LESSONS LEARNED FROM MARINE CASUALITIES
(III 11/4, ANNEX 1)

1 Categories of safety issues:

- Maintenance
- Planning and Procedures
- Management factors
- Legislation, standards and compliance

Casualty event: Occupational accident - electrical problems, explosion, fire

Casualty severity: Very serious marine casualty

What happened:

During sea passage, the second engineer entered the engine-room alone to check on the fuel separators due to an alarm received shortly after midnight. He was found lying next to the fuel separators the next morning by a fellow crew member without any vital signs. After calling for help and direct attempts to apply first aid, the assisting crew found the area where the second engineer was positioned under electrical current. One crew member received electrical shocks during the retrieval attempts. The second engineer showed severe injuries originating from electrical shock which was later pronounced to be the cause of death.

Why did it happen:

An electrical cable supplying a valve with power had snagged between a grating and its stool causing damage to the insulation allowing the live wire to create contact with the steel grating and subsequently putting it under electrical current.

What can we learn:

When entering machinery spaces alone, it is important to be aware of the increased risk and the necessity to apply mitigating measures such as informing fellow watchstanders of one's intentions.

Installations on board must be regularly checked in regard to safe operation and set up. Also, the laying down of covering material to protect from oil, in this case a piece of cardboard, should be prevented. Not only is a fire hazard created, but also visual inspection is impaired.

Who may benefit:

Ship operators/managers/owners, officers, crew.

2 Categories of safety issues:

- Anthropometric or personal factors
- Planning and Procedures
- Safety assessment review
- Natural environment

Casualty event: Occupational accident

Casualty severity: Very serious marine casualty

What happened:

A refrigerated cargo ship was on passage and was making way during a period of adverse weather.

Four crew members were at the forward mooring station to secure mooring lines when the ship was struck by a series of large waves, washing the four crew members off their feet, and propelling them into the ship's structure and deck machinery. Of the four crew members, two suffered fatal injuries, one sustained minor injuries, and the other required emergency medical assistance ashore.

Why did it happen:

Crew were called to mooring stations at around 02.00. Once clear of the port, at around 04.00, the master requested that all deck machinery and lines be secured for sea due to adverse weather conditions being forecasted. Due to a lack of rest, the bosun reported the forecastle was secure but decided to leave the mooring lines with a plan to complete the task later that day.

While the bosun and crew slept, conditions deteriorated but no measures were put in place to control access to the deck. When the bosun and crew returned to the deck, no one was aware of their movements and they were found by chance by the chief officer who was on deck and exposed to the same risk while completing a routine task.

What can we learn:

Work activity on open decks during adverse weather should be restricted and, where essential, appropriately assessed for known hazards and risks. Work should only be conducted with the appropriate personal protective equipment, including the use of lifelines, lanyards or securing arrangements.

The importance of communicating with members of the bridge team and or colleagues cannot be over-emphasized, especially as to one's whereabouts or planned areas of work.

Who may benefit:

Maritime community.

3 Categories of safety issues*:*

- Anthropometric or personal factors
- Planning and Procedures
- Safety assessment review

Casualty event: Occupational accident

Casualty severity*:* Very serious marine casualty

What happened:

A container ship was alongside, discharging containers. At around 03.30, with discharge continuing in close proximity, a deck fitter began hot work repairing a stopper from the lashing bridge. With the repair almost completed, the fitter was kneeling on a container in the cargo area to gain better access to the work area when he was struck by a container spreader attached to the vessel's gantry crane. He did not survive his injuries.

Why did it happen:

The deck fitter was working alone and unsupported. His location had been relayed to the person controlling the cargo operations but this information did not alter the cargo discharge plan. The design of the ship's gantry crane meant that the operator's view of the casualty location was obstructed. There was no hatchman present to mitigate this hazard. The officer overseeing the work expected the repair to be completed from inside the lashing bridge's rails but the task could not be completed in the manner imagined and the victim moved onto the adjacent container in order to complete the repair.

What can we learn:

Personnel involved in any potentially hazardous operation should be consulted to identify the hazards associated with completion of the task. If you do not understand the task, you cannot identify the hazards. If you have not identified the hazards, you cannot assess the risk or implement effective controls.

Risk assessments are ineffective if risk control measures are not implemented. When conducting work in port, clear and effective communication between the ship and terminal is key.

Who may benefit:

Shipping community.

4 Categories of safety issues:

- Planning and Procedures
- Natural environment
- Safety assessment review
- Legislation, standards and compliance

Casualty event: Others

Casualty severity: Very serious marine casualty

What happened:

A passenger ship was at anchor. In the afternoon, passengers were being taken to and from shore in the ship's inflatable boats, driven by staff from a specialist expedition company that had joined the ship for this section of its itinerary.

After several shuttle runs had been completed without incident, a boat with its coxswain and 10 passengers was shaping up to enter the harbour when it was caught in a breaking wave. In the trough of the swell, the boat's propeller touched the seabed, stopping the engine and halting the boat's momentum. Subsequent waves washed passengers overboard and took the boat close to the beach.

As passengers were being helped ashore the coxswain noticed someone was trapped under the boat. Once freed the unconscious victim was transferred to shore where a medical team made efforts to resuscitate him but he could not be revived.

Why did it happen:

Entry into the harbour was made difficult by the passage of a larger set of swells than had been experienced previously and complicated further by the presence of surfers in the water nearby. The boat's engine stopped when its propeller touched the seabed, leaving the boat and its passengers at increased risk from breaking waves.

Once passengers were washed out of the boat, the coxswain had to deal with multiple issues without the support of another member of crew in the boat. Once in the water, any effort to conduct an immediate head count was confounded by the distribution of passengers on the beach and the presence of people coming to assist.

The operation was prepared to deal with an onshore emergency with a nurse and defibrillator present at the landing site. With the coxswain as the sole member of crew in the boat, their ability to instantly respond to multiple passengers overboard may have been a factor.

What can we learn:

The use of inflatable boats for tendering operations or coastal expeditions is not addressed by any specific International Maritime Organization (IMO) instruments. The industry could benefit from further assessment of risks posed and a legislative framework to operate in.

Who may benefit:

Cruise ship operators and contractors.

5 Categories of safety issues:

- Planning and Procedures
- Management factors
- Safety assessment review
- Tool and hardware (design or operation)

Casualty event: Fire/explosion – fire

Casualty severity: Very serious marine casualty

What happened:

In the early morning, a liquified gas tanker had completed loading ethylene when the ship's gas engineer identified that liquid cargo was leaking from the cargo manifold. Having identified that the blank was probably missing a gasket, the gas engineer and duty able seafarer were unbolting the blank when the cargo vapour ignited, creating a fire ball that engulfed the manifold platform and extended 10 metres in diameter. The automatic water-spray system did not operate as required but the crew extinguished the fire after 17 minutes. The able seafarer was seriously injured. The gas engineer was severely burned and died due to complications five days after the fire.

Why did it happen:

The ethylene was introduced to the manifold due to the incorrect line up of valves during cargo sampling. It was exposed to atmosphere from the leaking blank and when the manifold drain valve was opened. The ignition source could not be determined with certainty but the spanners being used at the manifold were not suitable for use with highly flammable cargoes due to the risk of sparking. Additionally, the gas engineer was wearing a cold weather jacket that was of a type that could produce a static electricity charge.

The gas engineer was working without support or supervision on a complex system.

Fire-fighting efforts were complicated by a blocked head on the automatic water spray system.

Readiness (both onboard and ashore) was reduced on completion of cargo operations when the risk of fire was thought to be less.

What can we learn:

The use of non-suitable spanners on deck had become normalized as the necessary non-sparking tools to get the job done were not readily available.

The company's stop work authority was not robust enough to counter individual culture – none of the crew that were aware of the cargo at the manifold felt empowered to stop the work of a superior.

A retributive approach to mistakes and errors undermines a just culture: if people are worried about the consequences, it is more difficult for them to speak up.

Manufacturer's recommended planned maintenance methodology and frequency for water-spray systems may not ensure operability.

Who may benefit:

Ship managers, gas tanker operators and crew.

6 Categories of safety issues:

- Planning and Procedures
- Management factors
- Safety assessment review
- Tool and hardware (design or operation)

Casualty event: Occupational accident

Casualty severity: Very serious marine casualty

What happened:

A deck rating fell from a suspended portable gangway while working aloft in the hold of a general cargo ship. The ship was at anchor. The deck rating was transferred ashore by a local passenger launch and then on to a nearby hospital by ambulance. He was declared to be deceased shortly after arrival.

Why did it happen:

The portable gangway was jury-rigged to enable its use as a painting platform. It was suspended about 11 m above the hold bottom when the deck rating fell. The portable gangway was stationary and stable at the time, and the trigger for the deck rating's fall was not seen.

Rope guardrails fitted around the portable gangway were ineffective, possibly due to insufficient tension. Although the deck rating was wearing a safety belt and lanyard, the lanyard was not attached to the gangway structure or crane slings and therefore the rating's fall was not arrested.

The portable gangway was used to work aloft because the ship did not carry a dedicated platform, and it was necessary for the holds to be maintained prior to the next cargo being loaded.

What can we learn:

The safety management of the work aloft in the holds relied on a generic risk assessment and on the ratings involved following instructions. Consequently, important aspects of the work process such as supervision, communication, the potential hazards associated with the use of the portable gangway, the limitations of the lanyards provided, and emergency response, were not fully considered.

