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Article

The socio-economic and security issues of night landings and arrangements at the port of Owendo: The example of the mineral terminal

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Abstract: Global economic competition is leading companies to improve their competitiveness by increasing production and eliminating the main obstacles to the process of making products available. This approach concerns both SMEs and SMIs as well as multinationals. Thus, the Compagnie Minière de l'Ogooué (COMILOG), a subsidiary of the French group ERAMET, which until recently had a monopoly on manganese mining in Gabon, must now face competition from Asian operators. To export its ore, COMILOG must first transport it by rail for nearly 650 km, from the Moanda site (south-east of the country) to the port of Owendo. However, port operations, which until then took place exclusively during the day, limited the company's export capacities and the profits made, while increasing the stopover time of ships and their operating costs. To remedy this, the French company introduced nighttime docking and departures. This work addresses the challenges of the performance of port operations at the Owendo ore terminal and the security and natural risks of night manoeuvres. The general objective of the study is to assess the impact of these night services on ship traffic, on the one hand, and to identify the related socio-economic and security issues, on the other hand. Data collection was carried out using documentary research in libraries and research centres, consultation of websites, semi-directed interviews, questionnaire surveys and participatory observation. The sample of 50 people surveyed took into account management staff, supervisors and line managers, integrating the diversity of actors involved in the processing of ships calling at the port of Owendo. Finally, the surveys attest to a clear reduction in the time spent by ships at the Owendo Ore Port and an increase in their number calling. They also confirm the improvement in tonnages embarked and the improvement in turnover achieved by COMILOG. This study led to the conclusion that the introduction of night manoeuvres at the port of Owendo allowed COMILOG to increase its exports and the number of ore carriers received in stopover and then improve its turnover.

Keywords: night docking; economic and security issues; manganese; Owendo; port; ore terminal

1. Introduction

In Gabon, manganese production has evolved due to two essential factors. The first factor is the arrival of new players, notably Nouvelle Gabon Mining (NGM) and Compagnie Industrielle et Commerciale des Mines de Huazhou (CICMHZ). These two companies export their production from the competing Barracuda site, developed in 2016 and managed by Gabon Special Economic Zone (GSEZ). The second factor is the establishment, since 2021, by COMILOG, of offshore transshipments of larger capacity vessels. In order to improve its performance and face competition, COMILOG has introduced night docking and departures since 2020, which involve mooring, towing and pilotage.

As final approach or port exit manoeuvres, docking and departure of a vessel entail risks for the health and safety of the worker. Many authors have discussed night work, including Beaud et al. (1990); Conseil Economique Social et Environnemental (2010); Leonard (1998). However, they have not specifically addressed nighttime docking and departures in maritime and port environments, even though it has been noted that there is greater recourse, in many countries, to night work under the combined effect of technological, economic or social constraints (Barthe et al., 2004).

Nighttime services are often mentioned through insecurity (Zinsou, 2009) and (Makiela Magambou, 2007), despite the optimism of port terminal managers who believe that they improve the productivity and performance of port operations (Journal du Cameroun, 2014). This optimism leads to the following central question:

What are the socio-economic and security issues related to the exercise of nighttime docking and undocking operations at the Owendo mineral terminal? To this central question, the following two subsidiary questions are added: What is the impact of the PMO's nighttime port operations on the achievements of COMILOG and on the work of the professionals concerned? Have the night docking and departures at the TMO allowed the Railway and Port Facilities Directorate (DFIP) to improve the conditions for exporting manganese and to guarantee the navigation of ships at all times?

From these questions arise three research hypotheses. First, the economic objective set by COMILOG has been achieved. Second, the night manoeuvres have had a positive impact on ship traffic and manganese exports at the Owendo ore wharf. Third, the new services still involve logistical obstacles and security risks for the agents concerned.

This research aims to explain the motives for the introduction of night manoeuvres at the Owendo mineral terminal. It also aims to assess the impact of said operations on ship traffic and exports, while highlighting the potential security and logistical challenges of the port facilities and the railway.

2. Materials and methods

2.1. Presentation of the study framework

The ore terminal is an estuary bottom infrastructure, at a depth of −12.5 m, located downstream of the Owendo commercial quay, approximately 15 km from Libreville, on the right bank of the Komo Estuary, around 9°30 longitude and 0°17 latitude (**Figure 1**). The ore is transported there, over 900 m, through a sea boom. The various docking infrastructures of the port complex and the specificities of the Ore Port can be observed there. Initially taking place in the time interval from 5:30 to 18:30, the docking and undocking operations did not allow the exploitation of possible night tides and hindered the continuity of port services. When an ore carrier finished loading around 6:30 pm, it was unable to leave the berth to allow the next ship to arrive. This situation prolonged the ships' stay at Owendo and increased their operating costs.

