % of respondents assured that the risk is permanent during operations, though the assets are more exposed to the dangers during the active phase of the boarding and search. One commanding officer confirmed that risks are higher "on board the small craft, when boarding the vessel and inside compartments and rooms during visits and (searches)".

Even if the level of occurrence of accidents or incidents remains low, according to most respondents, the consequences can be serious for the assets. The results did not indicate the existence of an incident or near-miss reporting scheme. However, reporting the worst incident they noticed, one senior officer mentioned the loss of a boarding team in undetermined circumstances,

four respondents mentioned the loss of one coxswain's finger, and a few respondents pointed to the capsizing of a small craft with the boarding party on board. This evidenced that assets which approach a visited ship are more at risk. The respondents considered human health as the higher risk in VBSS operations and estimated that the risks are unequally distributed. Boarding operations are still being conducted, meaning a certain acceptance of risks. However, the results did not ascertain the existence of a specific tool for risk assessment in boarding operations. It seems that Risk Control Measures relied mostly on professional judgment. However, one executive officer mentioned a periodic risk assessment, without any reference in relation to the tools used.

Likewise, an overview of the observations showed three patterns in the options for risk mitigation. First, enhanced intelligence about the ship to board was one of the options suggested. Second, strengthening standardized procedures from the lessons learned and through a thorough mission planning process. Lastly, the provision of equipment and appropriate training to ensure the enhancement of the capabilities of the personnel. In addition, the results suggested that contingency planning was effective. Further several factors influence the deployment of RCOs: mission specificities, drills, strategic context, the availability of resources, the experience of the personnel, and the need to update procedures. Finally, additional inputs suggested that the heterogeneity of teams with different standards of training and qualifications, the non-domestication of international conventions, and psychological and societal impacts on personnel could affect such operations.

- Risk estimation

Using the formula **(1)**, **Table 1** shows all the relevant safety hazards whose indexes were greater than or equal to 6.

Table 1 Risk scenarios for safety hazards.

Assets	Risk Scenarios
Boarding team member	Harmful substances, Illness, Falling overboard, Pilot ladder accident, Fire, Bad weather, Fatigue, Stress, Cut, Confined spaces.
Vessel crew	Harmful substances, Illness, Falling overboard, Fire, Bad weather, Fatigue, Stress
Small craft crew	Harmful substances, Illness, Falling overboard, Pilot ladder accident, Bad weather, Fatigue, Stress
Vessel	Fire, Bad weather, Capsizing, Technical failure
Small craft	Fire, Bad weather, Collision, Capsizing, Technical failure
Communication equipment	Falling overboard, Technical failure
Service weapon	Falling overboard, Technical failure

Table 2 Risk scenarios for security threats.

Assets	Risk Scenarios
Boarding team member	Fire weapons, Bladed/Blunt weapons, Explosives, Self-propelled explosives
Vessel crew	Fire weapons, Explosives
Small craft crew	Fire weapons, Bladed/Blunt weapons, Explosives
Vessel	None
Small craft	Fire weapons, Explosives
Communication equipment	Explosives
Service weapon	None

It appears that the boarding team members were the ones exposed most to high risk; the weaponry and the communication equipment were least exposed. Likewise, small craft crewmembers experienced a higher risk level. For every asset, some hazards may induce death or the total loss of equipment. Therefore, the diversity of risks requires a holistic approach. The assessment for security threats reflected the results of the estimation of risk based on the formula **(2)**. **Table 2** shows the security threats in which risk index exceeded the limit, defined as the figure of 14.

The overview of risk scenarios shows that boarding team members and small craft crewmembers were more likely to be targeted. Although the scenarios appeared to be few, the nature of the potential adversaries remain unknown. Therefore, particular attention is required to control security threats. Finally, in terms of risk management, **Table 3** showcases the average score for each question on a Likert scale. An average score of 3 or lower was considered as in need of attention and further consideration.

Table 3 Average score for risk management.