Who may benefit:

Shipowners, ship managers and seafarers.

7 Categories of safety issues:

- Planning and Procedures
- Management factors
- Safety assessment review

Casualty event: Collision - with other ship

Casualty severity: Very serious marine casualty

What happened:

Early in the morning on board a north-eastern bound bulk carrier, the second officer was keeping the navigation watch on bridge, and the ship was proceeding at 10.5 knots. All statutory navigation equipment on bridge was in good order; both radars were on 12 nm range. On the radar, the second officer spotted a fishing vessel off the starboard bow about five nautical miles away and posing risk of collision. The second officer altered course to 010° to keep clear of patches of floating fishing nets. After this, the bulk carrier's course and speed basically did not change much until the collision with the fishing vessel happened.

The fishing vessel's speed was kept at about nine knots, but the course varied from 298°, to 307°, 271°, 282°, 287°, 305° before it collided with the bulk carrier. The fishing vessel sank

as a result of the collision and the bridge watch keepers and several other crew members on the fishing vessel lost their lives in the collision.

Why did it happen:

As a give-way vessel in the crossing situation, the bulk carrier did not take substantial action as early as possible to give way to the fishing vessel. As a stand-on vessel, the fishing vessel did not fulfil the obligation of maintaining course and speed due to several changes in its course in the 10 minutes before the collision. The extent of the collision-preventing measures taken by the bulk carrier was too small and the fishing vessel did not take such action to best avoid collision.

The bulk carrier could not establish VHF radio contact with the fishing vessel, and as a result both ships were unable to understand each other's intention.

The second officer on board the bulk carrier relied on radar equipment and the situation between the two ships and the risk of collision were not accurately judged; the bulk carrier's speed was not reduced in dense traffic.

The pre-job training of the bulk carrier's second officer was not specific. The navigational operation characteristics of coastal fishing boats and collision-preventing measures were not emphasized in its officers' training. Besides, the supervision of the performance ability of the second officer on board the bulk carrier was inadequate, and the manager did not find and correct his watch keeping habits such as reliance on radar and unfamiliarity with the navigational characteristics of fishing boats.

The manning on the fishing vessel did not meet the requirements of the marine fishing minimum manning standard.

What can we learn:

The importance of strengthening pre-job training, bridge resource management and collision avoidance rules, especially strengthening the training of operators of coastal fishing boats.

Improving collision avoidance knowledge of commercial vessels and fishing boats so as to further improve the crew's skill level and safety awareness.

The importance to crew fishing vessels adequately and keep proper watch keeping arrangement on fishing vessel bridges.

Who may benefit:

Shipping companies, seafarers, fishing vessels owners and crews.

8 Categories of safety issues:

- Safety assessment review
- Legislation, standards and compliance

Casualty event*:* Occupational accident - slipping, stumbling, falling of person to a lower level

Casualty severity*:* Very serious marine casualty

What happened:

A pipe-laying vessel was mobilizing for a project at anchor. Work was conducted by crew and subcontractors, with each team independently completing their own permits to work. Permit-controlled work included work aloft by a rope access team and hot work at a higher level. The welders had already started work when the rope access technician and assistant arrived at their work area. The assistant raised concerns about visible sparks, but the rope access technician assured him that the risk was negligible and proceeded to climb to the work area with an open container of paint thinner attached to his safety line. Meanwhile, the welder's assistant noticed the rope access technician but did not mention anything to the welder.

Shortly afterwards, sparks from the hot work ignited the paint thinner. The rope access technician pushed the paint thinner container away but the ignited material splashed onto the safety harness, causing it to melt and fail. The rope access technician fell approximately five metres to the deck and died from his injuries.

Why did it happen:

The following factors contributed to the casualty:

- lack of full team representation and involvement in pre-planning meetings;
- safety management system requirements were implemented, but in isolation, rendering them ineffective by other simultaneous operations;
- inadequate high-level supervision and control for multiple activities; and
- the vessel's "stop work" policy was ineffective.

What can we learn:

While conducting simultaneous operations, effective supervision means maintaining oversight of the entire operation to enable identification of areas which overlap and the associated potential risks. During simultaneous operations, job safety analyses, permits to work and risk assessments lose their effectiveness if each team completes their own in isolation. It is important to think of ship and crew safety holistically, not as isolated departments. Stop work Authority is a safety policy that authorizes employees to put a stop to unsafe work, even when they normally do not have that level of authority. It is only effective when considered more than a written policy and actually utilized.

Who may benefit:

Many of the lessons to be learned from this casualty are for crew, contractors and subcontractors involved in simultaneous operations, particularly in the offshore sector. However, it is important for companies, operators and managers, regardless of the scope of operation, to understand the risks associated with shipboard teams working simultaneously while assessing their safety in isolation.

9 Categories of safety issues*:*

- Planning and Procedures

Casualty event: Occupational accident - slipping, stumbling, falling of person to a lower level

Casualty severity: Very serious marine casualty

What happened:

Early in the morning, the deck cadet found a stevedore's shore technician lying unconscious on the top of a twenty-foot container stowed under the deck in the cargo hold. He reported the accident to the duty second officer and the chief officer. Both of them immediately proceeded to the scene to check the situation. Fifteen minutes after the technician was found, a shore rescue team arrived to examine the technician and declared his death.

Why did it happen:

The technician lacked safety awareness of the risk of falling from height while working alone in the vicinity of the opening of the centre hatch cover.

The crew did not follow the requirements of the shipboard safety management system (SMS) to ensure the technician was wearing appropriate personal protective equipment (PPE) during cargo operation.

The external communication between shore personnel and the crew was ineffective.

There was no risk assessment and no control measures were taken for working aloft.

The hatch cover was not closed as soon as the cargo operation stopped.

Internal communication between shore technicians and the service company was also ineffective.

What can we learn:

Enhance safety awareness of the risk of falling from height while working in the vicinity of the opening of the hatch cover.

Strictly follow the requirements of shipboard SMS to ensure that the shore technicians use appropriate PPE during cargo operations, including wearing a safety harness with a lifeline or other arresting device when working aloft.

Enhance the communication between shore personnel and the crew on board by:

- carrying out a safety meeting before cargo operations, including providing safety instructions for wearing appropriate PPE, and conducting a risk assessment with control measures for working aloft; and

- strictly following the requirements of the Code to close hatch covers immediately after the cargo operation stops.

Who may benefit:

Seafarers, stevedores, operators.

10 Categories of safety issues:

- Planning and Procedures
- Management factors
- Safety assessment review

Casualty event*:* Occupational accident – Others

Casualty severity: Very serious marine casualty

What happened:

A fatal accident happened on board a general dry cargo ship that was discharging fumigated logs. At the time of the accident, a stevedore could not be contacted after entering a spiral ladder space of an almost fully loaded cargo hold through an access entrance on the main deck. Soon after, the chief officer on board tried to rescue the stevedore and also lost contact after entering the ladder space. Both were found dead in the spiral ladder space, which contained poisonous phosphine and lacked oxygen.

Why did it happen:

- the ship did not comply with the requirements of the Code of Safe Working Practices for Merchant Seafarers (the Code) and the shipboard safety management system (SMS) to properly control the entry into enclosed spaces;

- the crew did not follow the shipboard SMS procedures for entry into cargo holds by conducting a full risk assessment and issue an entry permit before entering the ladder space;

- the crew did not comply with the requirements of the Code and the shipboard checklist to properly plan the cargo handling, including safe entry into cargo holds;

- the shipboard safety training and drills, including enclosed space entry and rescue as well as knowledge of the limitations on the use of mask respirators, were ineffective;

- both the stevedore and the chief officer lacked awareness of the fatal risk inside the ladder space; and

- the foreman/terminal did not identify the risk in the hold.

What can we learn:

The ship management company, all masters, officers and crew members should strictly follow the requirements of enclosed space entry, cargo fumigation, risk assessment and plan the cargo handling properly, enhance crew's safety awareness and enhance crew training and drills. The management company should ensure crew strictly follow the proper procedures for enclosed space entry and cargo fumigation.

Who may benefit:

Companies, crew including masters.

11 Categories of safety issues:

- Maintenance
- Planning and Procedures
- Safety assessment review

Casualty event: Occupational accident - slipping, stumbling, falling of person to a lower level

Casualty severity: Very serious marine casualty

What happened:

A bulk carrier departed under ballast condition to the next port to load coal.

The deck crew of the vessel was divided into three groups to wash a cargo hold, using fire hoses with seawater during the voyage. Before the hold cleaning, the chief officer conducted a toolbox meeting which included issues on risk assessment for the hold cleaning, briefing of safety control measures when working aloft, and issue of a permit for working aloft by the master.

Later that morning, two able-bodied seamen were on a platform to wash the forward upper part of the hold. When one seaman walked to the port side of the hold with a pressurized fire hose, the grating of the platform detached from its support frame where he was standing. As a result, he lost his balance and together with the detached grating fell onto the tank top from a height of about 16 metres. The bosun immediately reported the accident to the chief officer and the master. The master then assembled the rescue team to provide first aid to the seaman and altered the ship's course to seek emergency medical assistance ashore. The seaman was transferred to a local hospital by a coastguard patrol boat for further medical treatment. He did not survive his injuries.

