

**ΑΚΑΔΗΜΙΑ ΕΜΠΟΡΙΚΟΥ ΝΑΥΤΙΚΟΥ
Α.Ε.Ν ΜΑΚΕΔΟΝΙΑΣ**

ΠΤΥΧΙΑΚΗ ΕΡΓΑΣΙΑ

ΕΠΙΒΛΕΠΟΥΣΑ ΚΑΘΗΓΗΤΡΙΑ: ΠΑΝΑΓΟΠΟΥΛΟΥ ΜΑΡΙΑ

**ΘΕΜΑ
INCIDENTS AND ACCIDENTS AT SEA**

**ΤΟΥ ΣΠΟΥΔΑΣΤΗ: ΓΚΑΙΤΑΤΖΗ ΙΩΑΝΝΗ
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<i>1</i>				
<i>2</i>				
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ΤΕΛΙΚΗ ΑΞΙΟΛΟΓΗΣΗ				

Ο ΔΙΕΥΘΥΝΤΗΣ ΣΧΟΛΗΣ :

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INTRODUCTION

While working in the maritime industry can be exciting and lucrative, it can also be highly dangerous. Accidents that lead to injuries, and sometimes even fatalities, are not uncommon in people who do this work. Whether you work in a port as a longshoreman, aboard a ship as a seaman, on an offshore platform, or in some other maritime role, the work is often physically demanding, requires long hours, and comes with the risk of being involved in an accident.

Shipping accidents are unexpected events that result in financial loss and properties, damages and either loss of people. Several reasons as human errors, technical failures, natural conditions, shipping factors, route conditions and cargo related factors play role in these accidents. Unfortunately, shipping accidents are inevitable cases of maritime field, in contravention of creative and innovative technologies in shipping sector and execution of precautionary safety rules and regulations.

The working deck of a vessel continues to be one of the most dangerous environments in the world. Often due to the unseaworthiness of vessels, maritime injuries and accidents to seamen frequently involve the use of a crane, winch, net reel, or crab pot launcher. Deckhands are also frequently injured in the galley, engine room, by an open hatch or while making and breaking tows aboard tugs and barges. Many seamen also suffer from hearing loss due to working in noisy environments without adequate protection.

A series of regulations has been introduced and implemented to ensure the safety and security of the seafarers working on ships. However, there are few types of life threatening accidents which still keep of taking place on board ships.

Definitions

Accident

An accident means an occurrence that involves a ship and in which:

- a person is seriously harmed as a result of
 - being on the ship; *or*
 - direct contact with any part of the ship including any part that has become detached from the ship; *or*
 - direct exposure to the wash of the ship or interaction (other than direct contact) between 2 ships; *or*
 - being involved in the salvage of any ship - except where the injuries are self inflicted or inflicted by other persons or when injuries are to stowaways hiding outside the areas normally available to passengers and crew; *or*
- the ship sustains damage or structural failure that:
 - adversely affects the structural strength, performance or seaworthiness of the ship; *or*
 - would normally require major repair or replacement of the affected component; *or*
 - poses a threat to the safety of people on board the ship; *or*
 - there is a complete or partial failure of machinery or equipment that affects the seaworthiness of the ship; *or*
- there is a loss of, or damage to, or movement of, or change in the state of, the cargo of the ship which poses a risk to the ship or other ships; *or*
- there is a significant loss of, or significant damage to, property (not being the cargo carried by the ship) or the property of any person (whether or not aboard the ship), whether or not the loss or damage arises from an interaction between 2 ships; *or*
- there is a loss or escape of any substance or thing that
 - may result or has resulted, in serious harm to any person; *or*
 - may pose a risk, or has resulted in damage to the ship or other ships; *or*
 - may pose a risk, or has resulted in damage to any property (whether or not on board the ship); *or*
- a person is lost at sea (whether or not subsequently found) or is missing; *or*
- the ship is foundering, capsizing, being abandoned; stranding; missing or has foundered, capsized, been abandoned, been in a collision, or has had a major fire on board.

Incident

An incident means any occurrence, other than an accident, that is associated with the operation of a ship and affects or could affect the safety of operation.

Mishap

A mishap means an event that:

- causes any person to be harmed; *or*
- in different circumstances, might have caused any person to be harmed.