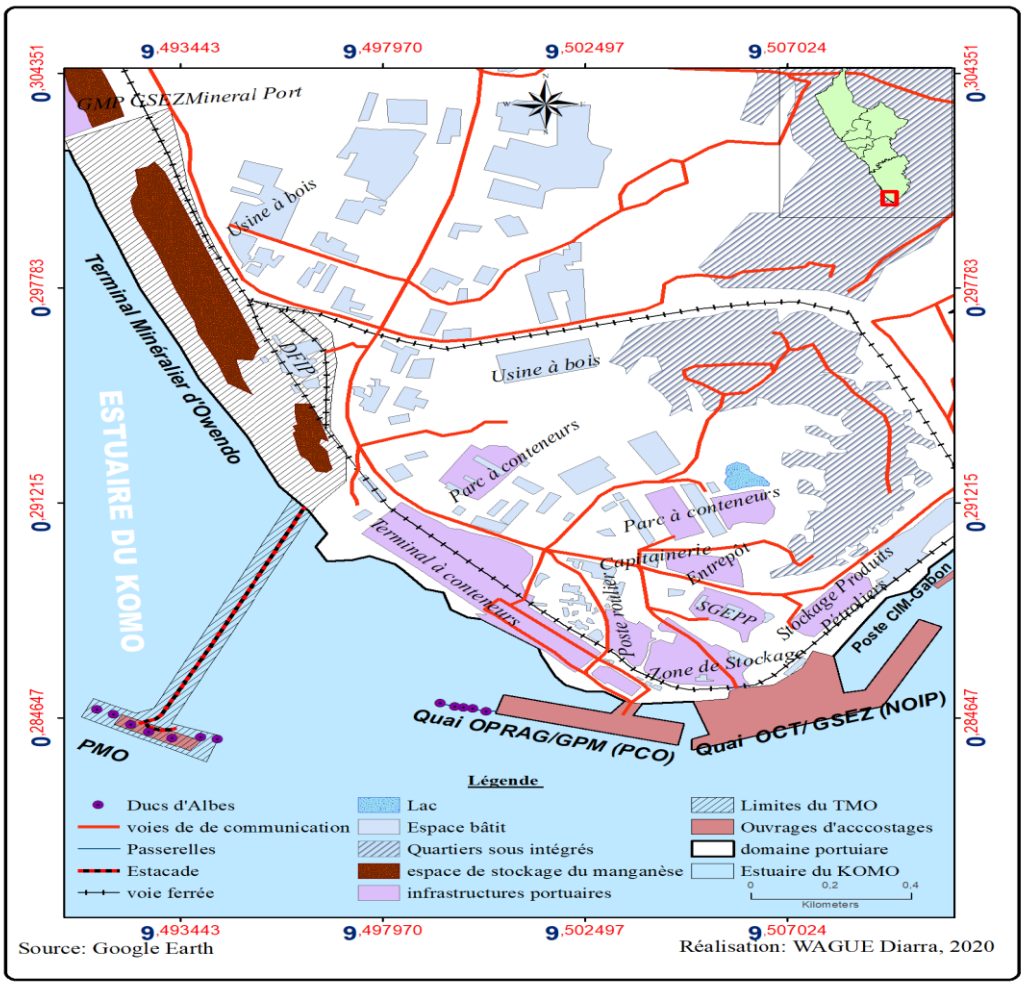

Figure 1. Location of the Owendo mineral terminal.

2.2. Data collection

The work required documentary research related to the theme and the sub-themes to which it relates. The documentary research thus began in the various documentation centres of Omar BONGO University, in particular at the university library and at the National Center for Oceanographic Data and Information (CNDIO), attached to the Institute for Research in Human Sciences (IRSH) of the National Center for Scientific and Technological Research (CENAREST). A number of dissertations, including those of Abogho Essono (2018); Moutsiangou Boubeya (2018); Ntsagui (2005); Okoula (2018) as well as the doctoral thesis of Makiela-Magambou (2007) were consulted.

Bibliographic research was also continued on the internet; This allowed us to consult a large number of sites and download documents in PDF format, on the themes of safety, health, and night work. Data collection required the three main methods, i.e., semi-directive interviews, questionnaire surveys, and participant observations. To conduct this study, the choice fell on centred/targeted semi-directive interviews which consist of asking precise and short questions on the specific aspect of the phenomenon studied. These interviews were conducted with the professionals concerned: Pilots of mooring boats, moorers, agents of the

Shipping Department of the DFIP, port pilots and agents of the Owendo harbour master's office, agents of the Technical Department and the Ship Movement Department of GPM, consignees of mineral carriers and shipping agents, ship crews, agents of the General Directorate of the Merchant Navy (National Maritime Authority). These semi-directive interviews made it possible to question a target population of fifty (50) individuals, distributed according to **Table 1**.

Table 1. Distribution of the sample of respondents at the Owendo port complex.