Items	Themes	Score
Top management	Risks in decision making	3.3
	Role in risk management	3.4
Procedures	Existence of RA tool	2.4
	Contingency plan	3.3
Risk awareness	By actors	3.7
	Part of training	3.4
Organizational culture	Effectiveness of practices	2.8
	RA is a common practice	3.3
	Risk taking	2.3

The average score for the question related to the role of the top management in risk management showed that the perception of the role in decision making was recognized. For Procedures, the results suggested that contingency procedures have been established to deal with unexpected events; however, the utilization of a pre-boarding risk assessment was not a common practice. For Risk awareness, the results showed that the personnel involved in boarding operations acknowledge the risks related to boarding operations. For Organizational culture, the findings implied that risky behaviors were accepted in the organization.

4.2 Discussions

- Similarities with pilotage boarding operations

To open the topic of boarding to non-military activities, an interview was conducted with a pilot of Abidjan Port. After more than 5,000 ships serviced, the interviewed pilot estimated that the level of occurrence of major accidents was low. To his knowledge, in Côte d'Ivoire, no fatalities, and only 3 accidents (a pilot fallen in water, a crushed toe and a crushed ankle) had been reported. These figures might be underestimated because minor incidents are rarely reported. The most common incidents remained missed step on the pilot ladder, shocks on articulations, or injuries. The pilot confirmed similarities between pilot boarding operations and VBSS operations, especially in relation with embarkation and disembarkation phases. He highlighted that climbing on the ladder is a particularly critical moment (**Figure 3**).

Furthermore, the pilot viewed the risks as higher when disembarking. Indeed, the pilot cannot anticipate the risks before being on the ladder and is pressured to leave the ship in any weather conditions. Finally, the pilot noticed than the psychological impact, due to the permanent risk factor or after an accident, pushed some pilots to leave the corporation. It is important to recall

that the International Maritime Pilots' Association provides extensive guidance to pilots and ships and has worked for more than 50 years with the IMO to enhance the safe transfer of pilots and regularly participates in policy developments (IMPA, N.D.).

Figure 3 Embarkation of boarding team.
Photo: Côte D'Ivoire Navy. Reproduced with permission of the photographer

- Risk management and risk communication

The provision of equipment and the conducting of the right training are paramount to enable risk reduction in VBSS operations. The two interviewed navy officers stressed the possession and maintenance of equipment having been highlighted as pre-requisites to safeguard operations. Also, according to the chief of operations, the maintenance of those equipment should follow a clear policy. On this point, the study could not ascertain the existence of a document describing equipment requirements. The interviewed pilot argued that more resources should be allocated to ships to preserve the quality of boarding arrangements, as required by the IMO (2011). The issue seems more acute on fishing fleets. Additionally, on fishing vessels, the low freeboards make boarding operations more hazardous (Five Associations, 2021).

Training reinforces personnel capabilities in using equipment and their understanding of the process. The commanding officer stated that good training can also complement the lack of clear procedures, but also that refreshment sessions are needed. This can be problematic, since VBSS training in Côte D'Ivoire often relies on external resources. Nevertheless, experience seems to be a key factor for the safe execution of boarding. Due to the lack of resources, many boarding personnel reinforced their capabilities on-the-job or during regional maritime exercises. This observation point is also confirmed by the pilot who estimated that formal risk assessment was not part of their training. Risk awareness comes by doing the job with other pilots first and alone by experience-building.

Assets in VBSS operations are vulnerable to threats. Cox (2008a) stated that using equations to assess security risks obliterates the unpredictability of intelligent threats. Addressing risks posed by those threats means gathering information about them, being prepared, and preventing potential

attackers from gathering useful information. As explained by Guilfoyle (2017), intelligence gathering is important for intercepting those threats. Regarding uncertainties during boarding phases, procedures contribute to risk mitigation and may compensate for lack of experience. Moreover, procedures play a role in the training of personnel. Certification of teams should include procedures to evaluate each individual's training and fitness, but also to ensure their cohesiveness when teams are mixed with people from different organizations. The chief of operations argued that some initiatives were already implemented, but they were functioning in isolation. Both interviewed navy officers also stressed the implementation of standard operating procedures (SOPs) which need to be approved by the top management in order to reduce the flexibility of personnel at sea who may not have the authority to support decisions, particularly when risks are higher. Finally, as mentioned by NATO (2005), procedures for communication should be well-established.