Why did it happen:

- the crew did not follow the requirements of the shipboard Safety Management System (SMS) to effectively carry out a risk assessment onboard before the hold cleaning including identifying the risk of the dislocation of the grating of the fore platform;
- the seaman did not wear a safety belt when working aloft during the hold cleaning;
- the crew did not supervise the hold cleaning on the spot while working aloft;
- the crew did not carry out proper maintenance of the fore platform in the hold;
- the crew did not identify the defective platform in the last detailed inspection of the hold;
- the crew did not check the condition of the fore platform in the hold before entry for the hold cleaning; and
- the accident also revealed that the shipboard training on working aloft for the crew was ineffective.

What can we learn:

- strictly follow the shipboard SMS to carry out an effective risk assessment before cargo holds cleaning and identify risks of dislocation of gratings of platforms;
- ensure the crew wear safety belts when working aloft;
- enhance supervision of the person in charge on the spot during the cargo hold cleaning;
- ensure platforms and their gratings are properly maintained and inspected;
- ensure the conditions of platforms and their gratings are checked before entering into the cargo holds for cleaning and maintenance;
- enhance shipboard training of the crew on working aloft and their safety awareness on the use of safety belts; and
- crew members should strictly follow the requirements of the shipboard SMS for working aloft and the maintenance of the vessel.

Who may benefit:

Crew, company.

12 Category of safety issues*:*

- Planning and Procedures

Casualty event: Collision - with other ship

Casualty severity: Very serious marine casualty

What happened:

A collision between a liquefied gas carrier and a local tugboat caused the tugboat to sink and one crew member of the tug went missing.

Why did it happen:

The crew of the gas carrier did not follow the requirements of COLREGs or the local rules of navigation. The crew did not fully discharge navigation duties on bridge. The crew did not plan and execute the passage plan.

What can we learn:

- strictly follow the requirements of rule 5 of COLREGs to maintain a proper lookout at all times during transiting so as to make a full appraisal of the situation and of the risk of collision;
- strictly follow the requirements to take appropriate actions for safe navigation, including overtaking another vessel under authorization, and stopping movement when passage ahead is unclear;
- strictly follow the requirements for safe navigation during pilotage, including taking appropriate actions if in any doubt as to the pilot's actions or intentions; and

- ensure the passage plan is prepared properly with sufficient awareness of the requirements of the Rules of Navigation and is executed fully as planned, especially for monitoring of traffic conditions and maintaining a proper look-out.

Who may benefit:

Crew, company, owner, local vessels.

13 Categories of safety issues:

- Anthropometric or personal factors
- Planning and Procedures
- Emergency handling
- Management factors
- Natural environment
- Tool and hardware (design or operation)

Casualty event: Grounding - while under power

Casualty severity: Very serious marine casualty

What happened:

A cargo ship was drifting. The ship was in an area for which a gale warning had been issued and was pushed by the wind and waves. The crew therefore started the main engine and navigation; however, the ship continued to be pushed without gaining sufficient propulsion or rudder effect and ran aground on a shallow reef.

The ship's hull subsequently broke in two at the centre section.

Why did it happen:

It is probable that the accident occurred when, under conditions in which a gale warning for the area, as well as a high winds advisory and heavy seas warning had been issued, the ship drifted. The ship was subject to northerly wind and waves on the port side and was pushed south; the ship continued to drift even after the wind and waves intensified until the distance to the shallow reef reached about 3 m. The ship subsequently started its main engine and began navigating in an attempt to proceed north. She could not gain sufficient propulsion and rudder effect to overcome the external forces and therefore continued to be pushed in an uncontrollable state and ran aground on the shallow reef.

It is somewhat likely the ship could not gain sufficient propulsion and rudder effect after re-starting the main engine because the master continued to use the main engine at half-ahead revolutions and did not use the maximum available output, resulting in main engine output that was approximately 40% of the MCR.

It is probable that the ship was drifting, without steps for taking refuge, such as heaving to using the main engine, because the master thought, based solely on weather information he obtained from an overseas weather information website, that the weather and sea conditions would not present a problem for navigation if they were as forecasted.

It is probable that the ship continued to drift even after the wind and waves intensified until the distance to the shallow reef reached about 3 m because the master thought the weather and sea conditions would not present a problem for navigation, if they were as forecasted, and therefore did not instruct the officer of the watch to monitor and maintain the ship's position during drifting. The master did not specify matters to be reported to him concerning changes in weather and sea conditions, etc., or the timing of such reports.

What can we learn:

The following measures may prevent recurrence of and mitigate the damage caused by similar accidents:

- In cases where a passage plan must be changed, the master of a ship should obtain the latest data and information on the revised destination and weather and sea conditions from the ship management company or a local ship's agent.

- The master should make weather predictions based on comprehensive judgements from multiple sources of weather information, including forecasts from local weather authorities. When weather and sea conditions are expected to worsen and a safer anchorage is available inside port, the master should coordinate with their ship's agent or other concerned party to permit early port entry. If a suitable place of refuge is unavailable, the master should consider moving to safe waters away from the shore and using the main engine to turn the bow to windward or heave to.
- When drifting, the master should select a drifting location with no shallow reefs or other such features downwind that is suitable for the forecasted weather and sea conditions as well as geographical conditions.

- The master should confirm in advance the possibility of arranging a tugboat in case the vessel's control becomes difficult. When intending to use a tugboat, the master should request it with plenty of time to spare.

- When drifting, the master should give clear instructions to the officer of the watch concerning monitoring and maintaining the ship's position and specify the matters to be reported to the master concerning changes in weather and sea conditions, etc., and the timing of such reports, and should have officers of the watch make reports to the master so that moving to a safe area can be completed as soon as possible before the danger of approaching a shallow reef, etc. increases.

- The master and officers should, based on a full understanding of the ship's manoeuvring performance and engine performance, handle the main engine within a range that extends to its maximum available output so that sufficient propulsion can be obtained for early movement to a safe area if the vessel encounters stormy weather.

- The master should share information on the status of ship operations, use of the main engine, and other matters between the bridge and the engine-room, and should establish an operating environment that allows him or her to receive advice on the use of the main engine not only from the crew members on the bridge but also from those in the engine-room.

Who may benefit:

Seafarers and shipping industry.

14 Categories of safety issues:

- Planning and Procedures
- Safety assessment review

Casualty event: Occupational accident - slipping, stumbling, falling of person overboard

Casualty severity: Very serious marine casualty

What happened:

After the pilot disembarked from a bulk carrier, the master instructed one of the crew members to secure the pilot – accommodation ladder combination arrangement. The crew member went down to the bottom of the accommodation ladder to adjust the platform that was still inclined. During the process, the crew member fell overboard. His body was recovered about 1.5 hours later.

Why did it happen:

- The crew member may have fallen overboard either while trying to adjust the accommodation ladder's bottom platform with one hand, after placing the securing pin in the slot, thereby shifting his centre of gravity towards the edge platform and overside, or he may have slipped on the ladder shortly after the pin was placed into the slot, due to ice accretion.
- The crew member was wearing neither a safety harness nor a working life vest/life jacket while working on the accommodation ladder.

What can we learn:

- The importance of making use of fall prevention equipment when working aloft.

Who may benefit:

Seafarers, shipowners, ship operators, ship managers.

15 Categories of safety issues:

- Anthropometric or personal factors
- Emergency handling

Casualty event: Occupational accident - body movement without any physical stress (generally leading to an external injury)

Casualty severity*:* Very serious marine casualty

What happened:

A bulk carrier experienced inclement weather, and the voyage plan was progressively amended, based on the advice received from a weather routeing service. The eductor was started to pump out the water from the forecastle store, which was found flooded by the crew. On the next day, the eductor developed a fault and five deck crew members, including the deck cadet, were instructed to extract the remaining water from the forecastle store and chain lockers, using portable pumps, then dry up the store, cover the spurling pipes on the forecastle deck, and arrange and secure all equipment within the store. The ship's course was altered to minimize the rolling and pitching and thus, facilitate the safety of the deck ratings. While the crew members were covering the spurling pipes, a large wave washed over the forecastle

deck. All of the crew members were swept across the forecastle, and several were injured. One of the crew members succumbed to his injuries a few hours later.

Why did it happen:

- the spurling pipe covers were blown off due to the strong winds and spray washing frequently over the forecastle deck;

- the spurling pipes were uncovered, water filled up into the anchor chain lockers. This water then leaked out of the chain lockers, past worn-down seals around the bitter end release pins, and flooded the forecastle store; and

- the crew members were concerned that the flooding of the forecastle store would affect the stability of the vessel. Consequently, they felt it necessary to cover the spurling pipes at the earliest.

What can we learn:

- Risk perception and decision-making can be influenced by at least two critical factors, i.e. a situation which would not have been experienced before and the context, which may not allow a serene assessment of the evolving situation.

Who may benefit:

Seafarers, shipowners, ship operators, ship managers.

16 Categories of safety issues:

- Maintenance
- Planning and Procedures

Casualty event: Fire/explosion – fire

Casualty severity: Very serious marine casualty

What happened:

A fire was detected in the engine-room of an oil-chemical tanker. The crew mustered on the poop deck, where it was confirmed that the duty engineer officer of the watch and the motorman were missing. Quick closing valves were activated, and the engine-room fire dampers were closed. Although the fire was brought under control and extinguished in a relatively brief period of time, the two missing crew members did not survive.

Why did it happen:

- The fire appeared to be related to accidental spillage or spray of diesel oil/waste oil onto the incinerator, directly from the deck above, while the incinerator was either in use or hot after being operated just before the fire.