Serious harm

Serious harm means:

- death *or*
- any of the following conditions that amounts to or results in permanent loss of bodily function, *or* temporary severe loss of bodily function:
 - respiratory disease
 - noise induced hearing loss
 - neurological disease
 - cancer
 - dermatological disease
 - communicable disease
 - musculoskeletal disease
 - illness caused by exposure to infected material
 - decompression sickness
 - poisoning
 - vision impairment
 - chemical or hot metal burn of eye
 - penetrating wound of eye
 - bone fracture
 - laceration
 - crushing
 - amputation of body part - including part of a finger
 - burns requiring referral to a specialist registered medical practitioner or specialist outpatient clinic
 - loss of consciousness from lack of oxygen
 - loss of consciousness, or acute illness requiring treatment by a registered medical practitioner, from absorption, inhalation or ingestion, of any substance
 - any harm that causes that person to be hospitalised for a period of 48 hours or more commencing within 7 days of the harm's occurrence

Harm

Harm means - Illness, injury *or* both.

TYPES OF MARITIME ACCIDENTS

1. Offshore Oil Rig Mishaps:

Offshore oil rigs constitute great danger in terms of their heavy machinery and the complexities of the processes involved. Even a minor error by way of negligence of a simple process or overlooking in the working of a machinery part can lead to immense damaging consequences across the world.

2. Cruise Vessel Mishaps:

Cruise vessels form a very important part in the vacation itinerary of people. However, a major type of maritime accident occurs in cruise vessels. Cruise vessels could capsize or face tough weather conditions causing the ship to develop major problems. Another important case of accidents in cruise ships is because of the negligence on the part of workers. As per statistical data nearly 75% of fires are caused because of a mere mistake by people working on the cruise ship.

3. Commercial Fishing Mishaps:

Even fishing for commercial purposes can lead to fatal incidents being caused. Inexperienced fishermen – sometimes even experienced ones – can fall overboard. Harsh weather conditions can also could severe damages to a commercial fishing expedition.

4. Accidents on Tugboats:

Tugboats are those which help move huge ships to enter docks. They are small in nature but are powerful to ensure that the large vessels are handled safely. But sometimes because of the blockage of the visibility of tugboats by the larger vessels, maritime accidents occur. Also human error on the part of the pilot of the tugboat can also lead to unwanted and unexpected tugboat mishaps.

5. Maritime Accident because of Drugs and alcohol:

Drug or substance abuse is a major problem across the world. Even in the marine world, substance abuse can cause irreparable damage. If the workers of a particular ship engage in substance abuse or alcohol, the addiction-induced frenzy could cause the worker to behave erratically and thereby lead to an unwanted maritime accident on board ships.

6. Crane Mishaps:

Just like crane operations on the land, marine crane operations on ports and on ship are also risky. The risk is further stressed because of the oceanic operations where the cranes are required. Because of faulty wires or winches, crane workers can lose their life or in a worst case scenario, be alive but with irreparable physical handicap. Alternatively, accidents because of crane operations are also caused because of negligence and inexperience on the part of the worker.

7. Accidents in Shipyards:

The shipyard is the place where the ship is assembled and constructed in its entirety. Fitting and welding accidents are common in the shipyard which could spare the worker his life but hamper the worker's overall working abilities. Similarly constant inhaling of poisonous fumes also becomes another shipyard accident cause.

8. Maritime Accidents on Diving Support Vessels:

People who want to explore the mysteries of the deep sea use a diving support craft to take a plunge into the water. However if the diving support craft is unfit and if the crew also happens to be really unfit to oversee and manoeuvre the whole operation effectively, a major accident can be caused.

9. Accidents on Barges:

Barge mishaps occur mainly because of the overall build of the barges themselves, which allows them limited movement on the water and because of the problems of the barge-towing equipments. These problems could be caused due to inexperience on the part of the person at the helm of the towing boats or due to usage of faulty towing cables.

10. Cargo Hauling Accidents:

Cargo hauling maritime accidents are those accidents caused to workers who work as cargo haulers. However, according to several maritime accident investigations, it has been reported that cargo hauling workers overstate their cargo-hauling injuries. The maritime accident investigation, consequentially reports that because of this, this profession has one of the most severe rate of work-place absenteeism.

