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LESSONS LEARNED AND SAFETY ISSUES IDENTIFIED FROM THE ANALYSIS OF MARINE SAFETY INVESTIGATION REPORTS

Report of the Correspondence Group on Analysis of Marine Safety Investigation Reports

ANNEX 1

Draft Lessons Learned from Marine Casualties

1 Collision

Very serious casualty: Collision between two ships with foundering of one ship

What happened?

The 40,000 GT bulk carrier was on her way to the next loading port. Around midnight the bridge was manned with the officer of the watch (OOW) and one lookout. At the same time the 240 GT fishing vessel sailed from the fishing grounds to her home port with a crew of 15.

In a distance of about 6 nm the fishing vessel appeared on the radar screen of the bulk carrier and it was optically visible on the starboard bow. There were about 25 fishing vessels in the vicinity. During this time the bulk carrier ran with a speed of about 14 knots, the fishing vessel with a speed of about 9 knots. The OOW of the bulk carrier detected that the fishing vessel would pass the bow from starboard to port side. Both vessels met in a crossing situation in which the bulk carrier was the give-way vessel.

During the approach of both vessels the closest point of approach (CPA) decreased, although the bulk carrier had started a small course alteration to starboard. The bulk carrier continued with a bigger course alteration to starboard. Shortly afterwards the fishing vessel made a course alteration to port which led to the collision of both ships.

The fishing vessel was struck by the bulbous bow of the bulk carrier on the starboard side amidships and suffered severe damage with a massive intake of sea water. This caused the foundering of the fishing vessel shortly thereafter.

Only two crew members of this vessel survived. None of the bridge team was rescued.
The bulk carrier continued her voyage without any activities as they thought nothing had happened.

Why did it happen?

The OOW of the bulk carrier accepted a small CPA for too long. The bulk carrier as the give-way vessel did not take early and substantial course alteration. The OOW of the fishing vessel did not use the whistle or other means to alert the other ship. The OOW of the fishing vessel altered the course too late for avoiding the collision and also to the wrong side.

What can we learn?

 If there are any doubts about the intention of other ships, then it is best to act in time in accordance with the COLREGS.

Who may benefit?

Seafarers and ship operators.

2 COLLISION

Very serious casualty: Collision between two ships in a fairway

What happened?

The 3,000 GT cargo ship was leaving the port through a dredged fairway during the early hours of the night. At the same time the 960 GT dredger was entering from the opposite side. The visibility was good. The wind was moderate.
The bridge of the cargo ship was manned with the captain and an AB as helmsman. After finishing the aft mooring station, the second officer also went to the bridge. There he switched on the AIS device and was responsible for the engine telegraph. Therefore the AIS signal was only available 1.5 minutes before the collision.
The bridge of the dredger was only manned with the master. After entering the dredged fairway, the captain checked the situation ahead by radar, which was switched to the 2.5 miles range. He did not detect any radar target. During the approach of the only bend in the channel, the dredger neared the middle of the fairway and then cut the corner at the bend and sailed on the wrong side. In the meantime, the attention of the captain was distracted by a small boat which crossed his way from starboard to port.
The captain of the cargo ship was aware of the dredger and his approach to the wrong side of the fairway from the beginning. The captain assumed that the dredger would alter the course to the right side in time. As he noticed the top lights of the dredger in a line, the captain of the cargo ship became aware of the danger of collision. He used the whistle and he flashed with the daytime signal lights. In the meantime a VHF call was made to the dredger. But there was no reaction. Then the captain ordered to let go the laid out anchor and to take full astern.

The captain of the dredger started to turn the ship shortly before the bend. During the course alteration he realized the close quarter situation of the cargo ship. The captain of the dredger neither noticed the whistle blasts nor the light signals. Assuming the cargo ship would turn to the port side, he switched to manual steering, put the rudder hard to port and the engine to full astern.
Both ships collided shortly afterwards. The cargo ship struck the dredger on the starboard side midships. This resulted in a bigger hole in the cargo hold of the dredger and he capsized subsequently. Later on, the dredger was declared a total loss. The cargo ship suffered only minor damages to the bow and the bulbous bow.
The crews remained unharmed. An oil spill damaged a seaweed farm in the vicinity.

Why did it happen?

The ship's command of the cargo ship assumed for too long that the dredger would alter the course to the right side of the fairway. Therefore they neither altered the course to the outer right side of the fairway nor reduced the speed or gave signals or made VHF calls in good time.
The captain of the dredger was alone on the bridge. His attention was neither appropriate to the radar nor to the fairway in front of the ship. The ship sailed on he wrong side of the fairway.

What can we learn?

 If there are any doubts about the intention of other ships, then it is best to act in time in accordance with the COLREGS.

 It is essential during the navigational watch to make use of all technical and visual resources in order to maintain situational awareness.

 Keeping on the right side of the fairway is one step to minimize any risk of collision.

Who may benefit?

Seafarers, ship operators.

3 FATALITY

Very serious casualty: Fatal fall from height

What happened?

The bosun of a 36,000 GT bulk carrier was fatally injured when he fell about 6 metres from a cargo crane grab while preparing to descend from the grab where he had been working. The ship was carrying a cargo of coal and was at sea. A number of its crew had been tasked to replace the wire rope of a cargo crane grab stowed on its stowage platform on the main deck. The weather was fair and working at height precautions, including completing a ship's 'permit to work aloft', had been taken.

The work started in the morning and was completed in the evening. Two seafarers first descended from the grab. The bosun then prepared to descend. Shortly after unclipping his safety harness lanyard, he lost his footing and fell about 5 metres onto the platform railing and a further 1 metre onto the deck below. He suffered a head injury, which began to bleed profusely. The bosun was given first aid, moved to the ship's hospital and the ship's master sought radio medical advice. However, he died about an hour after the accident.

Why did it happen?

The bosun lost his footing just after unclipping his safety harness to descend from the grab. The ship's procedures did not refer to hazards related to access/egress from a worksite at height, and it could not be determined if the risk of going up and down from the grab had been assessed.

The shape, size and position of the grab meant poor hand and foot holds, and it was concluded that the bosun probably perceived the risk involved as acceptable and within his control. The fall prevention equipment on board was not ideal for vertical movements, such as a double-legged energy absorbing lanyard. The equipment was of a type that necessitated unclipping the safety harness lanyard to ascend or descend the worksite.

What can we learn?

 Suitable fall prevention equipment, such as a double-legged energy absorbing lanyard, should be provided on board ships to adequately address the risk of falling from height.