- The main diesel oil non-return valve spindle assembly was found missing, possibly dismantled to investigate the lack of diesel oil flow and left unattended.

- The spilled diesel oil came in contact with the hot incinerator's furnace door.

- Both crew members tried to escape the space by wearing an Emergency Escape Breathing Device (EEBD) hood. However, one EEBD was not activated and the other EEBD ran out of air.

- There was no indication that the two crew members were heading towards the space's emergency escape routes.

What can we learn:

- Parts on fuel oil systems need to be either isolated or bypassed before they are dismantled, as part of a risk assessment to clearly understand the related hazards.

- The need for realistic drills to ensure that crew members are fully conversant with the use of emergency equipment and familiar with all the emergency escape routes from the machinery spaces in restricted visibility.

Who may benefit:

Seafarers, Shipowners, ship operators, ship managers.

17 Categories of safety issues:

- Anthropometric or personal factors
- Management factors

Casualty event: Collision - with multiple ships

Casualty severity: Very serious marine casualty

What happened:

During the early morning hours, a 56,000 deadweight (DWT) geared bulk carrier encountered a large concentration of fishing vessels. The weather was good with visibility of over 5 NM. After passing through the concentration of fishing vessels, the ship encountered two additional fishing vessels. One was off the ship's starboard bow and the other was off the ship's port bow. The fishing vessel that was off the starboard bow was engaged in fishing and was on a northerly course. The fishing vessel that was off the ship's port did not appear to be making way. The bulk carrier's officer of the watch (OOW) initially determined the ship would pass between the two fishing vessels.

As the bulk carrier approached the fishing vessels from the west, the fishing vessel that was off the ship's starboard bow started manoeuvring sporadically towards and away from the ship as the fishing vessel's crew members tried to cut the trawl free. Seeing the fishing vessel turning back and forth, the bulk carrier's OOW decided it was necessary to change course and ordered the helmsman to make two successive 5° turns to port. The collision occurred a short time later. The fishing vessel's hull was damaged and began flooding. All 10 of the crew members who had been on board were rescued before the fishing vessel sank approximately three hours after the collision.

Why did it happen:

The marine safety investigation determined the collision was the result of the ineffective application of navigation watchstanding principles on board the bulk carrier. The investigation also determined that the fishing vessel's captain was not maintaining a safe navigational watch

while concurrently conducting manoeuvres and monitoring crew members' work on deck. The marine safety investigation also determined that the white deck lights on board the fishing vessel interfered with the ability of the bulk carrier's bridge team to see the navigation lights that were exhibited by the fishing vessel.

What can we learn:

- The importance of navigation watchstanders making effective use of all available means to assess the risk of collision and of taking early and positive action when it is determined that there is a risk of collision.

- The need for navigation watchstanders to use extra caution when navigating in the vicinity of fishing vessels.

Who may benefit:

Ships' masters and navigational watchstanders; ship managers; fishing vessel operators; training centres.

18 Categories of safety issues:

- Planning and Procedures
- Management factors

Casualty event: Occupational fatality

Casualty severity: Very serious marine casualty

What happened:

While at sea, the master of an 82,000 DWT bulk carrier laden with grain was informed by the charterer that the ship's crew would need to remove the fumigant from the cargo holds prior to the ship's arrival at its discharge port. The master was informed the reason for this was that shore personnel would not be permitted to embark the ship due to restrictions imposed because of the ongoing COVID-19 pandemic. The operations staff agreed for the ship's crew to remove the fumigant after determining there were not any viable alternatives, including having the fumigant removed at another port.

The ship's master and chief officer conducted a risk assessment and prepared a plan for ventilating the cargo holds and then removing the fumigant. They then conducted a toolbox talk with the ship's bosun and two able seafarer deck (ASDs) who had been assigned to complete this task. The bosun and one of the ASDs were also provided full face respirators with phosphine filters. The bosun and both ASDs were also given single-use, non-woven polyethylene coveralls.

The cargo hold hatch covers were opened for two to three hours before the chief officer checked the atmosphere on top of the cargo and on deck in the vicinity of the hatch coamings for phosphine before the bosun and one of the ASDs started removing the fumigant. The weather while the work was being conducted was good, with clear sky and temperatures of 29--30°C.

After removing the fumigant from one of the cargo holds, the bosun told the chief officer that the work was heavy and asked if more crew members could assist with the task. The chief officer said it was not possible since the ship had only been provided two full-face respirators with phosphine filters. After the bosun and the ASD had removed fumigant from two more cargo

holds, the bosun told the chief officer that it was very hot and hard to breathe with the respirator on. The chief officer then had the bosun give his respirator to the second ASD and told the bosun to go aft and rest.

The bosun started to feel unwell and asked to be taken to the ship's hospital, where the ship's medical officer (second officer) administered medical oxygen. He also used fans to try to cool the bosun as the master was seeking shoreside medical advice. After a few minutes, the bosun lost consciousness. A short time later, the crew started to administer cardiopulmonary resuscitation (CPR) after observing that the bosun was not breathing and did not have a pulse. The master then contacted the nearest Maritime Rescue Coordination Centre (MRCC) to request a medical evacuation. The crew continued to administer CPR until the bosun was placed on board a rescue helicopter. The bosun was determined to be deceased when he arrived at the hospital.

Although the bosun may have been exposed to phosphine while removing fumigant from the ship's cargo holds, moderate to severe heat stress likely contributed to his death.

Why did it happen:

- Ineffective assessment of the potential that seafarers may suffer moderate to severe heat stress while working under full sun with air temperatures of 29-30 °C when wearing a full-face respirator and non-woven polyethylene coveralls.

- The COVID-19 related port access restrictions at the discharge port prevented qualified personnel going on board the ship to remove the fumigant from the cargo holds prior to discharge.

- Inadequate internal communications amongst the ISM manager's staff when making the decision whether to allow the ship's crew to remove the fumigant.

- The absence of international regulations mandating compliance with IMO circular MSC.1/Circ.1264 during in-transit fumigation of ships laden with grain.

What can we learn:

- The importance of taking the effects of PPE such as full-face respirators and special purpose coveralls into account when assessing the risk associated with working in hot climates.

- The need for masters and ISM managers whose ships may carry cargoes that are required to be fumigated to be familiar with the guidance in IMO circular MSC.1/Circ.1264.

- The need for masters and ISM managers to be aware of the arrangements for removing fumigant at the discharge port prior to agreeing to permit in transit fumigation.

Who may benefit:

ISM managers, charterers, Masters, port authorities.

19 Categories of safety issues:

- Planning and Procedures

- Management factors
- Tool and hardware (design or operation)

Casualty event: Damages to ship or equipment

Casualty severity: Very serious marine casualty

What happened:

During cargo operations with an offshore support vessel (OSV), the starboard pedestal-mounted crane on board a 1966 built, self-elevating accommodation unit collapsed. The incident occurred while the crane was being used to shift the position of a container that was on board the OSV. The crane cab, gantry structure and boom fell onto the OSV's deck. It then slipped overboard and sank with the crane operator in the cab. The crane operator's body was recovered from the crane cab during a subsea search. No crew members on board the OSV were injured. The OSV suffered minor damage.

The weather at the time of the incident was good with winds of 10 knots and seas of less than 1 m.

Why did it happen:

The crane collapsed as a result of a structure failure in the pedestal structure. The likely cause of this failure was material fatigue. The manufacturer of the crane had previously issued service letters addressing fatigue cracks in cranes of similar design and construction but had not indicated that these letters could also apply to the model of the crane that failed.

The operator's procedures for lifting operations did not establish requirements for managing dynamic amplification factors when making offboard lifts nor did the load chart posted in the cab of the crane include safe working loads (SWLs) for onboard and offboard lifts.

The crew on board the accommodation unit had routinely conducted lifting operations without complying with the operator's procedures.

The standards in place when the crane was designed and built did not require that dynamic amplification factors be taken into account.

What can we learn:

- The need for vessel operators and third-party inspectors to be aware of the potential for material fatigue in older equipment.
- The need for vessel operators to ensure that procedures for use of lifting gear are appropriate for the types of operations that will be conducted.
- The importance of conducting all lifting procedures in accordance with established procedures.

Who may benefit:

Vessel operators, crewmembers who conduct lifting operations, classification society surveyors, flag States.

20 Categories of safety issues:

- Anthropometric or personal factors

- Maintenance
- Planning and Procedures
- Emergency handling
- Management factors
- Safety assessment review
- Fatigue
- Natural environment
- Tool and hardware (design or operation)
- Legislation, standards and compliance

Casualty event: Occupational accident - electrical problems, explosion, fire

Casualty severity: Very serious marine casualty

What happened:

Engine-room watchstanders observed that the seawater discharge pipe for the main engine cooling pump was leaking on board a 8,900 DWT oil tanker that was under way on the high seas. The chief engineer determined that the leak could be repaired by pad welding over the corroded area of the discharge pipe. He informed the fitter and instructed him to prepare to weld the pipe.

As required by the ship manager's safety management system (SMS), the chief engineer completed a risk assessment and a hot work permit for the planned work. The risk assessment and hot work permit both indicated that the discharge pipe was dry and that the welding equipment was free of defects. The risk assessment also indicated that the worksite was inspected and was free of water. It was also indicated that the ground cable for the welder would be connected to the saltwater discharge pipe. The risk assessment and hot work permit were both approved by the master.