Sectors of activity	Supervisory staff	Supervisors	Enforcement agents	Total	Percentages
Pilots of mooring boats	2	2	0	4	8%
Mooring men	0	3	3	6	12%
Agents of the DFIP Consignment Service	2	2	2	6	12%
Port pilots and agents of the Owendo harbour master's office	3	3	2	8	16%
Agents of the Technical Directorate and the GPM Ship Movement Service	0	3	2	5	10%
Ship consignees/Shipping agents	2	3	3	8	16%
Ship crews	0	1	3	4	8%
Agents of the General Directorate of the Merchant Navy (National Maritime Authority)	3	3	3	9	18%
TOTAL	11	20	19	50	100%

Author's elaboration, March 2023.

The sample selected (**Table 1**) reflects a desire to gather the opinions of a wide range of port stakeholders to better understand the socio-economic and security issues of nighttime services at the Owendo ore wharf. Upon observation, the tasks performed by the mooring crews and pilots of the mooring boats expose these two socio-professional categories the most to security challenges. Indeed, while continually intervening on the water, they must remain in contact with the ship's personnel and other stakeholders involved in managing the ship's stopover.

We individually allocated thirty (30) min to one (1) h to each agent consulted. The information collected using a dictaphone and a notebook focused on the issues of nighttime operations at the PMO. The data collected was processed (on Microsoft Excel) and analysed; the various opinions were cross-referenced.

Of course, the questionnaire was not administered to all individuals, due to their unavailability and absence during our survey period. However, the semi-directive interviews by questionnaire, conducted with the main stakeholders in the operational management of the nighttime services of the Owendo mineral port (pilots, tugs, pilots of the mooring boats and port pilots) provided statistical data.

The participant observation which required the visit of the COMILOG port facilities, made it possible to understand the operation and management of port operations during the day and at night. Also, this study made it possible to make trips to the Technical Department of GPM, to visit the PMO infrastructures, to attend certain nighttime docking and undocking operations, and therefore to understand the organisation and management of port services on this platform.

3. Results

They are structured around the motivations for the introduction of night manoeuvres and the resulting impact first, logistical obstacles to the transport and storage of ore then, constraints of the water level, difficulties and risks incurred by the agents finally.

3.1. Night manoeuvres at the TMO, a profitable choice for COMILOG

This is the place to discuss the reasons for the entry into force of the new services as well as their impact.

3.1.1. Socio-economic motivations for the introduction of night manoeuvres

The project stems from the performance objectives set by COMILOG managers in the context of competition from the Barracuda mineral terminal (known as Gsez Mineral Port), in terms of production, transport and export of manganese ore. Indeed, although it held the exclusivity of national manganese exports until 2017, the PMO must now adapt to the opening of this competing platform. At the same time, and according to information collected on the ground in March 2023, as early as 2011, the OPRAG hierarchy considered that improving the performance of Gabonese ports required night work according to the 3 × 8 h formula (**Figure 2**).

Figure 2. Night view of the Owendo mineral post.
Source: GPM infrastructure service photo (2019).

The nighttime services were aimed at increasing manganese exports by improving the handling rates of port equipment, which reduce nighttime downtime. They were aimed at improving services to ships and reducing demurrage, i.e. the costs paid by the ship's captain if the time limit set by port regulations for staying at the port is exceeded. This perspective avoided the strong pressure exerted by shippers and amateurs who demanded greater speed in carrying out port operations.

Field surveys, conducted in March 2023 with managers of the COMILOG Railway and Port Facilities Directorate (DFIP), revealed that the desire to increase manganese exports is accompanied by work on the railway section and the Owendo port site in order to store a larger quantity of ore before loading. Thus, taking into

account the reduced capacities of the storage area of its Owendo terminal, limited to 600,000 tonnes of ore, the DFIP hierarchy has favoured night manoeuvres to increase the export capacities of its port facility.

3.1.2. The positive impact of night manoeuvres on port operations

The impact of night docking and departures at the Owendo mineral terminal is evaluated here through four elements. First, the reduction in the stay of ore carriers in stopovers (in the harbour and at the quay), then the increase in the rotation of ships and their number, then the significant improvement in the tonnages of manganese exported, and finally the increase in the turnover of the Compagnie Minière de l'Ogooué (**Figure 3**).