 Shipboard procedures and permits to work at height should address the risk of falling at all stages of the work, including the risk when ascending/descending the worksite.

 An objective and robust risk assessment process can ensure individual risk perception of working at height is not a factor.

Who may benefit?

Seafarers, ship owners and operators.

4 FATALITY (DISAPPEARANCE)

Very serious casualty: Loss (disappearance) of a person at sea

What happened?

A member of the supernumerary riding crew disappeared from the 73,000 GT container ship during working hours at sea. A search for the missing man on board and of the sea area failed to find him.

The four-person riding crew were cleaning the ship's aft peak tank. They started work early in the morning. According to their foreman, the man who disappeared had exited the tank about mid-morning to urinate. When the riding crew stopped work for lunch more than an hour later, the man was still absent. They reported that they then searched for the missing man in their cabin (Suez

crew cabin) and the deck toilet, but did not find him. The foreman then informed the chief officer of the situation (about 2 hours after the man was reportedly last seen).
Shortly afterwards, a search of all the ship's spaces was started, and the ship was turned around for a man overboard search. About 4.5 hours later, the ship had returned to the position where the missing man was last reported to have been seen. Despite an extensive search (with other ships and aircraft assisting), the man was not found.

Why did it happen?

The investigation concluded that it was unlikely if it could ever be established whether the loss of the man was accidental, deliberate or assisted. Nor could it be determined how he disappeared (as there was no assurance that significant events and their sequence as reported were factually accurate).
The investigation, however, concluded that the ship's crew did not adequately supervise the riding crew. Adequate supervision may have helped avoid the occurrence, and assisted the keeping of an accurate record of their work and events.

What can we learn?

The investigation concluded that something could be learned from 'pertinent issues' related to this occurrence. These issues are related to the supervision and management of third-party contractors, such as the supernumerary riding crew, on board. The following lessons are based on the investigation's recommendations.

 Safety management systems (SMS) need to address the training and supervision of third-party contractors on board, and compliance with procedures should be verified at internal audits.

 Appropriate familiarization and training on board should be provided to contractors.

 Training provided to contractors before shipboard deployment should be verified.

 The ship's working language should apply to all personnel working on board.

Who may benefit?

Seafarers, ship owners and operators, supernumerary contractors and their employers.

5 COLLISION

Very serious casualty: Collision between passenger ferry and assisting tug – resulting in the tug capsizing and the loss of two crew

What happened?

The tug had been engaged to assist the ro-ro passenger ferry to berth in high winds. There was no harbour pilot on board the ferry because the master held a pilot exemption for the port. The tug was manoeuvring close to the port bow of the ferry while attempting to establish the tow, when the stern of the tug collided with the ferry's bulbous bow. As a result of the collision the tug became broadside on in front of the ship, heeled dangerously to port and took on water. The tug capsized and two of its crew died.

Why did it happen?

The tug was forced to leave the 'safe zone' and manoeuvre close to the bow of the ferry in order to establish the tow, whereupon hydrodynamic interaction between the hulls of the ferry and tug drew the tug inwards to collide with the ferry's bulbous bow.

The speed of the ferry through the water at the time was too fast to safely establish the tow. The relatively high speed through the water meant the 'safe zone' in which the tug must remain was further away from the ferry, making it more difficult to establish the tow.

The relatively high speed through the water also meant the tug was using a high percentage of its available engine power to match the speed of the ship, leaving minimal reserve power to manoeuvre.

The pilot-exempt master of the ferry was not required to have undergone additional training for tug assistance, which was usually requested during adverse and difficult weather conditions.

Water down-flooded through an open door and open engine-room ventilation duct when the tug turned broadside on and heeled over. This allowed down-flooding to occur, further reducing stability and ultimately causing the capsizing.

The tug crew were unable to close the engine room ventilation duct during operations because it was required to be open in order to supply air for the tug's engines.

The tug did not comply with the required stability parameters, which meant it was prone to excessive heeling during operations and early down-flooding.

What can we learn?

 Establishing a tow between a tug and ship should be conducted at as low speed as practicable in the circumstances and conditions in order to give the tug greater manoeuvrability and avoid it having to depart from the 'safe zone' where dynamic interaction is less likely to occur.

 Ship masters (especially pilot exempt masters) and tug masters must have a thorough understanding of both the theoretical and practical aspects of safe tug/ship operations.

 Tugs should be fit for the purpose they are being used. They require good stability and sufficient power and manoeuvrability for the intended operation.

 Down-flooding will quickly erode any reserves of stability and will be a major factor contributing to a capsizing. During critical or high-risk operations all doors and other openings that need not be open should be securely closed.

Who may benefit?

Seafarers, ship owners and operators, designers and operators of vessels engaged in towing and providers of safe ship management systems.

6 FOUNDERING

Very serious casualty: Vessel takes on significant list and founders in heavy weather

What happened?

The ship had recently undergone a change of management company and a totally new crew joined the ship. Following a brief handover from the previous crew, the ship sailed with no cargo. The previous crew reported that all the double bottom ballast tanks were full and the wing ballast tanks were 60% to 65% full (about 80% total ballast capacity). The replacement crew did not verify the status of the ballast tanks.

In the next port a total of 116 loaded twenty-foot-equivalent containers were loaded in the holds and on deck (estimated 1,900 tonnes in total). The crew made no changes to the ballast configuration, meaning that in addition to the loaded cargo the ship was still ballasted to about 80% total ballast capacity. The crew had still not verified the status of the ballast tanks.

The ship departed for the next port, where it took on fresh water before departing for its final destination. Shortly after departing, the ship encountered heavy weather caused by a combination of the monsoon winds and a typhoon, which was tracking northwards through a strait.

The ship was rolling heavily and developed a list of about 25 degrees to starboard, towards the wind and waves that were coming from the starboard side. After about 1 hour the list increased to 30 degrees. Without attempting to establish the cause of the list, the master issued a Mayday and ordered the 12-in-total crew to abandon ship into a liferaft. The crew were all safely retrieved from the liferaft by helicopter.

When the crew boarded the helicopter, they noted the ship was listing about 45 degrees. All of the deck containers were still in place, and as they had left the main engine and generators running, the lights were still burning. The crew reported that there had been no noticeable failure of the ship's equipment or systems, and there had been no movement of the containers on deck. The crew assumed that there was no movement of the containers in the holds because the containers were so tightly packed athwart ships that no appreciable transverse movement would have been possible.