ACCIDENTS ON DECK

Deck is one of the major accident prone areas onboard as deck operations involve numerous risks and dangers that can easily make way to an accident.

The best way to avoid such ill-fated accidents is to be completely aware of one's personal safety and to enhance and maintain a good safety culture onboard.

Given below are 7 most common types of accidents that occur during deck operations:

1. Slips and Falls

Slips and falls are one of the most common accidents that occur on ship's deck. Slips can easily take place at any moment and likely during an activity on deck. Falls are most common while working on heights such as on masts, lashing bridges, hatch covers, cargo holds and working aloft or outboard.



These accidents are not as silly as they sound, as slips and falls cause injuries ranging from severe physical damage to fatality. The main reasons for slips and falls are:-

- Slippery deck
- Improper use of catwalks
- Missing grating, railings and stanchions
- Missing warning signs
- Improper personal protective equipment (PPEs) especially safety shoes and safety harness
- Lack of situational awareness
- Lack of awareness of the job
- Absence of safe job analysis

They can be best avoided by :

- Cleaning up after work and maintaining the deck free from oil and other slippery substances
- Follow designated catwalks and correct passages on main deck and avoid shortcuts

- Using proper non-skid safety shoes on deck and use of safety harness while working on heights
- Safety and situational awareness
- Analyzing the hazards and risks that are associated with the job, and understanding the nature of possible accidents prior commencing the job

2. Improper Manual Lifting



Lifting things is something we carry out regularly on ships. Improper lifting techniques are the main reason for accidents and injuries, especially those related to back.

“The correct method of lifting up a load is to squat down to the load and keep the back as perpendicular to the ground as you can, and to use the leg and arm muscles to lift up instead of the back muscles.”

While carrying out lifting, the following points are to be noted to avoid accidents.

- Load should not be too heavy and to be evenly distributed. If not, ask help and avoid lifting alone
- Any sharp edges are to be noticed and avoided
- Take small steps while walking with the load
- Find places to stop and rest in between
- Make sure the load is not disturbing a clear vision ahead
- Use feet to change direction, avoid twisting the body
- When unloading, bend knees to keep the load down instead of bending the back

3. Compressed Air Accidents

Compressed air is used on deck for various pneumatic power tools and cleaning purposes. There have been several accidents in the past where compressed air has led to serious injuries.

Therefore, it should be treated and used with utmost care as jet of compressed air/gas applied to an open cut or wound may force its way into the blood stream and can kill a person. While using compressed air/gas, keep in mind the following:-

- Never blow compressed air towards a person. It can cause serious injury
- Do not use a jet of compressed air to dust down any clothing/boiler suits. It never helps to get cleaned up and the dust will blow and pierce into the cloth
- Ensure air/gas cylinders should always be secured in vertical position away from hot area
- While using compressed air through pipelines and hoses, after the use always, make sure to depressurize the line

4. Exposure to Chemicals

Exposure to chemicals is another common accident that occur while working on deck. Chemicals coming in direct contact with the skin leads to burns and serious injuries.

Constant exposure and contact to chemicals such as paints, thinners, metal brite should be avoided. Chemical contact with eyes is extremely dangerous and can lead to loosing partial/complete eye sight.

While working and handling with such chemicals, the person should be dressed in proper PPE including safety goggles and face masks.

Any accident should be immediately reported to the Medical officer. The nearest emergency eye wash stations should also be noted.

5. Electrical Accidents

Electrical equipment are used on deck for a wide variety of purposes. Without taking precautions of the electrical hazards, a shock from a live wire or tool or machine with poor insulation can cause fatal damage.