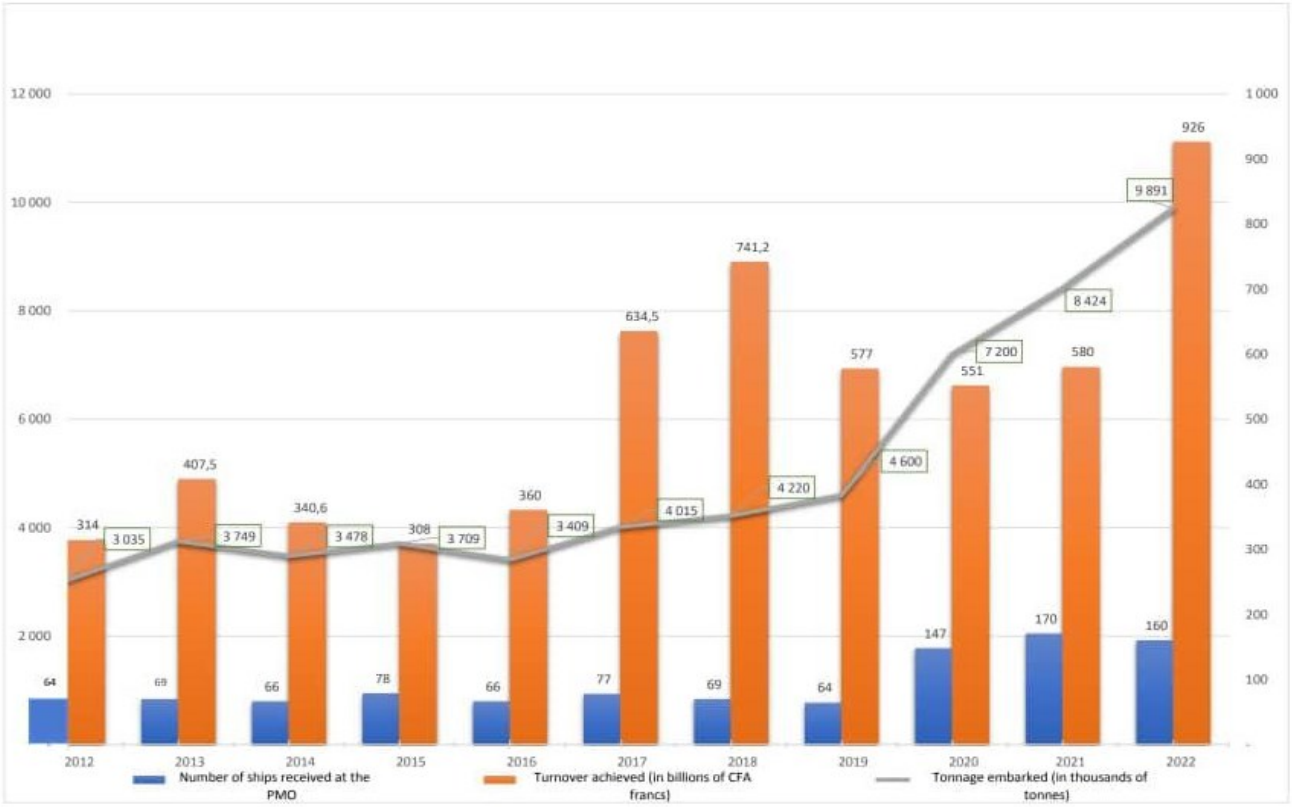

Figure 3. Evolution of manganese exports, ship traffic at the PMO and COMILOG turnover between 2012 and 2022.

Sources: Capitainerie de l'OPRAG; Directinfosgabon, 2019, 2021, 2023; Eramet, 2021; Gabonreview, 2018; Infosplusgabon, 2013; Jordan, 2017; Mihindou, 2021; Owona, 2016. Réalisation: Ndjambou Léandre Edgard, 2024.

Night manoeuvres have reduced the prolonged stay of ore carriers calling at Owendo. Indeed, until 2019, the waiting time of ships in harbour varied between 01 and 10 days while their stay at the quay fluctuated between 3 and 7 days. Since 2020, the duration in harbour is now on average 6 days and the loading time 4 days maximum. A reduction in the operating costs of ships has also been noted. According to surveys carried out in the field in March 2023 at the PMO, the taxes required from ore carriers mainly include fees for staying in harbour or on a private quay, established by volume and per day, at the rate of 0.0213 euros, or 14 CFA francs with a minimum collection of 220.8986 euros (144,900 CFA francs). Added to this are the fees for stay, pilotage, movement in the pilotage zone, towing, towing,

mooring (with a supplement of €1,104,493, or 72,450 CFA francs per mooring) and finally the fees for the supply of water. All these costs are increased by 50% when the various services are carried out at night, on public holidays, on Saturdays or Sundays, etc.

Surveys conducted at the Owendo mineral port in March 2023 also reveal that the introduction of night operations was followed by an increase in the number of ship calls and manganese exports, as shown in **Figure 3**. It appears that the correlation between the number of ships calling and the evolution of manganese exports is real, even if the latter experienced a see-saw evolution until 2016. According to information provided by DFIP officials in March 2023, the year 2012 was disrupted by a general maintenance operation on the facilities carried out by their entity. On the other hand, the contraction from 2014 to 2016 is the result of a voluntary shutdown of the extraction process linked to the strong variations in the price of the ore on the international market. The increase in exports in the 2017–2020 period is due to an improvement in prices and global demand. And the significant increase recorded between 2020 and 2022 is explained by the introduction of night manoeuvres at the PMO, on the one hand, and by the completion of the Jéroboam project initiated in 2021, on the other hand.