The process for decision making was not clearly defined, or was left to the appreciation of every party. The commanding officer mentioned that less experienced personnel lack overall risk awareness. This observation called for a systematic risk assessment process; risk is a "normal" parameter in boarding operations. As the commanding officer explained, even if resources that were at his disposal were not optimal, taking risks beyond capabilities was necessary for the protection of waters. This is probably because military organizations are hierarchical in nature, so the willingness of the top management or high command may be to overlook some risks in order to gain opportunities. A way to overcome this issue is sensitization and professionalism. Sensitization could increase risk awareness, while professionalism could incite people to always work within the limits of their capabilities. Furthermore, mitigation measures need validation from decision makers. Hence, the definition of key performance indicators (KPIs) was also a point for consideration. On this point, the interviewed commanding officer pointed to difficulties in obtaining statistical data to back up arguments. Finally, the pilot estimated that external factors may push certain ship-owners to reduce investments in necessary arrangements for boarding at sea, affecting both pilotage and any boarding operation. The chief of operations concluded that the development of safety culture was a prerequisite, because safety is a key element of success for all.

5. Conclusions and recommendations

5.1 Conclusions

Permanent risks exist during VBSS operations, and their consequences can be very severe for personnel and assets. Therefore, effectively managing these safety and security risks requires a comprehensive approach. In current boarding operations in the Côte d'Ivoire Navy, risk acceptance is under consideration, but the criteria used for that purpose are not clearly defined. It can be assumed that the absence of a purpose-made risk assessment tool may be a reason for inconsistency. As a consequence of the lack of a well-structured framework, the experience of the commanders involved guides the definition of Risk Control Measures (RCMs), making them sensitive to each individual's experiences, perception, and knowledge.

For risk mitigation that is both effective and makes sense to the people on the ground/executing the operation, efficient information sharing, capacity building through better procedures, and the "right" equipment are essential. Training activities and improving the associated organizational behaviors are also among the portfolio of recommended measures. However, their overall effectiveness depends on the support and approval of the top management in the chain of command. While port pilots rely effectively on experience, it is important to note that they have performed such operations nearly every day for years with the same personnel boarding and in crafts, which is a significant difference with navy crew management.

5.2 Recommendations

After the relevant analysis and discussions, the recommendations can be formulated as a systems approach (holistic approach) of physical and administrative barriers with four pillars:

"Training", "Equipment", "Organizational culture", and "Procedures"; working in a collective manner, all these can be integrated to a safety management system (SMS) (Dalaklis, 2017b).

- Training

No matter the role played in boarding operations, a high level of proficiency and specific skills are required. The Côte D'Ivoire Navy should ensure that the personnel receive adequate training opportunities and are able to work as a team. Training should also be designed as a risk awareness process. Furthermore, a partnership with local port pilots should be formalized, in order to take advantage of their relevant experience and, at the same time, exchange/share their views.

- Equipment

The personnel in these operations should wear and maintain adequate personal protective equipment (PPE) adapted to the marine environment, but also corresponding to the level of threats. Côte d'Ivoire may not have enough financial resources to acquire all these equipment, so particular attention should be devoted to the maintenance of existing ones.

- Procedures

Another important point to consider is the development and/or the renewal of SOPs. The Navy should also set up clear procedures or processes for boarding and for incident or near-miss reporting. Finally, the inputs and outputs of those procedures should be documented and analyzed as feedback mechanisms for improvement. Naval forces should consider implementing generic and specific risk assessment tools. In addition, personnel deployed at sea should possess comprehensive contingency plans to respond to emergencies and unexpected events.