With assistance from another crew member, the fitter started work after the risk assessment and hot work permit had been approved. The fitter was wearing insulated gloves, a welding helmet, overalls, and safety shoes.

The chief engineer and other crew members who were in the engine-room reported hearing the fitter yelling about 40 minutes after he had started working. They immediately responded and saw the fitter lying on the tank top. The crew members disconnected the welding leads from the welder and also disconnected the welder from the power supply. They then lifted the fitter, who was not breathing and did not have a pulse, up onto the deck plating. They administered cardiopulmonary resuscitation (CPR), but the fitter did not respond and was determined to be deceased.

Why did it happen:

- The tank top was free of water but was damp in the area where the fitter was working and this created an electrocution hazard.

- The pre-task hazards assessment conducted by the chief engineer was insufficient since it did not identify the hazards associated with the tank top being damp.

What can we learn:

- The importance to risk assessments of ensuring that the potential hazards associated with the conditions that exist at the time that a task is going to be performed are identified and addressed when planning the task.

- That consideration should be given to using insulating mats when operating electric welding equipment or portable electric tools in wet or damp areas.

- The importance of conducting regular, periodic inspections of machinery and associated piping systems to identify signs of deterioration before failure and conducting the necessary repairs in a timely manner.

Who may benefit:

ISM managers, seafarers.

21 Categories of safety issues:

- Anthropometric or personal factors
- Planning and Procedures
- Emergency handling
- Safety assessment review

Casualty event: Occupational accident – Others

Casualty severity: Very serious marine casualty

What happened:

There was an unsafe cargo tank entry incident onboard an oil tanker while in an anchorage, which led to the death of the chief engineer of the ship.

Prior to the incident, the vessel had discharged cargo at the terminal. The ship cast off the terminal after the discharge operation was completed.

While en route, the ship commenced tank cleaning to prepare for the loading of next cargo. As such, there was inerting and purging of cargo tanks. The ship arrived at the anchorage and dropped her anchor at about 05.00.

At about 10.00 and after necessary permits and protocol were observed, a team comprising the chief engineer, chief officer, pumpman and ordinary seaman entered the cargo tank to inspect the condition of the deep cargo pump which was not working properly. About two minutes later, the chief engineer and the rest of the team came out safely from the tank.

Shortly after, the chief engineer and the pumpman re-entered the cargo tank to carry out maintenance on the faulty deep cargo pump. After about 10 minutes, the pumpman raised an alarm that the chief engineer had become unconscious inside the tank, and the rest of the crew were informed of the situation.

The ship crew placed an Emergency Escape Breathing Device (EEBD) on the unconscious chief engineer, and he was brought out of the tank and taken to the main deck, where cardio-pulmonary resuscitation (CPR) was carried out on him by the crew.

When the unconscious chief engineer did not respond promptly to the first aid being administered on him by the crew, the captain notified the company of the incident.

At around 11.00, the unconscious chief engineer was lowered into a speed boat and transported to the shore, where the company had an ambulance waiting to receive him. He was conveyed to the hospital, where he was pronounced dead at about 14.00.

Why did it happen:

Safety issues related to:

- Safety management onboard the ship.
- Compliance with the vessel's SMS Manual.
- Tank entry procedure

What can we learn:

- There is need for crews to comply with ship tank entry procedures which are designed to serve as safe guides for tank entry/exit; compliance to such procedures will assist to reduce/avert marine accidents and incidents from tank entries on board and safely manage emergency situations.
- There is need for crews to carry out risk assessment before embarking on shipboard operations to enhance safety. Such risk assessments should recognize, evaluate, measure, control and eliminate the hazards associated with each shipboard operation to avert marine accidents/incidents.
- The importance of onboard safety training and drills cannot be over-emphasized. There is need for shipowners and onboard crews to ensure safety drills are carried out as and when due, in line with the ship's SMS Manual, to enhance the crew's safety consciousness and emergency preparedness.
- There is need for shipping companies to confirm that ship crews are actually carrying out onboard drills; pictorial and video evidence of routine drills may be necessary to ascertain that the crews are prepared to safely handle emergency situations onboard.

Who may benefit:

Shipowners, shipping companies, Seafarers and the maritime industry.

22 Categories of safety issues:

- Anthropometric or personal factors
- Planning and Procedures
- Safety assessment review

Casualty event: Occupational accident – slipping, stumbling, falling of person overboard

Casualty severity: Very serious marine casualty

What happened:

A fatal man overboard incident occurred on board an offshore supply vessel while the vessel was "double banked" with other vessels at a jetty.

The deceased crew member was trying to cross from one double-banked vessel to the other when he slipped off from the fenders of both vessels and fell overboard into the water, resulting in his death.

Why did it happen:

Safety issues regarding:

- Improper boarding and disembarkation procedures onboard both vessels.
- Inadequate compliance with the ISM Code.

What can we learn:

- There is need for ships/shipping companies to ensure that proper risk assessments are carried out for all shipboard operations. This will help to identify hazards and ensure that adequate control measures are put in place to address them.
- Familiarizations, safety meetings/training, drills and safety briefing/toolbox talk should be done in accordance with the approved ship's SMS manuals; crew should also ensure that adequate PPE are worn during any operation and life jackets or personal floatation devices where there is any risk of falling overboard.
- There is need for companies to establish measures to address occupational health related accidents onboard; this may include onboard training of crew on occupational hazards and measures to address risks.
- There is need to always maintain effective communication, adequate coordination and monitoring throughout all vital shipboard operations.
- Crew should at all times adhere to personnel boarding and disembarking procedures onboard.

Who may benefit:

Shipowners, shipping companies, seafarers, ship crews and the maritime industry.

23 Categories of safety issues:

- Natural environment
- Tool and hardware (design or operation)
- Legislation, standards and compliance

Casualty event: Ship/equipment damage - ship/equipment damage

Casualty severity: Very serious marine casualty

What happened:

A passenger ship was on a crossing when it was hit by a breaking wave. The accident caused seven stateroom windows to break and caused major damage inside the staterooms in question. One passenger died and eight were injured.

Why did it happen:

The investigation has shown that the ship was struck by a breaking wave that, in combination with the ship's course and speed, caused the windows to shatter. At the time of the accident, the crew did not have sufficient information to predict the risk associated with a breaking wave reaching so high up on the shipside with such great force.

Further, the investigation has shown that the pressure from the breaking wave exceeded what the windows were designed to withstand. The investigation has not identified rules for ships or ship windows which account for the effects of breaking waves towards the shipside.

What can we learn:

The windows were inadequately dimensioned and the design pressure requirements in the current regulations for windows in this position yield too low values to be able to withstand pressure loads from breaking waves within the extent of the validity of the rules.

The Investigation Authority recommends that the classification society promote the problem in question in the International Association of Classification Societies (IACS) to ensure that all class rules, independent of class society, are developed to include requirements that account for breaking waves against the shipside. This also has to be reflected in the classification society's own rules.

Who may benefit:

Class society, shipyards, Maritime Administrations, shipowners, seafarers.

24 Categories of safety issues:

- Planning and Procedures
- Management factors
- Safety assessment review

Casualty event: Occupational accident – Others

Casualty severity: Very serious marine casualty

What happened:

The vessel commenced discharging cargo with a vacuum machine. The machine has a turning fork on the bottom, which churns and aerates the cement, allowing it to flow freely for proper suction. As the cargo level was going down, members of the ship's crew were situated in a gondola work platform suspended by the ship's crane, brooming and sweeping down residue of the cement cargo dust inside the cargo holds. At about 06.00, when the crew in the gondola were preparing for a change of shift, the gondola frame got stuck under the hatch coaming of the hold. On lowering the gondola to ease the messenger cum guideline, it got freed, then swung with a rebound. One of the crew members who was in the gondola, was knocked into the steel structure under the cross-deck and hit his head, which led to his death.

The emergency alarm was sounded and the gondola was landed on the jetty, along with the two crew members. The stevedore personnel called 911 and paramedics arrived soon after the incident. The paramedics gave first aid but the crew member was declared dead.

Why did it happen:

- Lapses in the SMS system and not having a daily safety meeting, as it was a critical operation and not a daily routine job.
- Improper procedures for operating the crane without a signal man.
- Inexperienced crew on the gondola cage giving instructions.
- It was the "Astronomical Twilight Zone Period" during which period it is dark, which can be an underlying factor.
- The crew were working in shifts and the accident took place at the end of the shift. Since it was the end of shift, the crew could have been fatigued leading to:
    - Impaired ability to think rationally.
    - Poor concentration on critical decisions.
    - Improper and poor judgement.
    - Inability to focus.

What can we learn:

Procedures – Safety Manual System:

Working aloft, such as cleaning hatches, is a critical operation for which a safety meeting is normally held prior to undertaking the job, and a work permit is issued. It should be emphasized that a permit system should not be carried out without sufficient thought i.e. with a tick-box mentality.

Permits are also a means of communication between those who carry out the work and the person responsible for their safety. Someone unaware of the intricacy of the work being performed could be a hazard.

Issuing a permit does not by itself make a task safe, however monitoring and thoroughness of those preparing, supervising, and carrying out the work makes it safer, and the crew should be trained to use and follow the permit system.