Jéroboam is a manganese ore transshipment operation set up by the Compagnie Minière de l'Ogooué. It allows part of the exports to be loaded offshore onto Capesize vessels that can hold between 180,000 and 200,000 tons of ore. The restriction of the draft of 11.50 m, at the exit of the port, led COMILOG to agree to an investment of approximately 40 million US dollars to allow the barges to dock at a floating platform from where the excavator lifts the ore to deposit it in a hopper which distributes it in the ship.

Concretely, these various improvements have led to an increase in COMILOG's turnover, as shown in **Figure 3**. Indeed, having generally aligned with the evolution of the number of ships and that of the tonnages of manganese exported, for the same mobiles, the turnover of the mining company experienced a sawtooth growth between 2012 and 2019. From 2020, the increase was steady until reaching the peak of 2022.

3.2. Logistical obstacles to the operation of the railway and the storage area

The "Transgabonais" railway, 650 km long, has many weaknesses, including the simultaneous operation for the transport of passengers and the transport of freight, forest products and manganese. This often results in an extension of the time taken to make manganese available at the TMO due to the long downtimes of ore convoys that are marked to give way to trains going in the opposite direction. Added to this is the limitation of train speeds due to the dilapidated state of the track on certain segments (Ndjambou, 2008).

Recurring derailments on the railway line (**Figures 4–6**), particularly in so-called unstable areas, are another constraint that hinders the normal progress of port operations at the PMO, often causing a temporary interruption of rail traffic. This then results in a slowdown in handling rates and ship traffic, because the loading of

manganese depends on the availability of ore in the storage area. It may also happen that the ore is not loaded due to its humidity or low demand. The other difficulty of the manganese sector is the near saturation of the storage area of the ore terminal. The dedicated site capable of holding 600,000 tonnes has almost reached its limits while ore production has been growing continuously for five (5) years as shown in the previous **Figure 3**.

Figure 4. Derailment of an ore train in 2019.

Figure 4 illustrates the derailment of an ore train that occurred on 5 January 2019 at Kilometre Point 575, over a 300-m stretch, between the Mboungou Badouma and Lifouta stations. A total of 13 wagons were damaged.

Figure 5. Accident of ore train No. 6612 that occurred on the night of 1 to 2 March 2022.

Figure 5 shows the derailment that occurred between Kilometre Points 41 and 42 caused the loss of ore and the overturning of fifteen wagons. It damaged 600 m of railway track, near the village of Andeme.

Figure 6. Derailment of mineral train No. 2610 on 1 November 2023.

Figure 6 is an accident that occurred between the Lastourville and Milole stations at Point Kilomètre 455 led to the interruption of traffic on the track and damaged 200 m of the rail and 17 wagons.

3.3. The constraints of the body of water, the difficulties and risks incurred by the agents

On the water, since nighttime port operations are dependent on the tidal effect, ships calling must take into account the nautical conditions of the access channel to the port of Owendo, over nearly 19 miles or 35.188 km between the tip of Owendo and the Pénélope buoy (Makiela Magambou, 2007). The reception of vessels is limited to 11.5 m of draft, even if the ore berth offers depths of −12.5 m. The partial silting of this estuarine site then leads ships to make their movements according to the tide. This lengthens their stay at the mooring posts or in the harbour and causes time losses during loading operations.

Here the tides are semidiurnal with strong inequalities, characterised by the movement of ebb and flow that affects the sea in 24 h. These tides are of low amplitude, with deviations limited to 0.9 m during two successive sessions, the durations of which vary between 5 h 30 min and 7 h for a flood or an ebb. The low amplitude of the tidal range constitutes a serious obstacle for navigation on the West African coast, in Owendo the size and capacity of the vessels are limited by access restrictions.

The tides are an obstacle for night docking at the PMO, because not all are conducive to the movement of vessels in the port basin. Indeed, at the Owendo point, night falls from 7 pm and extends until 6 am Night docking like night tides, for their part, begins on average around 5 pm. The semi-diurnal peculiarity of the tides is structured into two high tides and two low tides which are temporally divided into two successive tides during the daytime period and, in the majority of cases, into two tides during the nighttime period.

We have a first nighttime tide which is located in the time interval from 5 pm to midnight on average and a second which generally starts after midnight, to extend until dawn, depending on the difference in tidal amplitudes. Understanding the time phases of nighttime tides is useful, because some nights are marked by low tides during which no ship can dock or sail due to insufficient depth. Similarly, some high tides are not very usable due to the high risks of operational accidents related to fatigue, as evidenced by field surveys conducted in March 2023.

In addition to the high and low tide limits that hinder nighttime docking and departure, the PMO is subject to the high coefficients of certain nighttime high tides. As an indicator for measuring the tidal range, the tide coefficient generally varies from 20 to 120 cm. A tide with a coefficient greater than 70 is called spring tide, while it is called neap tide when it has a coefficient less than 70. According to the information provided by the DFIP Shipping Services, during our surveys in March 2023, ship manoeuvres at the PMO are carried out when the tide coefficient is less than or equal to 70, because a higher coefficient results in a faster rise in the sea, a stronger current and more marked sea agitation which compromises the safety of the ship’s mooring and unmooring operations.