Six days later a search found the ship still afloat and listing between 15 and 30 degrees to starboard. All of the deck containers were missing, but the hatch

covers were in place and appeared intact. However, when a salvage tug arrived about 4 days later, the ship had sunk.

Why did it happen?

The cause of the ship taking on a list and subsequently sinking was not conclusively identified.

The crew were not fully aware of the severity of the forecast weather conditions and consequently, the ship had not implemented heavy weather procedures.

The course of the ship was beam on to a heavy sea and swell, resulting in heavy rolling for a sustained period of time.

In the absence of any other obvious factors, the reason for the ship developing a heavy list is likely related to a change in stability resulting from an ingress of water, and/or an uninitiated change in the status of the ballast tanks.

The crew had not verified the amount of water in each ballast tank since they had boarded the ship more than 3 weeks before the casualty. Therefore, the pre-departure stability calculation made on the ship's stability computer might not have been a true representation of the ship's actual stability condition.

The crew took no action to identify the reason for the ship taking on a list and therefore took no remedial action (if any was possible).

The crew were unlikely to have been properly familiarized with their ship before it departed on the accident voyage.

There appeared to be minimal support and assistance provided to the new crew by the new ship management company when it took over the operation of the ship.

What can we learn?

 It is essential that the officers and crew be fully familiar with a new ship, particularly when an entire crew change has taken place.

 It is essential that the master and deck officers check and monitor the distribution of cargo, ballast and all other fluids within their ship in order to have an accurate appreciation of the ship's stability at all times.

 The master and crew should have a good appreciation of the likely weather to be encountered during the voyage, and prepare the ship accordingly before any adverse weather is encountered.

 When something unusual happens to a ship, such as taking on a substantial list, all early efforts should be made to identify the cause and take remedial action before it is too late.

Who can benefit?

Seafarers, ship managers, ship owners, ship operators.

7 Fatality

Very serious casualty: Crew member falls from a ladder during hold cleaning operations

What happened?

Hold-cleaning operations were being conducted during a ballast voyage in the East China Sea. The weather conditions were favourable – Force 3 wind and a low swell. The crew were using a high-pressure water blaster to remove previous cargo residue from the sloping bulkhead that formed part of the hold hopper construction. The crew were using a ladder resting flat against the sloping bulkhead to access the upper portion of the bulkhead.

The ladder was secured by rope at the top and was being supported by a crew member at the bottom. A crew member then scaled the ladder and directed the waterjet onto the bulkhead to remove the cargo residue. While on the ladder the crew member was supported by a safety line that was attached to his safety harness. The safety line led through a pad eye on the bulkhead above and was controlled by another crew member from the tank top below. This was a long-established method for cleaning the cargo hold.

In this case the crew member on the ladder was climbing down to the tank top in order to reposition the ladder for the next section. The crew member was about 1 metre from the tank top when he stopped and disconnected himself from the safety line. He then immediately lost his balance and fell backwards onto the tank top, striking his head, and became unconscious.

The injured crew member was evacuated by helicopter. However, despite the first aid efforts of the crew and the medics on board the helicopter, he was declared dead on arrival at the hospital. The cause of death was attributed to a head injury.

Why did it happen?

The crew member disconnected himself from the safety line before he reached the safety of the tank top.

The crew member's safety helmet was not secured by the chin strap and dislodged during the fall. Although this factor did not cause the accident, had the helmet remained attached to his head it could have provided sufficient protection to lessen his injuries from a fall from such a relatively low height.

What can we learn?

 Even falls from low or moderate heights can result in serious injury or death. Seafarers should not become complacent about the dangers of working at height, particularly when using ladders.

 Seafarers should not disconnect their safety devices until such time as they are in a safe position to do so.

 A hard helmet will provide a greater level of protection if it is secured by a chin strap.

 There is an element of risk when seafarers are working with ladders of any description. While ladders are necessary for providing access, it is not considered good safe industry practice to use them as a work platform.

Who can benefit?
Seafarers, ship managers, ship owners, ship operators.

8 FATALITY

Very serious casualty: Crew member falls overboard while lashing log cargo in port
What happened?
A bulk and log carrier was loading logs at an anchorage. Loading logs on deck above number one hold were complete. The ship's crew were lashing the logs above number one hold while loading continued at other holds.
While lashing, one of the ordinary seamen fell overboard into the sea. Another member of the deck crew jumped into the water to search for the ordinary seaman. Despite an extensive search over several days, involving several other vessels, the ordinary seaman was never found.
Why did it happen?
What caused the ordinary seaman to fall overboard was not established. He was wearing coveralls, gloves, a safety helmet and studded overshoes.
The ordinary seaman was not an experienced seaman and, not only was he not experienced in log lashing operations, he had received no training or briefing from senior crew members as to the risks involved in working on log stacks.
No guard lines or rails had been erected and nor was the ordinary seamen wearing a safety harness attached to an appropriate fall arrestor, so there was nothing to prevent or arrest his fall when he fell from the log stack.
The ordinary seaman was not wearing a lifejacket or buoyancy aid to aid his survival when he fell into the sea.
Nothing in the ship's safety management manual required the crew to rig safety lines or wear safety harnesses when working on top of log stacks.
What can we learn?
 Working on top of log stacks is a risky operation that involves working at height. Crew need to take all necessary precautions to mitigate the risks involved.

 When working at height on top of log stacks, crew should be protected at all times by either guard lines or safety harnesses attached to an appropriate fall arrester system.

 When working near the side of the vessel on top of a log stack, crew should be wearing an appropriate buoyancy aid to improve their chances of survival should they fall overboard.

 Safety begins at the top with management. A ship's SMS should be underpinned by a robust risk assessment, where hazards are identified and measures taken to mitigate the risks.

Who can benefit?
Seafarers, ship managers, ship owners, ship operators.

9 FATALITY

Very serious marine casualty: Crew member hit by crank handle

What happened?
A 16,000 GT bulk carrier was waiting at the anchorage for berthing when the ship's crew were involved in a routine abandon ship drill. The enclosed davit-launched lifeboat was being recovered when it failed to operate. The ship's electrician was summoned to the boat deck to identify the reason for the winch controller's failure. In the interim, the master instructed the bosun, ordinary seaman (OS) and another crew member to recover the boat manually. The crew inserted the manual crank handle to hoist the boat. The electrician, on being told by the bosun about the motor, went to the switch board location to restore the power. At the lifeboat deck, the motor started to turn. Along with it, the manual crank handle, which was still inserted into the hoisting slot, turned a few rounds and hit the bosun and the OS who were standing in close proximity to the handle. The bosun received injuries to his skull as the rotating handle struck his head while the OS sustained minor bruising to his hip. The bosun succumbed to his injuries at the local hospital.