Electricity can also burn the body from electric arcs, flashes and fires when having contact with overheated electrical equipment. Always ensure the following:-

- There should be no frayed or damaged contacts
- If needed, the equipment should be isolated
- Keep wires and leads away from any heat sources and conductive liquids
- Do not have wires lying across floors to create a trip hazard
- Use proper PPE as always

6. Crane and Lifting Gear Accidents

Crane and lifting operations also involve a high percentage of accident on ships deck. There have been several dangerous incidents associated with crane and lifting gear operations in the past



Therefore, it should be noted that,

- Cranes should be operated only by authorized trained persons such as certified seaman
- When operating persons involved in the operation shall stay clear from the crane and the suspended load
- The standard signaling system and walkie-talkie radios shall be used to communicate with the crane operator. The persons involved should be aware of these signals
- Slings, hooks, and chains used should be approved and certified
- Safe Working Load (SWL) of the lifting gears must be compared to the load to be lifted

7. Deck Tools and Machinery Accidents

Accidents such as cuts, wounds, and burns normally occur while using various tools and machinery on deck. The degree of impact increases for the accidents occurred during the use of Pneumatic or hydraulic powered tools. Tools used for drilling, surface preparation and grinding such as jet-chisel and pneumatic wire brushes should be used with extreme caution.

- Use the designated tool intended to use for the specific job
- Never use a defective tool
- Always ensure the condition of the tool
- Proper PPE must be worn
- While using rotary equipments and power tools, refrain from wearing loose clothes and jewelry and accessories

ENGINE ROOM ACCIDENTS

The ship's engine room is the home to a variety of machinery and systems, which work together to move the ship from one port to another. Engine room professionals have to continuously work amidst such high temperature and pressure systems, which make an extremely hostile working environment.

In spite of taking all the precautions and safety measures while handling engine room machinery systems, accidents are bound to take place in the ship's engine room. Many of these accidents are extremely dangerous not only to the ship's property but also to the lives of seafarers. Mentioned below are ten such types of extremely dangerous engine room accidents that occur in ship's engine room.

1. Crankcase Explosion of Ship's Engine

Explosion of ship's crankcase is one of the most dangerous accidents in the ship's engine room which has led to devastating consequences, including loss of lives in the past.

In the engine crankcase, oil particles are churned into smaller particles of up to 200 micro meters in diameter. These small particles cannot ignite readily even with some naked flame. However, if a hot spot comes in contact with these small particles, it reduces the size of the particles, resulting in the formation of mist, which can be readily ignited with a hot spot.

In the crankcase, all the three elements required for fire are available – lubricating oil (fuel source), air, and heat from a hot spot. Coming together of all these three elements can lead to a major explosion that will not only damage the engine but also take lives of crew members.



2. Over-Speeding of Generators

This kind of accidents though rare have occurred in the past, causing heavy damage and loss of lives. When the ship's generator starts, there are high chances of it to over-speed. If this occurs and the over-speed trip fails to work properly, the high RPM of the generator leads to failure of internal parts. When such situation goes out of control, the internal parts such as crank shaft, connecting rod, nut-bolts etc. become loose, get detached, and are thrown away because of the high speed. If crew members do not evacuate the surrounding place in time, the loose parts can severely harm the crew members.

3. Boiler explosion

Everyone working on ships has heard about boiler explosion as one of the most deadly accidents in the ship's engine room. A highly pressurized equipment on board ships, boiler has been attached to different kind of accidents as a result of mistakes while operating them. Boiler explosion is one such dangerous accident which is caused because of the following reasons:

- Fuel dripping inside the furnace of the boiler. If the dripping is more and the boiler is fired after an interval, it can lead to blowback and even explosion.
- Misfiring
- Overheating of boiler due to loss of water circulation
- No pre and post purging
- Exhaust gas boiler fire



4. Compressor Airline Explosion

Air compressor on ships is also a highly pressurized equipment that can cause deadly accidents. Compressor's airline explosion is one accident everyone is afraid of. Such explosions usually occurs when during maintenance, the discharge air valve in the line is closed. There is also a common practice among seafarers to shut the discharge valve of the air compressor to minimize air leakage. But when this discharge valve is not opened again while starting the compressor and if the relief valves fail to operate, the airline gets over-pressurized and explodes.



5. High Pressure Fuel Line Bursting

All high pressurized lines and equipment on board ships are accident prone. The high temperature and pressure fuel line which supplies fuel to the combustion chamber of marine engines can explode if proper maintenance is not carried out. Also, if the lines are not adequately secured, they can burst due to continuous vibrations and friction. Fuel line bursting leads to severe burns, injury and even death of seafarers.

As per regulations, all high pressurized pipes must be jacketed type to avoid chances of fuel leakages and sprays from the pipe joints.