At the port level, nighttime docking and departures which are carried out in two (2) h and one (1) h respectively require special attention from the professionals concerned. The field surveys, carried out in March 2023, revealed numerous shortcomings which are summarised in **Tables 2**–**5**.

Table 2. The main difficulties encountered by mooring men teams.

Difficulties encountered by mooring men	**Effectifs (6)**
Lack of manoeuvring space	6
Weather conditions	5
Duration of operations	5
Nautical conditions (tide, agitation of the water, currents)	6
Movement of other vessels	1
Infrastructural inadequacies	4
Reduced visibility	5
Insufficient lighting on mooring lines	5
Fatigue	2
Accidents	2
Hours of service	2
Lack of communication with the ship (Vessel)	4

Source: Enquêtes de terrain, mars 2023; Réalisation: Ndjambou Léandre Edgard, 2024.

The mooring men (12% of the population surveyed) identified as the main difficulties they face at night, the lack of space to manoeuvre on the mooring lines, the duration of operations and the nautical conditions, particularly the agitation of the water. Despite the lighting requirements, 83% of this socio-professional category finds visibility still reduced on the mooring lines. More than half of them believe that the mooring structures are insufficient and that they are rarely maintained. This situation exposes the agents to significant risks of accidents. On the operational level, 67% of these agents complain about the lack of communication with the navigating personnel when transmitting the mooring lines. Hence the risk of accidents they incur. These risks are greater when night manoeuvres are carried out during bad weather conditions, strong currents, high tide or violent winds (Zinsou, 2009).

Table 3. Inventory of safety risks associated with night mooring operations.

Safety risks	**Risk factors**
Risk of falling into the water	• agitation of the water (high coefficients at night); • presence on a mooring boat; • sea currents; • fatigue.
Cold	• weather conditions; • night temperature; • permanent humidity at night.
Capsizing	• agitation of the water; • risk of collision if the vessel drifts; • insufficient lighting; • snagging during the transmission of the mooring lines.

Table 3. (*Continued*).

Safety risks	Risk factors
Exposure to breakage or breakage of the mooring lines	• narrowness of the gangways on the mooring lines; • pressure of the mooring lines during docking manoeuvres; • obsolescence of the mooring lines on some vessels.
Risk of falling onto the mooring lines	• defect in the flooring on the mooring lines; • lack of maintenance on the mooring and docking lines.
Injuries and entrapment	• defect in the flooring on the mooring lines; • corrosion on the fixing hooks; • defective ladders on some mooring dukes.
Collision with the mooring launch	• agitation of the water during disembarkation at the mooring post; • defective ladders on the Ducs.
Drowning, death	• accidental falls.
Risk of accidents	• insufficient communication with on-board personnel.

Source: Enquêtes de terrain, mars 2023; Réalisation: Ndjambou Léandre Edgard, 2024.

Table 3 above, which presents the various risks to which pilots are exposed during night PMO services, mainly includes falling into the water (accidental fall), capsizing during landing operations, drowning, and breaking a mooring line. For their part, pilots of mooring boats consider that the duration of operations and the agitation of the water are their main professional difficulties. Half of them (50%) also complain about the lighting conditions in the manoeuvring area of the boats. They say they are dazzled when passing the mooring lines to the pilots. Some say they are often confronted with the presence of fishermen or their drifting nets in their manoeuvring areas, which exposes them to the risks of collision or capsizing, because the net can become entangled in the propeller of a boat and damage it. Similarly, three quarters (75%) of pilots complain about the lack of coordination and communication with the cabin crew during docking and departure operations, both day and night.

Table 4. Difficulties encountered by pilots of mooring boats during night manoeuvres.

Types of hazards	Workforce (n = 4)
Weather conditions	1
Duration of operations	4
Nautical conditions (tide, agitation of the water, currents)	4
Presence of fishing net in the manoeuvring area	3
Reduced visibility	2
Insufficient lighting in the manoeuvring area	2
Loss of visibility due to excess light	3
Fatigue	3
Hours of service	2
Lack of communication with the ship	3

Source: Enquêtes de terrain, mars 2023; Réalisation: Ndjambou Léandre Edgard, 2024.

Table 4 summarises the main obstacles faced by pilots of mooring boats at the PMO during night manoeuvres. It includes difficulties related to the nautical conditions of the port basin, those related to the lighting of the infrastructure and others related to fatigue. Although accidents are rare, the problems noted can lead to capsizing, collision, etc.

Table 5. Risks incurred by speedboat pilots during night manoeuvres.

Security risks	Risk factors
Risk of capsizing	• Agitation of the water • Risk of collision if the vessel drifts • Glare due to excess light • Snagging during the transmission of the mooring lines
Risk of damage	• Presence of a net in the manoeuvring area of the launches • High agitation coefficient during night-time operations • Agitation of the water during the disembarkation of the pilots
Risk of collision	• Ship drifting during docking • Presence of canoeists in the maneuvering area • Insufficient communication with the edge
Risque d'accident	• Absence of coordination with the ship • Reduced visibility and insufficient lighting in the manoeuvring area

Source: Enquêtes de terrain, mars 2023; Réalisation: Ndjambou Léandre Edgard, 2024.