Why did it happen?
The lifeboat's electrical system was found to have been bypassed to overcome an inoperable or malfunctioning limit switch so as to facilitate the winch motor to operate during a previous repair. In order to restore the power, the electrician had to bypass the existing jumper or short circuit, thereby compromising the safety interlock which was designed to prevent accidents. During this process the lever for hoisting remained engaged in the stowed position while the bosun and the crew continued to hoist the boat manually using the manual crank handle. This condition allowed for the winch to operate when the electrician restored power to the breaker.

The crew on board the vessel were not well versed with the interlocking system of the lifeboat. Although the manual and drawings of the lifeboat system contained instructions and warnings, there were no warnings at the operation area to warn the users of hazards that may occur during launching / recovery of the lifeboat.

There was inadequate supervision of the boat deck when the officer in-charge left the station to look for the electrician. A routine drill recovery process was not upgraded to a high-risk operation when the hoisting mechanism failed to operate.

Despite the conduct and participation of crew in routine and regular safety drills, familiarity of alternative recovery modes was not routinely exercised.

What can we learn?

 Crew must fully understand the operating mechanism of the equipment on board the ship and ensure that safety interlocks are not bypassed under any circumstances.

 Work performed by shore contractors must be supervised by the ship's staff and verified.

 Manufacturer's instructions and warnings must be strictly taken into account when formulating procedures for compliance.

 Work on board should be constantly assessed and adequately supervised in order for appropriate mitigating measures to be introduced.

Who may benefit?

Seafarers, ship owners and operators, ship designers.

10 FATALITY

Very serious marine casualty: Crew member hit by falling plate

What happened?

A 12,000 GT chemical/products tanker was waiting at the anchorage for her next port orders, on completion of loading of chemical.

The engine room crew commenced preparation for some fabrication work. The work involved shifting of steel plates to the engine room workshop to fabricate rail guards for the ship's crane.

The 11 plates had been stowed vertically against an engine room structure in the compartment next to the steering gear room, and held together with steel cables to prevent them from falling down. Three personnel from the engine room, of which two were engineer officers and one engine room seaman, began removing the steel cables. As the cables were removed, the vessel experienced some rolling as a result of beam seas and the plates fell towards the crew.

While the two officers stationed at each end of the plate managed to move out of the way of the falling plates, the seaman who was in the middle of the plates could not. The plates, weighing about 900 kg, fell on the seaman causing multiple injuries. The seaman was evacuated from the engine room using a stretcher and transferred to a speed boat arranged by the agent to be taken ashore for treatment. Attempts to resuscitate the seaman were unsuccessful and he died of his injuries on the way to the hospital.

A tool box meeting had been conducted by the team prior to the task.

Why did it happen?

The vessel had anchored at the outer anchorage awaiting orders. The anchorage did not offer protection from seas and swells as compared to the

inner bay anchorage. Although the harbour rules conveyed through the agent to the vessel instructed vessels not to perform dangerous tasks that required movement of heavy equipment due to the open nature of the anchorage,
the tool box meeting conducted by the vessel's crew did not take account of the location where the vessel was so that appropriate risk mitigating measures could be implemented to minimize the risk of injury if the task had to be undertaken.
The steel plates were stowed in the vertical position with a small inclination angle, instead of the horizontal position (flat on deck), causing risks of the plates falling abruptly when the cables used to secure them were released.
What can we learn?
 Ship management companies' safety management system procedures regarding the planning and carrying out of the activities of storage and movement of weights on board, associated tool box meetings and risk assessments should be reviewed and take into account the vessel's location in port and at sea.

 Crew should be aware of risks on board and adopt safe work practices at all times.

Who may benefit?
Seafarers, ship owners and operators.

11 FATALITY

Very serious marine casualty: Crew member caught by rope
What happened?
A 21,000 GT chemical/products tanker was approaching the berth under pilotage with the assistance of tugs. The forward tug was to be released from the tanker's bow as the vessel was required to turn to starboard. The tug line's eye had been secured to the bollard on the forecastle. The eye had a messenger rope attached to it. The tug's line was slackened to facilitate its release.
The ordinary seaman (OS) eased the rope out through the closed chock (Panama Lead) and had taken a turn of the messenger rope around the bitts. As the tanker's turn to starboard for berthing continued, and the tug's line was in the water, the messenger rope's exit speed from the closed lead started to increase.
The officer in charge of the mooring operation warned the OS to step clear from the messenger rope. The OS moved between the bitts from port side to the starboard side, as rope's speed around the bitt quickened. He fell on the deck and was dragged with the rope entangled around his leg. His body hit a structure near the single point mooring chain stopper before he was dragged overboard through the Panama Chock. The OS was recovered from the water

by the tug boat, and received first aid and CPR. Emergency services subsequently transported the OS to hospital, but the OS died the next day.

Why did it happen?

The messenger rope's speed increased as a result of the increasing separation between the vessel due to the vessel's sternway and moving away from the tug's position, thereby increasing the relative distance between the two vessels. This increased speed of the messenger rope was not anticipated by the crew of the vessel, as the OS continued to hold on to the messenger rope's end.

When the officer in charge instructed the OS to step clear from the rope, the OS hastily moved to another location, but fell on deck. The long messenger rope's slack likely caught his leg as the rope's exit continued dragging him towards the Panama Chock and then overboard.

Although the company's safety management system manual (SMS manual) established that tug lines must be let out in a controlled manner so that they do not fall onto a tug boat's deck or to avoid it becoming entangled with the propeller, the dynamic situation of tug separation was not anticipated. The officer in charge did not instruct the OS to keep a safe distance from the messenger rope's turn, such as tending the rope from the end, in case unexpected tension on the messenger rope occurred, which would have allowed for a safety margin in case of unexpected increase in the rope's exit speed.

What can we learn?

 Shipboard operations are extremely dynamic in nature. Mooring operations of all kinds, including those involving tugs, should be undertaken with utmost care. All personnel involved must fully understand the various possible scenarios that can occur, owing to their dynamic nature.

 Specific and clear instructions must be given beforehand, as a part of a pre-job brief and a person in supervisory capacity should always assess risks and anticipate that circumstances and situations could change, so that mitigating measures can be communicated timely to members of his/her team.

Who may benefit?

Seafarers, ship owners and operators.

12 Capsizing

Very serious marine casualty: Capsize of vessel followed by grounding

What happened?