While issuing a work permit the following should be considered:

- a permit should specify the period of its validity and any time limits applicable to the work that it authorizes;
- sufficient monitoring of the work permit system (e.g. permit out of date/time);
- the permit to work system should be reviewed to ensure that it is being properly managed, that permits are actually being used are correctly completed and are effective;

- a permit to work should not be issued for too long a period of time as circumstances can change;

- a permit's validity should normally not exceed 24 hours;

- owners/managers should review and amend the SMS system for checklists and ensure that the validity of the work permit is no more than 24 hours; and

- an SMS non-conformity should have been raised and closed out by the DPA, as per the SMS system.

Who may benefit:

The maritime industry.

25 Categories of safety issues:

- Anthropometric or personal factors
- Maintenance
- Planning and Procedures
- Emergency handling
- Safety assessment review
- Fatigue

Casualty event: Fire/explosion – fire

Casualty severity: Very serious marine casualty

What happened:

The fire initiated in an auxiliary generator. The fire spread rapidly over the engine-room due to possible fuel oil leakage onto hot surfaces.

Due to the slow or late response of the crew, the fire reached the deck and erupted at a loaded container.

Moreover, the emergency generator was stopped, resulting in the emergency fire pump stopping.

Why did it happen:

Fire-fighting attempts failed to control the fire, as the emergency fire pump was out of service, in addition to the following reasons:

- Malfunction of the fire-fighting equipment.

- Improper usage of fire-fighting equipment.

- Lack of knowledge and inadequate training in fire-fighting techniques and the use of appropriate equipment.

What can we learn:

Fire drills and crew training must be taken seriously, and improving safety awareness and response techniques is a must to reduce such incidents.

The readiness of all safety equipment and appliances plays a vital role in controlling a fire.

Early detection and quick emergency response improve the chances of mitigating a fire.

The emergency fire pump must have a separate prime mover to be independently driven in case of a blackout.

The wind speed and direction may significantly influence a fire spreading when it reaches the accommodation and/or cargo deck.

The absence of prompt, serious, and well-planned communication with the owner/management company may result in the loss of the vessel and the cargo onboard. All fire-fighting team members must effectively participate in any fire incident.

Who may benefit:

The maritime industry.

26 Categories of safety issues:

- Planning and Procedures
- Management factors
- Safety assessment review

Casualty event*:* Occupational accident – loss of control of machine, means of transport or handling equipment, hand-held tool, object, animal

Casualty severity*:* Very serious marine casualty

What happened:

The chief officer of a refrigerated cargo vessel conducted a safety briefing before beginning cargo operations. The next morning, a fishing vessel moored alongside the cargo vessel to load cargo. The chief officer and other deck crew were stationed on the vessel's starboard side for the mooring operation of another fishing vessel. The bosun left his post as the derrick operator in the cargo hold to assist with the mooring operation. The chief engineer replaced the bosun and acted as the derrick operator for the loading operation.

When the cargo was lowered into the hold, the third engineer released the sling, emptied the cargo net, and signalled to the chief engineer to hoist up the derrick crane. When the cargo net was lifted, it got caught up on a metal sheet on the side of the cargo hold hatch coaming causing the metal sheet to fall into the cargo hold.

The motorman, who was standing under the visor, was hit in the head by the falling metal sheet and lost consciousness. The master reported the incident to port control and requested assistance in bringing the victim to the nearest hospital. Stretchers were delivered to the cargo hold by the crew. The crew delivered a medical first aid kit and applied it to the victim's head.

The crew evacuated the injured motorman to the fishing vessel's speed boat to deliver the injured crew member ashore. The second officer accompanied the victim and performed CPR

until they arrived at the shore. A medical evacuating car arrived at the port to pick up the motorman and bring him to hospital. A doctor pronounced the victim was dead.

Why did it happen:

- Communication between the cargo hold and the operator failed despite the operator declaring that he could see the people working inside the cargo hold.
- The chief engineer's lack of familiarity with the derrick winch system.
- Failure to identify the risk of working under the suspended load.
- The crew was allowed to work in the cargo operation even though this was not included in their work schedule.
- There were no toolbox meetings before the start of the work, and the personnel identification was unavailable at each location.
- The metal sheet was only fixed by bolts and not by welding. When it was caught by the cargo net, tension applied to the plate, and it came off.

What can we learn:

- To include in the SMS the production of work instructions for critical machinery to ensure safe operation.
- Implementation of toolbox meetings on a daily basis and identification of potential risks in the planned works.
- To include the maintenance of derrick winches in the PMS (Planned Maintenance System).
- All metal sheets that are fixed by bolts should be fixed by welding to avoid falling off when in contact with cargo equipment.
- To include in the work procedures that once a load or any equipment is lifted, the crew members involved in the operation must be in positions that prevent them from being affected by objects that may fall from the lift.
- Vessel owners/operators should focus on extensive internal audits to identify potential problems, especially in safety.
- The vessel should properly maintain equipment to improve the living conditions on board.
- The master should exercise caution when utilizing the crew for cargo operations, as this was not part of the crew's contract.

Who may benefit:

Operating companies, crewmembers.

27 Categories of safety issues*:*

- Planning and Procedures
- Management factors
- Safety assessment review

Casualty event: Occupational accident – slipping, stumbling, falling of person overboard

Casualty severity*:* Very serious marine casualty

What happened:

A container liner completed loading and departed from port in the early morning. Around 13.00, the bosun went to the starboard boat deck alone to change the cover of the disembarkation ladder of the lifeboat.

At 15.00, three crew members went to the crew mess room for tea break where they found the bosun was not there as usual. They called the bosun though the walkie-talkie but received no response. They divided into two groups to look for the bosun; the groups searched from the accommodation to the bow and astern respectively, including the engine-room. Since the bosun was not found, they reported the situation to the second officer on the bridge.

The chief officer received the news and went to bosun's cabin, but he did not find the bosun. At this moment, a crew member told him he saw the bosun around 13:15 at the starboard lifeboat. The chief officer rushed there and found the bosun's cotton jacket on the deck, the ladder cover was on deck, but the bosun was not in sight. The chief officer reported to the master at once and the master came to the scene.
After a quick search on board by all crew, the master confirmed the bosun was overboard. He manoeuvred the ship and sailed back at once. The crew found the bosun and took him back on board the ship. Unfortunately, the bosun had died.

Why did it happen:

After lunch, the bosun told the three crew members to continue working. He went to the starboard boat deck alone to change the cloth cover of the disembarkation ladder there without bringing the safety harness.

He took off the broken cloth cover from the ladder and put the new cloth cover on top of the ladder. Because the ladder was piled nearly 1.5 metres high, he had to pull down the edge of the cloth cover from the four sides of the ladder pile. He decided to pull down the cloth edge on the side of the ship's side first. Then, he took off the hook on the chain that connected the handrails. He stepped over another two chains that were still connected between the handrails and then tried to pull the edge of the cloth cover down to the deck. At that moment, probably caused by ship swinging lightly, the bosun lost his balance, his body inclined to outboard of the ship. He clutched the edge of the cloth cover tightly and tried to stop his body moving outboard of the ship. Unfortunately, the other end of the cloth cover was not fixed; the bosun was overboard with the new cloth cover.

Because the bosun did not wear a safety harness, he accidently went overboard while he changed the new cloth cover of the starboard disembarkation ladder. Meantime, because he worked alone at the time and nobody was on-site, his fall overboard was not found in time.

What can we learn:

- The bosun did not wear a safety harness when he stepped over to the outboard side of the handrail.

- The bosun did not fully consider the safety of the task before he took action to change the cloth cover of the ladder, such as how to take off the cloth cover, how to place the new cloth cover, whether a person needed to go to the outboard, whether it needed one more person. Therefore, he went to change the cloth cover there by himself.

- It is recommended that the management company should set up a compulsory rule in the SMS to regulate that the deckhands should wear a safety belt or safety harness when they plan to work on the weather deck, especially working near the handrail.

- It is recommended that shipowners should strengthen the education on safety awareness during the pre-boarding education and emphasize any work and actions should follow the relative regulation on board.

- It is recommended that the flag State set up a compulsory rule designating the safety belt or safety harness as Personal Protection Equipment (PPE) and regulate that every deckhand should wear a safety belt or safety harness when they work on deck.

Who may benefit:

The maritime sector.

28 Categories of safety issues:

- Planning and Procedures
- Management factors
- Safety assessment review

Casualty event*:* Capsize/listing – capsize

Casualty severity: Very serious marine casualty

What happened:

A cargo ship departed the loading port with 750-metric tons of sand and aggregates. There were 22 officers and crew on board. While navigating in the early morning, the vessel began to experience three metre swells with a wind speed of approximately 22 knots. Subsequently, the vessel began to experience heavy rolling and pitching.

Thereafter, the ship began to develop a list of up to 15° to port which prompted more seawater to enter the cargo deck which deluged the cargo of sand and gravel. Seawater had accumulated at the aft section of the cargo deck, prompting the master to order the use of two submersible pumps to pump-out the water on deck.

Due to the continuous ingress of seawater and shifting of cargoes, the list to port increased up to 30°. The situation prompted the master to send a distress call on Channel 16 and declared the order to abandon ship. All officers and crew were able to deploy the two liferafts and boarded safely. While on board the liferafts, the crew observed that the vessel immediately capsized to port with the hull bottom exposed to the surface of the water.

Why did it happen:

- There was no specific loading plan on carriage of solid bulk cargoes. It was disclosed that essential information such as cargo characteristics, stowage factor,

angle of repose and special properties of the cargoes in bulk were not taken into consideration during loading of cargoes.