Table 5 highlights the risks and risk factors faced by pilots of mooring boats during night operations at the PMO. These risks include capsizing, collision due to lack of coordination with the on-board personnel (ship) when passing the mooring lines, insufficient lighting, agitation of the water and the presence of fishing nets in the manoeuvring area of the boats.

4. Discussion

Night work is not a Gabonese specificity, because the activity is booming on a global scale. Its evolution in almost all countries of the world is linked to technological, economic or social issues as shown by B. Barthe et al (2004). In Cameroon, night work was also considered by port officials to relieve congestion in the port of Douala (Journal du Cameroun, 2014). At the port of Mohammedia in Morocco, high expectations related to the obligation for ships to dock only during the day led the National Ports Agency (ANP) to approve night docking. The application of nighttime docking and undocking at the Owendo ore wharf was part of a profitability objective according to the COMILOG Annual Report (2017) which aimed to increase the export and storage capacities of COMILOG's port facilities in Owendo. Indeed, the Owendo stopover used to require ships to pay significant demurrage, because the waits before docking were long and the handling rates were low. As a result, the port dues applicable in Gabon were still among the most expensive on the West Coast of Africa (Europe-Africa Observatory, 2017).

The socio-economic motivations are mentioned by Calas (2006) in the study devoted to urban changes in Tanzania, in particular "port horizons". It highlights the 160% increase in the number of ships docking at the port of Dar-Es-Salaam, following the night opening of this platform. For its part, UNCTAD (1983) mentions the impact of night activities in the port sector, through the application of shift work in the British port of Hull. The tasks carried out there without interruption are in principle equivalent to two shifts from 6 to 8 am depending on the port. The study reveals that the introduction of two-shift work, in association with daytime work, from 7 am to 2 pm in the morning and from 2 pm to 9 pm in the afternoon, is the best guarantee of an increase in port productivity.

This statement is nevertheless qualified by Barthe et al, (2004). Indeed, they believe, on the one hand, that it is not entirely true that work that is easily performed during the day would be equally so at night. They also question the assertions that night tasks are less well performed because of a drop in vigilance that is often mentioned. For these authors, the realities can vary from one situation to another depending on the activity actually performed. On the subject of work in ports, Moutsiangou Boubeya (2018) provides the necessary insight, because she believes that the ship that is on call must obtain in the said environment the best quality, most efficient and safest services possible, thanks to the infrastructure and equipment in good condition.

The factors that hinder nighttime docking and departures at the Owendo ore wharf are addressed by many authors. While Makiela-Magambou (2007) mentions the financial difficulties of the "Transgabonais" to justify the continuous deterioration of the railway heritage, Ndjambou (2008) deplores the dilapidated state of certain segments of the infrastructure and the recurrence of accidents that negatively impact port operations in Owendo. The persistence of difficulties on this axis is such that Ndjambou et al. (2014) mentioned train derailments to explain the lengthening of the wagon rotation time, which is on average 18 h. This study is corroborated by that of Ango Obiang (2019) which notes the problems that undermine the optimal functioning of the route and that of Ibouanga et al. (2022) which evokes the problems of the "Transgabonais" through the difficulties encountered by its various managers.

The constraints of operating the body of water appear in the analysis of Makiela-Magambou (2007). It calls for understanding the phenomenon of tides, characterised by certain nights of low tides during which docking and undocking operations are suspended due to the lack of the necessary water level and other nights marked by high tides, beyond midnight. The latter are unexploited because of the risks of accidents linked to fatigue. The study by Moutsiangou Boubeya (2018) falls within the same field, as it presents pilotage as an activity exposed to bad weather conditions, such as unpredictable tides and currents, and underwater dangers. Renamy Awenza (2023) agrees, as she believes that during severe storms from September to November and from March to May, severe weather conditions often disrupt port operations and contribute to delays in the loading of ore and the departure of ships.

The difficulties and risks to which port professionals are exposed at night are analysed by Ntsagui (2005). In his study, he already noted the obsolescence of the

pilots' communication equipment, which hindered communication with the ship's crew and did not facilitate docking manoeuvres and operations related to the arrival and departure of the ship. He also recommends improving the working conditions of the personnel concerned, acquiring communication tools for their benefit and training them in port safety and security standards. Furthermore, he suggests introducing a fine for pirogues passing near the quay, in order to strengthen the safety of docking and undocking operations of vessels. For his part, Abogho Essono (2018) believes that since 2009, the managers of the port of Owendo had chosen port safety and health as priorities for their actions. Specifically, regarding the risks associated with handling manganese, Abogho Essono (2018) highlights the toxicity of the chemical product on human health.