A dry cargo vessel loaded cargo. On completion she sailed for bunkers. As approaching port, the vessel developed a severe port list due to cargo shifting and subsequently water entered the engine room via a weathertight engine room escape door being left open. This exacerbated the list and the crew abandoned ship. The main engines were left running and this caused the vessel

to make circles and make boarding very difficult if not impossible. Eventually this led to the vessel's grounding on a shoal where she became a constructive total loss.
It became evident during the accident investigation that the cargo was not stowed and secured as required by the vessel's cargo securing manual.

What can we learn?

 The importance of following the instructions contained within vessels' cargo securing manuals when securing a cargo prior to proceeding to sea.

 The need to ensure that all weathertight doors are kept closed and properly secured while a vessel is underway.

 If the correct abandonment procedures had been followed and the main engines shut down, the vessel may not have run aground and become a total constructive loss.

Who can benefit?

Seafarers, ship owners, insurers

13 Fire

Very serious casualty: Fire on board a ro-ro ferry (initiated on open ro-ro cargo space main deck), 11 persons deceased, 22 persons missing

What happened?

A very serious fire broke out on board the ro-ro passenger ship during navigation.
The smoke was first seen through the bridge windows. An AB was sent to check the condition and the AB informed the bridge that a truck had its engine running and was generating some smoke (engine running for the reefer container).
There was a fire alarm from the Deck 4 garage. The master saw flames coming out the windows abaft of the lifeboat. The master ordered the activation of the drencher pump. The first engineer confirmed the drencher pump was started. However, based on the evidence collected during the investigation, the valves of Deck 3 instead of those of Deck 4 were opened. Then the first distress signal was launched. The fire team could not approach the fire scene because of smoke and heat.
The engine staff left the engine room themselves, and not by the master's order. The quick closing valves were closed. The main engine was then stopped due to fuel oil cutting off.
At the time of the accident, No. 1 and No. 2 generator engines were working in parallel. The generator engines stopped due to the engine room being full of smoke and there not being sufficient oxygen for the combustion of the engines, thus resulting in a blackout. The emergency generator started automatically, but

could not be on load to supply electricity. The chief engineer and the electrician tried to put the emergency generator on load manually, but in vain.
The fire developed and spread into a severe situation within a short period of time at the starboard side and therefore all starboard side evacuation means could not be used. The port side lifeboat carrying 88 persons was launched into the sea by some crew members without a specific order by the master. Also, the port side liferafts were launched into the sea directly by the passengers without being ordered by the master. The vessel carried 417 passengers, 55 crew members and at least 3 ascertained illegal immigrants. People were rescued by the ships which arrived at the accident area, the Coast Guard, the Navy and the Air Force. There were 11 persons deceased and 22 missing. Eighty-eight of the 452 survivors were rescued by lifeboat or liferaft; the remainder were rescued by helicopters and patrol vessels sent to the spots.

Why did it happen?

The vessel was not properly informed of the specifications of the vehicles to be loaded and the accurate passenger list. Also, the master and the chief mate just followed the procedures of the company's SMS manual to collect the supplied information of the vehicle's cargo; they did not intend to ask for and to collect sufficient information of the vehicle cargo, including the refrigerator truck, in advance to prepare the loading plan and to place the vehicles in the most suitable position by considering the possible adverse sea and weather conditions. During loading, they did not verify a suitable position for connecting the power supply to the refrigerator truck. The lashing of vehicles was not really made in a perfect way and was incomplete in several points as per the requirement of company procedure. The refrigerator truck kept her main engine running for the refrigerator instead of by using the ship's power might cause overheat and fire. The patrol could not find the fire on time; even the duty person passed the fire initiating area, and firefighting teams found it difficult to enter the garage area because the vehicles were parked close to each other. The fire was developed to such huge dimensions due to the wind blowing at the side openings.
The correct valves of the drencher pump for Deck 4 were not opened; the valves of Deck 3 were opened instead. After a few minutes they became unusable, as the main power supply disconnected – probably because of the damage by fire to the exposed cables on the ceiling of Deck 4. Then the drencher system could be powered by the fire emergency pump with insufficient water to effectively extinguish the fire.
The emergency management was in confusion on board the ship after the fire spread. The crew members often acted out of personal initiatives, which were neither agreed upon nor ordered by the captain, also during the evacuation operations; The engine room staff left the engine room after 10 minutes without a specific reason and without informing the master and/or the navigation bridge; they also closed the fuel supply to the main engine without confirmation of the master. As a result, it was not possible to take any further measure to mitigate

the fire's devastating effects by operating the stretcher drencher system or to recover the main electrical supply of the ship.
It was not clear how the order of abandon was given by the master; the crew members operated the lifesaving and rescue appliances and arrangements without the master's abandon ship order. It may be related to the impact on the crew members' behaviour due to the stressful situation generated by the fire. As starboard survival equipment was damaged by fire flame, and the disorder of the management on operating the MES, the MES of 101 persons' capacity was not used for evacuation. Most persons' evacuation was through air rescue means.
The firefighting system could not be used after the blackout, then the emergency fire pump could not supply appropriate water for the drencher system.
Reefer trucks remaining in operation in the garage area during the voyage are serious fire risks, the internal combustion engines of the reefer units which are not permitted to operate during the voyage, but they can start automatically if a ship's power supply is lost. The patrol crew member found the reefer truck without connecting ship's power and the combustion engine was running, he reported to bridge. This was not considered important or dangerous by the crew, even though it indicates a problematic operation of the reefer engine. Therefore no actions were taken, such as calling the driver of the reefer to stop the operation or enhance the monitoring of the area.

What can we learn?

 The loading of vehicles was not properly carried out. The master/chief officer should collect sufficient information to prepare a suitable loading plan with consideration of adverse weather conditions and prevention of fire. The company should review the procedure for the loading of vehicles and communication amongst different parties (ship, charter party and terminal). A detailed list of cargo should be provided in advance for preparing the stowage plan on considering the reefer truck to be connecting the ship's power supply, and a completed list of passengers should be provided before departure.

 The training and education of the crew was insufficient. It was found that wrong deck valves were opened for the drencher pump and there was lack of control of passengers by the ship's crew during evacuation. The company should strengthen the training of ship crew for emergency procedures.

 Pursuant to the SOLAS regulation III/13.1.5 "Each survival craft shall be stowed: as far as practicable, in a secure and sheltered position and protected from damage by fire and explosion". The lifesaving appliances at the starboard were damaged shortly after the fire. The company and the shipping industry should review the placements of the lifesaving appliances, taking into account the large side openings of the open decks of the vessel, with the aim of

preventing lifesaving appliances from being easily damaged in the event of a fire.