6. High Pressure Steam Leakages

High pressurized steam lines are present in several parts of the ship's engine room. These high temperature steam lines when burst or crack, lead to leakage of steam at extremely high pressure. Steam burns are extremely dangerous and can even cause instant death. Accidents due to steam leakages can occur because of following reasons:

- Failure of steam joints
- Steam burns or scalding from opening of boiler mounting valves if not properly isolated or de-pressurized
- Steam line bursting due to failure of material or crack from vibration or if not properly secured

7. Hydraulic High Pressure Components Bursting

Hydraulic high pressure equipment tools are used during overhauling of ship's machinery and other important systems. If these high pressure systems are not properly tested before use, it can lead to bursting of their high pressurized parts and causing serious injury to the ship's crew operating them. Some of the major types of hydraulic high pressure accidents are:

- Hydraulic jack oil seal leakage
- Hydraulic jack oil pipe fracture resulting in high pressure jet of oil
- Loose or worn-out connection between jack and pipe causing snapping of pipe which can harm the user

8. Turbo Charger Explosion

Turbo charger explosion on ships is caused when turbochargers are not cleaned for a long time. When the parts of turbo charger are not cleaned properly, the carbon deposits do not allow the parts to cool down properly. As a result, when the oil gets into the exhaust side of the turbo charger through the cracks, the heated parts and fuel source form the perfect combination of an explosion.

9. Electrical Shocks

Equipment and cables carrying high electrical power are extremely dangerous for people working on ships. If any kind of maintenance is carried out on such systems without isolating them properly, then there are high chances of getting electrical shocks. Moreover, accidental starting of electrical equipment during maintenance has also been a serious cause of seafarers deaths in the past. Electrical shocks frequently occur on board ships and therefore adequate precautions must be taken to prevent them.



10. Accidental CO2 Release

CO2 system is used to release CO2 in the ship's engine room during fire emergencies only after all the crew has left the engine room. But accidental release of CO2, when the crew members are still present in the engine room, would lead to instant and tragic death of all. Cases of accidental CO2 release in the ship's engine room has caused several deaths in the past.

MAJOR ACCIDENTS AT SEA

Collision

Ship collision is the name given to the physical impact that occurs between two ships resulting in a damaging accident. This particular collision can also occur between a ship and a stable or a floating structure like an offshore drilling platform or an ice berg or even a port.

In majority of such cases the impact is devastating to say the least. The damage that such an accident causes cannot just be measured in terms of costing or money, in fact it goes beyond that. With the increase in the traffic on the high seas and the technological advancements in the marine engineering resulting in the development of heavy and huge ships with great speed, the risk of such accidents has increased a lot.

When a ship collision occurs it has immeasurable consequences. Firstly, the loss of life is always an irreparable damage and something that can never be compensated for. Unfortunately the possibilities of loss of life in such cases are very high. Secondly, the environmental impact is very negative especially if any one of the vessels in the collision happens to carry any chemicals or any other harmful material that could be dangerous for marine life.



An oil tanker is a very good example of this and the world has seen many accidents involving a tanker. The oil spills not only create a biological crisis but also remains damaging for a very long time thereby resulting in financial losses to the tune of millions of dollars. In such cases the communities residing in the coastal area near the site of the ship collision suffer the most.

The next big sufferers are obviously the owners of the ships or those who had some financial stakes in the two or any one of the vessels. Although there are laws that govern the calculation of the damage and the subsequent penalty, in any case the loss plus the financial penalty if any is a huge setback to the owners. And finally, the damage to the infrastructure is also something that has to be taken into consideration.

Although in terms of the overall impact it is considered to be the least important at that point of time but a little later when the dust settles on the issue, the true extent of the loss is calculated and the infrastructure is in no way any less, especially if the ship collision occurred at any stable structure like the harbor or the offshore platforms etc.

The causes of any ship collision are numbered. It could occur due to a blatant human error, be it an error in judgment or navigation or both. In fact in most cases this is the root-cause. In addition to this any technical malfunction or mechanical failure of the system or machinery like the propulsion unit can also be a genuine cause. And last but not the least an act of sabotage can also not be ruled out although this has not been the case in the majority of the cases thus far.