When discussing the prevention of risks for workers, Abogho Essono (2018) suggests first detecting, among the target socio-professional categories, the medical aptitudes (through related examinations) which would attest to their ability to be able or not to carry out the work intended for them in order to avoid certain accidents. Abogho Essono (2018) asks employers to check whether the worker is fit to work. These different positions are close to that of Barthe et al. (2004) which shows that there is a decrease in vigilance, therefore an increase in drowsiness among certain night workers from the beginning to the end of the shifts. And that the risk of accidents also arises from the succession of nights.

For their part, Beaud et al. (1990) address the issue of disruption of (daytime) sleep of night workers by highlighting the resulting consequences in terms of increased fatigue, sleep disorders and challenges, or even increased nervous fatigue. Indeed, according to Beaud et al. (1990), overfatigue resulting from night tasks affects the quality of night work and leads to a drop in concentration and the ability to anticipate. It therefore has a negative effect on staff performance… This can then result in a rate of errors, seriousness of accidents, incorrect manoeuvres, misunderstanding of information, poor handling of incidents, difficulty in anticipation. Other studies confirm the risks of night work. This is particularly the case of the Economic, Social and Environmental Council (2010) which suggests systematically informing, training and raising awareness among night workers about the risks associated with their tasks and the physical and mental stress throughout their careers. For his part, Leonard (1998) believes that night work is a source of quantitative and qualitative decline in production at the end of the night. He also shows an increase in the number of accidents occurring during the night (Leonard 1998).

Safety is also mentioned by Mondjo (2020) through the lighting of the Owendo port area, particularly that of the quay operated by GPM. Although he considers it powerful and satisfactory, our field surveys carried out in March 2023 prove the opposite. Indeed, while lighting helps improve the safety of personnel day and night, visibility remains insufficient to date in the manoeuvring area of the Owendo mineral port. For her part, Moutsiangou Boubeya (2018) recalls the importance of an efficient lighting system to facilitate night-time handling operations and ensure better port security. She also suggests ensuring the safety of personnel at the port by providing agents with Personal Protective Equipment (PPE), because said equipment is likely to provide protection for the head, eyes and face, arms and hands, legs and

feet, body, hearing protection, respiratory protection and fall protection. For his part, Okoula (2018) mentions the absence of personal protective equipment (PPE) among dockers at the secondary port of ACAE, referring to equipment covering minor risks, significant risks and serious risks with irreversible or fatal effects. Finally, Okirou-Guitenga (2024) points to the improvement of maritime safety in Gabon, specifying that it is an essential objective of the country's maritime policy. We note, however, that the facts tend to prove the opposite, judging by the laxity in certain maritime administrations.

5. Conclusion

This study has attempted to analyse the socio-economic and security issues of night manoeuvres at the Owendo ore terminal, by presenting the reasons for the establishment of these services, by evaluating their impact on ship traffic and the performance of port operations. It has also highlighted the multifaceted obstacles related to said operations, as well as the risks incurred by ship assistance teams (mooring, piloting of mooring boats).

The verification of the hypotheses makes it possible to affirm that the performance objectives set by COMILOG have been achieved, because the berthing and the equipping have improved the handling rates, reduced the dwell time of ships, increased the stopovers, increased the tonnages embarked and the turnover achieved. However, these new services have revealed the obstacles that still mark the ore export process, including the difficulties of the railway, the natural and operational constraints of the Owendo site and the safety challenges of the professionals involved.

As an improvement, we suggest, in parallel with the necessary improvements on the railway, the regular maintenance of the mooring structures, particularly the access ladders and the floor of the gangways on the mooring dukes, the hooks for fixing the mooring lines, because their metallic nature exposes them to corrosion. We believe that an enlargement of the gangways on the mooring dukes is also necessary, because they offer little room for manoeuvre to the pilots during the handling of the mooring lines. Due to reduced visibility, it is urgent to reinforce the lighting, particularly in the manoeuvring area of the launches and at the mooring berths and to prohibit fishing activities in the said area by ensuring that no fishing net is thrown in this perimeter. Overall, it is desirable to restrict the activity of pirogues in the area where the mooring boats operate.

We also urge GPM to raise awareness among its employees about the risks of accidents and to provide them with compensatory rest days, as well as a certain flexibility between daytime and nighttime work. It will be up to the company to ensure that the mooring boats and pilots assigned to nighttime work benefit from sufficient rest hours to enable them to carry out their duties safely. While endeavouring to examine its agents to detect signs of fatigue and to ensure that they do not consume alcohol or drugs, Gabon Port Management must raise awareness among all the pilots and pilots of the mooring boats, assigned to night services, on the nighttime exercise of their activity, to equip each agent embarked on a mooring boat with a head torch, a portable VHF device, a life jacket, protective glasses if

possible and gloves. In terms of mooring operations, the company must establish better communication and a certain coordination between the ship (service pilots) and the various stakeholders, then ensure that the number of personnel is reduced on each mooring boat to guarantee a certain safety during nighttime docking or departure operations.

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