 The crew members did not report their findings during the patrol – such as the reefer truck running its engine without the power cable being connected to the ship's power socket, and some vehicles not being lashed as required. The crew's patrol was not effectively conducted as there was not enough passage gap for the crew entering the garage due to the stowage of vehicles, and the officers silenced the fire alarm without further confirmation of the fire alarm being a faulty alarm. Existing procedures need to be integrated to improve the efficiency and effectiveness of patrols in the deck garages, particularly before the ship departure, in order to avoid security problems.

 On the garage deck with side openings, the efficiency of the fire detecting system and fire protective system might have been affected by the uncontrolled inflow of external air/wind. The areas of collective rescue means (including the MES and evacuation station as defined by SOLAS) should be passive protected by considering any hull openings of ro-ro areas, so as to prevent direct contact with open flames in case of fire. The minimum sufficient distance between the vehicles in the garage should be considered for enabling the operational and safe passage of the fire-fighting team.

Who may benefit?
Seafarers, ship owners and operators, ship designers.

14 Occupational accident

Very serious casualty: Crewman lost his life caused by hitting his head on a sharp-edged object in the changing room
What happened?
The casualty was the second engineer who went for a coffee break after the vessel was alongside the oil jetty. The accident was an unfortunate accident; there was no indication that either external influences (movement of the vessel) or existing medical conditions played a part in the incident. Based on the autopsy report and environment analysis, it is likely that the second engineer had crouched down, maybe tying his bootlaces, and then stood up. The evidence seemed to indicate that upon standing up, the second engineer was banged with considerable force on the right side of his forehead by the sharp edge of the robust towel rail. Further injury to his head was caused by him falling down and led to his death.
Why did it happen?
The towel rail with sharp edge was fitted with a risk of hitting the head while the person takes actions of change in the change room. The crew member hit his head heavily on the towel rail by imprudent movement.

What can we learn?

 The operators carry out risk assessments of areas with fitting at heights of between 1.2 to 1.8 m which jut out into areas normally used by personnel. These assessments should evaluate the potential risks of each individual fitting to the persons using the space.

 Any fitting judged to have the potential of causing injury to a person or persons using the space, by causing them to trip or stumble while in the space, should be removed or rendered safe. Ergonomic design / redesign in the changing room reflected from the contributing factors of the incident in the perspective of occupational safety.

Who may benefit?

Seafarers, ship owners and operators, ship designers.

15 Occupational accident

Very serious casualty: An able seaman was crushed to death between two cargo containers

What happened?

A crew member (able seaman (AB)) lost his life by being crushed between two cargo containers when a fork-lift driver was conducting a manoeuvre to avoid the lifted container striking an adjacent stack of containers and in preparation for loading it onto a waiting trailer.

Why did it happen?

The AB was probably unaware of the fork-lift truck driver's intention to manoeuvre the container in preparation for loading it onto the waiting trailer. It is therefore unlikely that he anticipated the container would subsequently move towards him.

The fork-lift driver did not anticipate that the AB would move forward to remove the container's twistlocks before he had realigned the container and had given a signal for him to proceed.

The locally arranged signalling procedure was not effectively briefed and enforced, and was potentially unsafe in that it did not require the fork-lift driver to stop his vehicle when the twistlock operator was no longer in his field of vision. The routine nature of an unsighted crew

member to remove the twistlock between containers, and the informality and lack of enforcement of the locally arranged signalling procedure, introduced complacent practices on

board the ship. This lack of a safe system of work led to an ambiguous situation where two operators on the same task had different expectations of each other's actions.

The locally arranged signalling procedure did not feature in the ship's SMS, was not covered in the familiarization process and was neither briefed nor enforced,

suggesting that an underlying cultural safety issue existed within the company. The SMS risk assessment related to working was insufficient. It did not identify the specific hazard of a crew member being crushed by a moving container, or the need to address the risk of an unsighted crew member being positioned in the container's path.

What can we learn?

 Implementation of SMS procedures should be strictly fulfilled: some procedures were not implemented according to the ship's SMS, e.g. briefings were not carried out by the C/O to the twistlock operators and vehicle drivers.

 All aspects should be assessed in the risk assessment: there was no identification of specific hazard of a crew member being crushed by a moving vehicle or container; and no address of an unsighted crew member being positioned in the container's path.

 Communication between ship crew and embarked vehicle team and locally arranged signalling procedure should be maintained. The SMS should be reviewed to include safety needs of cargo operations, e.g. the 'Cargo Operations Procedure' needed to take account of the other employers' (the embarked team of drivers) risk assessments. The company was required to provide proper familiarization to new personnel, including the embarked team of drivers, on their respective duties.

 It requires more precaution because the limitation of using closed-corner trailers necessitated crew members working in close proximity to suspended containers. Small gaps between containers stowed on the deck and the use of trailers with rear bumpers required fork-lift truck drivers to conduct manoeuvres that were difficult for assisting crew members to anticipate.

 The following risks should be borne in mind: the use of a fork-lift truck for handling containers not fitted with fork pockets runs the risk of damage to the lower edges of a container; and any shift or uneven distribution of the container's internal load could cause the container to fall.

Who may benefit?

Seafarers, ship owners and operators.

16 OCCUPATIONAL ACCIDENT

Very serious marine casualty: Fall from ladder while hold cleaning

What happened?

A bulk carrier was at anchor to carry out hold cleaning operations. The chief officer ordered two seamen to clean No.1 Cargo Hold and issued a permit to work for the activity in accordance with the ship's SMS.

The activity included the cleaning of the hold bulkhead corners by hand, which required the use of a portable aluminium ladder for working at height. One of the seamen ascended the ladder and carried out his task at a height of 4 metres above the cargo hold's tank top.
On completion of his task, the seaman, who was wearing a safety harness and lanyard, unclipped the lanyard. He then lost his balance, fell 2 metres onto the sloped side bulkhead, and then rolled a further 2 metres to the tank top.
The seaman was taken to the ship's hospital and later transferred to a hospital ashore, where he subsequently died of his injuries.

Why did it happen?

 There were several trip hazards where the seaman had been standing.

 The bulkhead against which the portable ladder was positioned was uneven.

 After unclipping the lanyard, there were no means to prevent the seaman from falling when he lost his balance.

 There was nothing in place to arrest the seaman's fall.