- It was also observed that there were no cargo trimming procedures reflected in the company's Safety Management System (SMS) Manual which would provide guidance to the crew. Cargo trimming is a mandatory requirement for solid bulk cargoes, to avoid the risk of the cargo shifting.

- It was also noted that the master and chief officer did not consider the significance of loads induced by fuel and ballast water prior to the vessel's voyage which can have an effect on the weight distribution along the ship length when subjected to rolling and pitching.

- It was also observed that the crew did not ensure that drainpipes and freeing ports located on both the forward and aft sections of the cargo deck were free from debris and accumulated sand and gravel. Seawater was trapped on the cargo deck.

- The ship was not issued an SMC and the owner was not required to obtain a DOC as per certification issued by the flag State. The requirement to develop, adopt and implement safety procedures compliant with the standards set by the *Revised guidelines on the Implementation of the International Safety Management (ISM) Code by Companies* (MSC-MEPC.7/Circ.8) pursuant to the ISM Code is compulsory for cargo ships 500 GT and above.

What can we learn:

- To immediately adopt and implement in the Safety Management System (SMS) Manual the cargo trimming procedures for solid cargoes in bulk, taking into consideration the cargo characteristics, stowage factor, angle of repose and special properties of the cargoes in bulk.

- To conduct additional fleet safety and navigational audits.

- To ensure that drainpipes, freeing ports and scuppers are free of obstructions and accumulated debris during voyages.

- To ensure the monitoring of weather condition and wave condition prior and during the voyage.

- To ensure the monitoring of cargo loading operation, and effective communication between the terminal and ship are maintained at all times, especially during the final trimming of the ship.

Who may benefit:

Companies, crewmembers.

29 Category of safety issues:

- Tool and hardware (design or operation)

Casualty event: Capsize/listing – capsize

Casualty severity: Very serious marine casualty

What happened:

An unregistered service tugboat from a shipyard was tasked to tow a 66 metre cargo vessel towards open waters for an intended sea trial.

The vessel put both engines on standby in preparation for transit. Thereafter, the ship's master ordered the starboard side throttle to dead slow ahead.

The service tugboat slightly manoeuvred to port but was pulled broadside by the towline coming from the cargo vessel when the later vessel begun to overtake the towing vessel. Subsequently, the towing vessel began to heel towards starboard while being dragged by the towline.

Due to the tension exerted by the towline from the cargo ship, the tug's righting lever drastically diminished and was completely overwhelmed by a high athwartships towing force. This prompted the tugboat to capsize and sink.

Why did it happen*:*

It was determined that the length of hawser or towline from the service tugboat to the ship being towed was only 20 metres rather than the required length of 50 metres as per the Amendment to SOLAS regulation II-1/3-4 (resolution MSC.256(84)) *Emergency Towing Arrangements and Procedures*.

There was no towline emergency quick release mechanism onboard the service tugboat.

What can we learn:

The emergency release function is to take priority over any emergency stop function. Activation of the winch emergency stop from any location is not to inhibit operation of the emergency release system from any location.

Who may benefit*:*

Tugboat community.

30 Categories of safety issues*:*

- Management factors
- Safety assessment review

Casualty event: Occupational accident - slipping, stumbling, falling of person to a lower level

Casualty severity*:* Very serious marine casualty

What happened:

A container ship was in a port fairway, about to berth with a pilot on board, when the bosun informed the bridge, via VHF, that a crew member had fallen from the top of a cargo hold to the deck (3.4 metres). The master sent the chief officer and a cadet to the location. The chief officer informed the master that the crew member was not conscious. The master called the agent and requested medical assistance. Approximately 80 minutes later, the ship was alongside and medical emergency services and the local maritime police boarded the vessel. The crew member was pronounced dead on-site.

Why did it happen:

The ship was preparing to go alongside in the port with two crew members preparing (unlashing) the containers. The crew members were operating alone as was typical for this operation on arrival to the port.

Working on deck is a complex situation, an enormous amount of information must be processed and assessed by the crew involved in the operation. The goal of the operation is to safely achieve an acceptable outcome. This information is based on the crew's experience and knowledge and involves mental shortcuts. These mental shortcuts are cognitive processes allowing a quick response in any situation, based on experience, knowledge, and risk perception – i.e. a deck rating who has recently been involved in a parted rope situation will likely judge rope operation risk to be higher than one who has not.

These mental shortcuts classify the perception of risk during an operation and, in conclusion:

- The perception of risk can stay the same even when the context and circumstances are evolving.
- The crew's ability to judge risk is constrained by the fact that decision-making is limited to their knowledge and experience.
- This conclusion emphasizes that dissemination of lessons learned, making it possible for other deck crews to learn from the insight of a single crew member, is of the utmost importance to improve maritime safety.

Through the analysis of the collected information, it was concluded that the crew of the ship was acting in accordance with the way the tasks were normally carried out, with an acceptable outcome.

The crew member working alone on deck must adapt to the conditions, which resulted in:

- The non-monitoring of the tasks carried out by the other team member.
- A real inability to react.

What can we learn:

The management is responsible for establishing the guidelines that refer to how the processes are carried out on board. The operation is responsible for carrying out safety action /corrective actions taken and shall not create a presumption of blame and/or liability.

A greater connection between the management and the operation will identify possible improvements in the organization's decisions, contributing to the improvement of processes, and consequently to the minimization of adverse consequences in future occurrences.

Who may benefit:

Personnel managing or involved in deck operations.

31 Category of safety issues:

- Management factors

Casualty event: Occupational accident - slipping, stumbling, falling of person overboard

Casualty severity: Very serious marine casualty

What happened:

A container ship was under way, proceeding to port.

A deck team was sent on deck to close the paint store door and check if the forward and aft stations were secure for sea passage, when a man overboard (MOB) was reported. The deck team ordinary seaman was reported missing.

He was washed overboard by a wave. The vessel reduced speed and returned to the MOB position, broadcast mayday on VHF Channel 16, and called, via satellite phone, the Maritime Rescue Coordination Centre. A Search and Rescue operation was deployed. The crew member was declared missing.

Why did it happen:

The crew member was washed overboard when an unexpected wave washed over the forward deck. The deck team was not secured to the vessel nor wearing lifejackets.

Working on deck is a complex situation; an enormous amount of information must be processed and assessed by the crew involved in the operation. The goal of the operation was to safely achieve an acceptable outcome – confirming that the vessel was prepared for sea passage and that the paint store door was closed.

This information is based on the crew experience and knowledge and involves mental shortcuts. These mental shortcuts are cognitive processes allowing a quick response in any situation, based on experience, knowledge, and risk perception. This refers to a set of techniques used to identify and examine the tasks that must be performed by humans when interacting with systems, i.e. a deck rating who has recently been involved in a parted rope situation will likely judge a rope operation risk to be higher than one who has not.

Through the analysis of the collected information, it was concluded that the crew of the ship was acting in accordance with the way the tasks are normally carried out, with an acceptable outcome.

The consequences of the fall would not have been so serious if the crew member was wearing an automatic inflation vest which would allow him to float even if unconscious.

What can we learn:

What is considered normal operation on board a ship is in fact abnormality; crew members operate in various degraded modes of operation, having to continuously adapt and respond to the scenario and work demands. Ship's deck teams are used to perform difficult operations daily, adapting to the context and variabilities to guarantee an acceptable outcome.

When operations have an unacceptable outcome, deck teams should focus on the many times that operation had a successful outcome and try to understand what the context was and how to replicate it again.

The management/organization is responsible for establishing guidelines that refer to how the processes are carried out on board.

The operation is responsible for carrying out the processes.

A greater connection between the management/organization and the operation will identify possible improvements in the organization's decisions, contributing to the improvement of processes, and consequently to the minimization of adverse consequences in future occurrences.

Before undertaking an unusual or undocumented task, take a few minutes to do a risk assessment among the team members, even if only verbally.

Who may benefit:

The maritime community.

32 Categories of safety issues:

- Anthropometric or personal factors
- Fatigue
- Legislation, standards and compliance

Casualty event: Fire/explosion – explosion

Casualty severity: Very serious marine casualty

What happened:

The explosion occurred on board a chemical tanker. The accident location on board was adjacent to a cargo tank, where the flame first ignited; explosions occurred two to three times consecutively; and then, the hull rapidly listed to starboard.

The accident occurred in the afternoon. The master, who was adjacent to the bridge wing, gave the order to abandon ship, pressed the distress button, and directed the crew to lower the life rafts. Approximately 30 minutes after the explosion, a total of 22 persons, consisting of 19 crew members and three pilots, were safely rescued by a boat from the local Administration. The fire was extinguished at around 20.00.

Why did it happen:

- The bosun cracked open the hatch of the cargo tank as instructed by the chief officer, probably resulting in the creation of a flammable gas mixture inside the tank. The bosun regarded the opening as preparation work for tank cleaning, and

thus he connected a portable rubber hose to the hatch and pumped in compressed air so that the residue could be removed from the cargo pipe. In this process, it is presumed that static electricity was generated inside the cargo tank and it ignited an explosion after meeting with a flammable gas mixture.

- The master reasonably determined that he had sufficient time to clean the cargo tanks as it took about 36 hours from the pilot station to the port and that the crew must be rested in case of an emergency response. Therefore, he ordered the chief officer not to carry out any operation on the deck until the tanker passed out of the river. However, the chief officer did not follow the master's order but gave a written instruction of five deck operations to the crew.