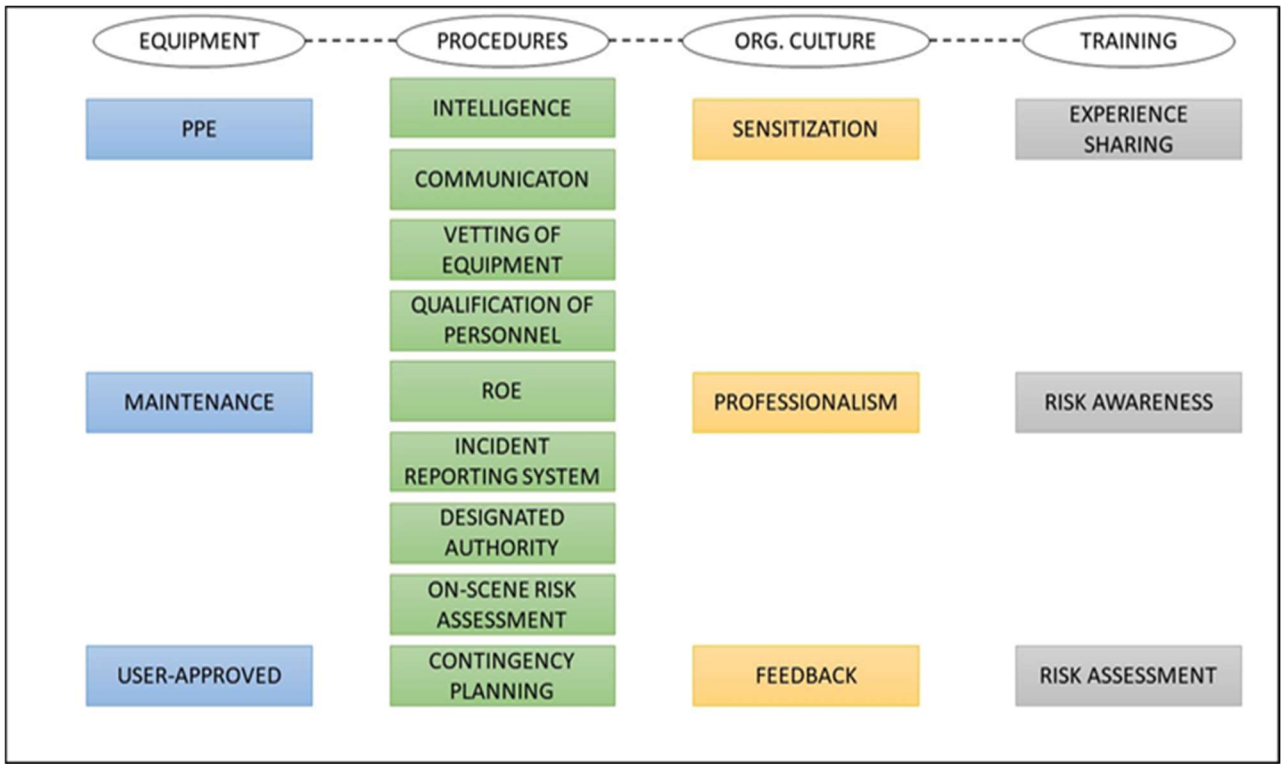

Figure 4 Recommendations for Risk Control Options (Authors).

- Organizational culture

As a military organization, a certain level of risk is acceptable in navy operations. However, an emphasis on sensitization and professionalism could reduce complacency. Risk should not be the

norm, and safety must prevail. During planning, training, and briefings, risks should be discussed, and measures to mitigate them must be identified. At the decision-making level, the right balance between the necessity of the mission, the limitations of assets, and the prerogatives of decision makers should be understood. Reporting any incident or near-miss is a must, and should be encouraged. Following operations, all relevant data and information should be analyzed and the feedback recorded. This will provide inputs for the improvement of planning and for statistical studies. **Figure 4** summarizes the recommended options.

5.3 The way forward

This research confirmed the validity of experts' judgement for risk analysis in providing relevant information for decision makers. Furthermore, it has clearly shown that the combination of a qualitative and a quantitative risk assessment model could bridge the gap and have valuable outputs. Enhanced relevant data collection would support further research on the field.

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