 The perception of the ship's crew was that personal care and vigilance were sufficient to avoid falling from the ladder once the lanyard had been unclipped.

 The activity was not supervised.

 The risk of falling in the cargo hold was neither specifically discussed in the ship's SMS nor identified in the ship's risk assessments.

What can we learn?

 An activity that poses a reasonable risk of falling a distance liable to cause personal injury should be properly planned and supervised.

 When identifying the safety controls required to reduce a risk of falling, the hierarchical principle of 'avoid, prevent and minimize' should be applied.

 If a risk of falling cannot be avoided, measures are required to minimize the distance and consequences of the fall, such as the use of a fall arrestor and/or safety net or air bag.

Who may benefit?

Seafarers, ship owners and operators.

17 COLLISION

Very serious casualty: Collision between tug boat and general cargo vessel, resulting in the sinking of the tug boat and rescue of her crew and passenger

What happened?

A 3,200 GT general cargo vessel, travelling at about 8 knots under mandatory pilotage and hand-steered by the master, collided with a 115 GT tug boat travelling at a speed of about 7 knots, steered by its AB under the command of its skipper.

The collision occurred at night, in a fairway, after both vessels had reported their respective positions and passage at the reporting point.

The master of the general cargo vessel, in accordance with his passage plan, altered his vessel's course, first by gradually moving to the centre of the fairway and then to its eastern side.

Some minutes later, the general cargo vessel's bulbous bow struck the port side midship hull of the tug boat causing the latter to lose its buoyancy and sink. Four (4) crew and one (1) passenger of the tug boat found themselves in water, where after several minutes they were rescued by a pilot boat and a rescue boat launched from a SAR vessel in the vicinity.

Why did it happen?

1. The Collision

The general cargo vessel was manned only by the master who had not arranged for a proper lookout. Her radar had detected the echo of the tug boat on the starboard side at a distance of about 8 cables, but no action had been taken to determine the passing manoeuvres or to move to starboard to the outer limit of the fairway.

The master had altered his vessel's course following the planned course as laid in his electronic chart, unknowingly positioning his vessel at the wrong side of the fairway.

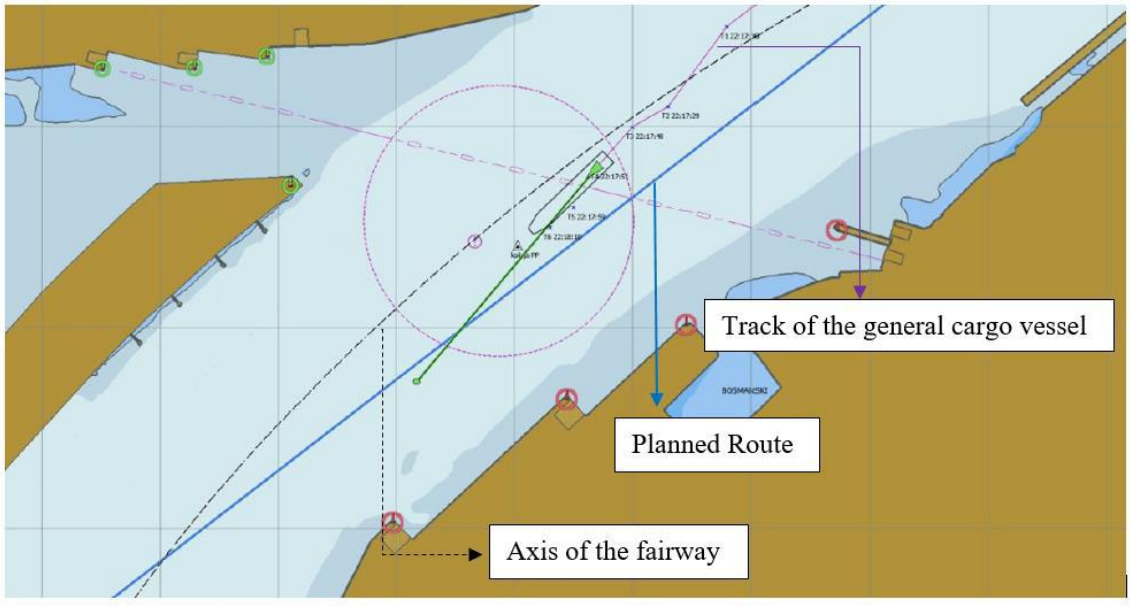

Photo 1 – The vessel's track (magenta line), the planned route (blue line), axis of the fairway (dashed black line) in the vicinity of the place of collision

The pilot, during the transit in the fairway, also did not intervene when the general cargo vessel's course was altered to port so as to navigate the vessel on the wrong side of the fairway.

On board the tug boat, the radar was not switched on and investigation revealed that its crew were busy talking in the wheelhouse about non-navigation related matters while operating the tug boat under the influence of alcohol. This condition may have impaired their ability to assess the risk of collision with the general cargo vessel. Additionally, although not contributory to the collision, the tug boat was carrying a passenger who was not on the tug boat's manifest.

2. The Sinking

After the collision, the master of the general cargo vessel operated full astern disengaging his vessel from the tug boat, causing water to flood the tug boat's engine room.

What can we learn?

 The incident highlighted the importance of:

- proper passage planning (passage planning error), especially taking COLREGs into account;

- effective Bridge Resource Management under all circumstances; and

- implementing proper watchkeeping and lookout.

 The incident highlighted the importance of the role of pilots in advising masters of piloted vessels to keep as near to the outer limit of the channel or fairway which lies on the vessel's starboard side as is safe and practicable in accordance with COLREGs; and of the use of approved charts for navigation provided by the pilot company and the importance of taking early and effective measures to determine risk of collision.

 The incident also offered lessons on the importance of having adequate oversight of the supervision of the crew such as to ensure that the vessel is not operated while under the influence of alcohol and/or of the carriage of alcohol on board.

 It also underlined the importance of declaring passenger(s) in the manifest and complying with the vessel's Safety Certificate when carrying passenger(s) on board.

 Crew having sufficient observation and attention to the surrounding (situational awareness) and the ill effects of distraction (inaction, distraction) on the vessel's bridge.

Who may benefit?
Seafarers, ship owners and operators, pilots and flag Administrators.

18 ENCLOSED SPACE

Very serious casualty: Enclosed space casualty/death

What happened?