- The tank cleaning operation carries a significantly high risk of explosion and asphyxia. Therefore, significant measures must be taken to prepare and check prior to the operation. Those who engage in the cleaning are required to have a thorough understanding of the operation and comply with the safety rules. In this instance, however, no preparations were done or plans made for the tank cleaning, as required in the Cargo Tank Cleaning Instruction. Moreover, they neither conducted a risk assessment on flammable cargoes nor checked the gas level inside the cargo tank. Procedures were in place allowing the crew to refuse the instruction of unsafe operations. However, such procedures were not followed.

- The tanker's management did not share the properties and precautions regarding the cargo (benzene, a highly explosive and toxic cargo) with those engaged in operations. Blowing residue out of the cargo pipe with compressed air may generate static electricity as a result of friction. Thus, if a flammable gas mixture exists in the cargo tank, so does the risk of explosion. The company's Cargo Management Procedures also prescribed that compressed air cannot be used for cleaning a line for flammable or static accumulator cargoes, but this provision was not followed.

- The chief officer and the bosun failed to communicate clearly with each other on work instructions and the tank cleaning confirmation. As a result, the crew performed the operation in a manner that differed from the provisions, and eventually an explosion resulted. Also, the company's education and training instruction required the tanker to offer on-the-job training to those who fail to satisfy the threshold of the work proficiency evaluation and those promoted while on board. However, these provisions were not implemented.

- The company was satisfying the hours-of-rest standards set by the Maritime Labour Convention by assigning additional officers to the tanker and easing the fatigue of the chief officer. Still, the chief officer stated that he had made a mistake out of fatigue when giving operation instructions at the time of the accident. It cannot be ruled out that he may have made a mistake if he had indeed had an extremely high level of fatigue.

What can we learn:

- Strictly carrying out the master's instructions.

- Complying with the Cargo Tank Cleaning Instruction and the relevant regulations.

- Strengthening management of flammable and static accumulator cargoes.

- Enhancing communication skills of the crew with different nationalities.

- Developing measures to manage the crew's fatigue during cargo operations.

Who may benefit:

Seafarers, shipping company.

33 Category of safety issues:

- Anthropometric or personal factors

Casualty event: Occupational accident – Others

Casualty severity: Very serious marine casualty

What happened:

An ordinary seaman on a chemical tanker is presumed to have died from inhaling residual benzene fumes after collapsing on the floor of a cargo tank he had entered without authorization while wearing an unapproved filtered mask on his face. He had done this after the chief officer had directed him to prepare for mopping during the gas freeing operation of the cargo tank.

Why did it happen:

In order to work inside an enclosed space, the chief officer is supposed to write up an entry permit for the enclosed space in question and gain final authorization on the written permit from the master. However, the chief officer directed four ratings of the deck department to prepare for the tank cleaning operation without following the entry procedures.

The chief officer is required to measure the atmosphere levels inside the cargo tanks before they are cleaned. Moreover, those who enter the tanks are to carry a portable gas detector in order to monitor the levels. However, the chief officer did not check the levels of residual benzene gases and oxygen in the cargo tank that the ordinary seaman entered.

The ordinary seaman is presumed to have violated the master's instructions as he entered the cargo tank for cleaning while wearing a filtered mask which could not protect him from hydrocarbon fumes and other toxic gases. Moreover, the master failed to provide oversight to ensure filtered masks were either discarded or prohibited from being worn.

The company clarified operating procedures for enclosed spaces in its SMS, while it neither managed nor supervised whether the crew were complying with these procedures.

What can we learn:

Strict adherence to operating procedures for enclosed spaces:

- The chief officer or the officer in charge should write up an entry permit for enclosed space prior to tank cleaning as required in the SMS. Moreover, the master should confirm and authorize the safety measures, including checking atmosphere levels and preparing PPE and emergency equipment.

- The chief officer or the officer in charge should measure oxygen and other gas levels with a gas detector to verify the level of residual gas inside the cargo tanks prior to their cleaning. What is more, those who enter the cargo tanks should carry

a portable gas detector to constantly check oxygen and other gas levels inside the tanks.

- A designated person of dangerous materials on board (either the master or the chief officer) should identify the safety conditions for onboard operations related to the treatment of dangerous materials and then remove risk factors or take safety measures. Prior to the tank cleaning operation, safety training on risk factors should be offered to those engaged in the operation. Moreover, the operation should be clearly directed in order to prevent any misunderstanding and the resultant unauthorized entry or exit of the cargo tanks.

Strengthening safety management and building shipboard safety culture:

- Since people working inside a cargo tank are highly susceptible to gas poisoning and asphyxia, the company should strictly train newly boarded crew members on operating procedures, including where enclosed spaces are and how to obtain an entry permit for enclosed spaces, as required in the SMS.

- The company should regularly manage and supervise its crew to ensure all members are duly practising the required SMS, including a preliminary safety meeting, safety instructions for onboard operations, and on-site safety inspections.
- The company should support its crew by providing the translated version of its SMS and the P&A Manual so that foreign crew members can understand and comply with them. Furthermore, it should make constant efforts to raise safety awareness among the crew members on board.

Who may benefit:

Seafarers, shipping companies.

34 Categories of safety issues:

- Emergency handling
- Management factors
- Natural environment

Casualty event: Fire/explosion

Casualty severity: Very serious marine casualty

What happened:

A container ship encountered a fire in the cargo area while at anchor. The fire eventually spread to other areas of the ship, prompting the crew to abandon the vessel which was subsequently declared a total loss.

Why did it happen:

The fire likely started from a leaking container carrying nitric acid which had not been offloaded despite the leak being reported 10 days prior. The leaking nitric acid interacted with various metals and materials, resulting in subsequent exothermic reactions and a fire. The response to the leak was inadequate, and a lack of coordinated efforts to offload the container.

What can we learn:

It is important to promptly and effectively respond to hazardous material leaks on board ships, including proper handling and offloading procedures. Additionally, effective command and control in emergency situations, as well as proper coordination with port authorities for assistance, are crucial for the safety of the crew and the vessel.

Who may benefit:

Maritime authorities, shipping companies, crew members, port authorities and emergency response teams.

35 Categories of safety issues:

- Maintenance
- Planning and Procedures
- Management factors
- Tool and hardware (design or operation)

Casualty event: Fall from height

Casualty severity: Very serious marine casualty

What happened:

A 27,000 GT container ship was anchored awaiting berthing instructions. After carrying out some routine maintenance on the shipboard crane, one of the deck crew went to the crane cabin to operate the crane.

Before the crane was operated, the deck crew member fell 20 metres down to the cross deck from the crane cabin when the floor plate gave way. The crew member was conveyed ashore by the coastguard for medical treatment but later succumbed to injuries at the hospital.

Why did it happen:

The crane cabin's floor plate gave way which caused the deck crew member to fall. The floor plate (as a part of the cabin floor) was found corroded with severe pitting along the welded joint which had thinned the material.

The Planned Maintenance System (PMS) incorporated a quarterly inspection schedule recommended by the crane manufacturer. The crew who conducted the inspections, and operators of the crane, did not notice the corrosion of the floor plate over a period of time.

The crane manufacturer deemed such inspections to only be carried out by their authorized and trained personnel. The crane manufacturer had not included the scope of inspection required for the crane cabin, including what was to be inspected and how the inspection was to be carried out.

The design of the crane cabin required the crane operator (in this case the deck crew member) to stand on the floor plate, albeit temporarily, adding weight on the plate which posed a risk to the operator, especially when the floor plate was corroded.

What can we learn:

A comprehensive inspection regime for areas which could pose a risk to the safety of personnel should be in place by the management companies with timely and appropriate intervention and established priority for carrying out repairs in a timely manner.

These inspections should highlight areas which are covered by anti-slip mats or any other similar concealment of metallic surfaces and welded joints where the chances of moisture being trapped is high.

The design of the crane cabin should take into account the need for additional load bearing support for the floor plate so that a weakened floor plate does not pose a risk to the operator while standing on it.

Who may benefit:

Seafarers, shipping companies, crane manufacturers, classification societies and flag Administrations.

36 Categories of safety issues:

- Anthropometric or personal factors
- Planning and Procedures
- Management factors
- Safety assessment review

Casualty event: Others

Casualty severity: Very serious marine casualty

What happened:

In the afternoon, a general cargo ship was berthing at a shipyard with the assistance of a tug. During the berthing manoeuvre, a seafarer participating in the manoeuvre on the tugboat died due to the jamming of the towing line.

Why did it happen:

The tug was not manned with a sufficient number of seafarers to perform safe manoeuvres.

There was insufficient knowledge of both the tugboat and cargo ship personnel about the dangers and risks arising from line manoeuvring.

The cargo ship was unable to give two lines at the same time.

There was a lack of effective communication between the tugboat and the vessel.

What can we learn:

- Employment of an additional officer and a seafarer on the bridge in addition to the master for safer operations of the tugboat during manoeuvres.
- Identifying the risks arising from tugboat operations and taking precautions against poor and incomplete communication, especially during manoeuvres.
- Establishment of procedures, including the applications to be made by the tugboat personnel in case the mooring lines cannot be given from the vessels at the same time.
- Employment of additional seafarers for safer manoeuvring of the ship's arrival/departure manoeuvres to the port or shipyard.
- Taking measures to reduce the risks by redetermining the possible risks that may occur during the vessel's arrival/departure manoeuvres to the shipyard or port.

Who may benefit:

Ship operators, tugboat management companies, seafarers.