Upon the vessel's early morning arrival, a water leak was detected by an engineering watch officer coming from the main engine turbo charger drain. Suspecting a water leak in the boiler/economizer, the chief engineer ordered it be shut down so that it could be inspected for leaks and repaired later that morning during normal working hours. About 5 hours later the second engineer, along with a fitter, entered the boiler space from the bottom manhole door after they were satisfied with all safety precautions having been taken for man entry. They identified a leaky boiler tube and plugged it from the bottom. Next, their plan was to plug the same tube from the top of the boiler and then restart the boiler. While the second engineer was exiting the bottom manhole door with the fitter right behind him, the inserted boiler tube plug fell off along with a small broken section of the water tube causing hot water from the boiler water drum, steam and smoke to leak out upon the fitter, killing him instantly.

Why did it happen?

Lack of SMS boiler work risk assessment process. Failure of the engine room team to identify all hazards involved for the intended procedure. Failure of the engine room team to adequately and effectively check that the boiler was drained of water and depressurized. Likely fatigue of the second engineer.

What can we learn?

 The dangers of working around, with, and on pressurized boiler systems.

 The value of having SMS procedures for working on pressurized systems such as boilers, as well as following those procedures.

 The dangers of relying on and making assumptions based on gauges.

 Risk assessment forms for this repair evolution were generic in nature and do not identify specific hazards associated with individual tasks.

 Boilers should only be depressurized to 2-4 bar when boiler water blow down commences to ensure all water from the drum is emptied overboard.

 Engineers should not solely rely on steam being emitted from the stack as the only indicator that a steam drum is empty. The boiler vent on top of the boiler should also be opened to check that a boiler is depressurized.

Who may benefit?

Seafarers, ship engineers, ship owners and operators.

19 CARGO HANDLING

Very serious casualty: Two longshoreman were killed, one seriously injured

What happened?

While alongside a wharf, the vessel was loading a cargo of heavy stainless steel pipe bundles. Suddenly, and without warning, the vessel lurched, the suspended pipe load swung uncontrollably in the vessel's cargo hold, crushing three longshoreman between the suspended load and side wall; two died and one was seriously injured.

Why did it happen?

The underside of the vessel's fenders on the starboard shoreside amidships hull caught and hung up upon the top of the wharf's fenders. As the tide fell and the vessel's draft increased due to loading of the cargo, the vessel's list increased to a point where the ship's fenders suddenly released from the wharf causing the vessel to quickly and heavily roll. This caused the hoisted pipe bundles to swing in the cargo hold, striking the stevedores who were trapped between the swinging cargo hoist and the vessel's side wall.

What can we learn?

 The dangers of working in, on or around a vessel subject to ever-changing and dynamic forces.

 Hazards of working with suspended cargo in a confined cargo space.

 The value of critically evaluating a vessel's condition while alongside a dock, paying particular attention to identifying and eliminating snag hazards.

 The value of establishing cargo work plans to consider the possibility of sudden hull rolling and identifying worker refuge areas.

Who may benefit?

Seafarers, ship owners and operators, break bulk shoreside terminal managers, longshoreman and shoreside workers.

20 GROUNDING

Very serious casualty: Grounding and total loss

What happened?

During early morning hours while the vessel was in a ballasted condition riding on a single anchor outside the port, the wind direction changed, its velocity increased and the sea state amplified. The vessel attempted to weigh anchor and put safely out to sea, but was driven by the wind and waves onto the port's sea wall where the vessel stranded and sank. The vessel was a total loss. There were no injuries or deaths of the 18 crew on board.

Why did it happen?
Weather and sea state information was not adequately obtained by the master who assumed there were no signs of worsening weather based on the surface analysis and coastal wave analysis charts. The vessel's deck officers had very limited wintertime experience in the port, a port susceptible to high wind and large swells from the west and northwest during winter months as denoted by the sailing directions and states that, if an anchor might drag or fail, a vessel might be washed ashore. The master did not understand the vessel's limited manoeuvring characteristics for the prevailing wind/sea state while in a ballasted condition, attempted to put out to sea too late, the vessel was underpowered and was overcome by the weather conditions; it lost vessel manoeuvrability and was driven onshore and grounded.
What can we learn?
 The need to consult port sailing directions to better understand a port's prevailing weather conditions and cautions for the seasonal periods transited/visited.

 The importance of maintaining awareness for local weather forecasts and alerts.

 The value of understanding a vessel's manoeuvring characteristics for various load conditions, especially under ballast.

 The need for, and value of, including vessel manoeuvring characteristics for various load conditions, especially under ballast, in a SMS.

Who may benefit?
Seafarers, ship owners and operators, port and waterways officials.

21 OCCUPATIONAL ACCIDENT

Very serious marine casualty: Fatal strike by tow line
What happened?
A messman was found entrapped in the shaft of a provisions lift on board a bulk carrier. The lift was found off the guard rails with the lift motor still running. Following the recovery of the trapped messman from the lift shaft, it was confirmed he was deceased. How the messman came to become trapped in the lift shaft is unclear.
Why did it happen?
The lift doors were not fitted with limit switches to prevent operation of the lift when the doors were open, although they were shown in the original circuit diagram.
The lift controls only required a single touch to operate; they were not required to be constantly pressed.

Neither ship nor company staff had noticed that the door limit switches had been missing since the ship was built.
The provisions lift was not included in the ship's maintenance system and was not routinely inspected.

What can we learn?

 The need for ship management to have an effective system of shipboard inspection and maintenance for lifts, which could include employing external specialists for the task.

 The importance of delivering appropriate lift operation familiarization to a ship's staff.

Who may benefit?

Seafarers, ship owners and operators.

22 OCCUPATIONAL ACCIDENT

Very serious marine casualty: Fatal strike by tow line

What happened?

A container ship was in the process of unberthing and a ship's mooring line was paid out from the ship's aft mooring deck to the waiting tug below. Once the line was secured, the tug pulled
away causing the line to come under tension suddenly. The mooring line jumped out from the bitts on the aft mooring deck and hit a crewman, who was standing nearby, in the chest, fatally injuring him.

Why did it happen?

 The crew man was standing in the snap back zone.

 The crewman was not adequately supervised.

 The officer in charge of the aft mooring deck was unfamiliar with the operation.

 No risk assessment had been conducted to ensure adequate precautions were in place.

 There was ineffective communication between the tug and ship.

What can we learn?

 The need to risk assess unfamiliar operations to establish suitable precautions.

 The importance of supervising junior staff.

 The need to employ the principles of good seamanship in paying out lines in a controlled manner.

 The need for clear and unambiguous communication between tug and deck crews when securing a tow line.

Who may benefit?
Seafarers, ship/tug owners and operators.

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