Fire / Explosion

To start a fire a source of ignition, combustible material and air is needed. In most engine room fires this translates to a non-insulated hot area, a leakage of oil and the air in the engine room. In cargo spaces it can translate into a cigarette, cargo and abundant air. The variations to start a fire are many, but with a fire preventive attitude and training in accordance to procedures the risk is minimised.

Facts and Findings

- In 7 out of 10 cases fires occur when the vessel is on passage at sea.
- Only in one tenth of the cases studied, the fire occurred during shipyard or drydock operations.
- Most fires start in the engine room and are, in 7 out of 10 cases, caused by fuel oil leakage or short circuit of electrical equipment.
- One third of the fires originate from cargo spaces.



Preventive measures

Machinery spaces

- Keep a high general standard of cleanliness in the machinery spaces.
- Ascertain that there is no hazardous leakage of oil in the machinery spaces.
- All pipes and fittings should be routinely checked.
- All repairs that are carried out to oil pipes and fittings should be of a permanent nature.
- All high-pressure fuel oil pipes should be properly shielded.
- Ensure that insulation/lagging covers all hot surfaces.
- Ensure that all readily combustible materials are stored away only in designated areas.
- Regularly test that the quick-closing valves are functioning.
- The fire dampers must be functioning and regularly tested.

Contactors and connections in electrical installations should be regularly checked. All repairs of electric equipment to be performed or supervised by qualified personnel. Test that the engine room fire alarm is working properly and be sure that the crew is well aware of the fire fighting and emergency procedures.

The risk of fires on board vessels is fortunately not very common as we can see from the statistics, but when fire does break out the consequences can be severe, and this can lead to tragic outcomes such as loss of life and also large cargo claims. The risk of a fire happening is something every seafarer is aware of and trained to respond to. When at sea there is no fire brigade that can assist and it is only the knowledge of the crew and the equipment on board that will protect the vessel and crew from disaster.

Engine room fires:

Prevention is best achieved by preventing any leak in the first place and is best served by ensuring that engineers and oilers are properly trained and supervised when undertaking their work and that work is checked on completion. This good maintenance practice should, of course, extend to work being carried out on all heat producing equipment in the engine room. Boilers and incinerators, for example, also have that dangerous mix of available fuel and a good ignition source.

Electrical fires:

Engine room training, supervision and checking protocols can help reduce the likelihood of a fire occurring, and if the latter, properly planned maintenance and monitoring, including the use of thermal imaging, can identify developing faults before they become too serious.

Hot work:

In many cases this combustible material is waste, such as rags (oily or otherwise). As these can be readily ignited by even relatively weak sources of ignition, such as a lit cigarette butt, it goes without saying that good housekeeping in an engine room is an essential.

Fortunately, most fires are similar in nature and are preventable. The most common areas where fires occur are engine rooms, accommodation blocks and in cargo, which I shall mention in turn.

1. ENGINE ROOM FIRES

By far the most common cause of fires in engine rooms is fuel spray igniting on a hot surface. Oil spray often occurs at purifiers, main engines and, in my experience, and most commonly, at auxiliary engines. The fuel spray can be heavy fuel oil, diesel or lubricating oil. Although fuel lines and couplings can fail spontaneously, it is more common that the leak occurs shortly after maintenance has been carried out, or while being carried out. This can range from simply turning a three-way valve on a fuel filter the wrong way, at the wrong time, to over-tightening or under-tightening nuts or physically damaging pipelines.

Spray from engine room equipment can be at relatively high pressures and can spray many metres from the source of the leak. Almost invariably there is a hot exhaust or some other hot surface nearby. Typically, these can be at a temperature greater than the auto ignition temperature of the sprayed liquid, resulting in a fire.

There is a SOLAS requirement for exhaust systems and other surfaces to be adequately shielded, but this is predominantly a matter of preventing injury and in practice it is difficult to make coverings around exhausts and turbochargers liquid tight when subjected to prolonged exposure to large quantities of liquid. Moreover, fine mists of hot liquid fuels can be ignited by other sources, such as sparks or hot surfaces in electrical equipment. Hence, prevention is best directed to not having the leak in the first place and is best served by ensuring that the engineers and oilers are properly trained and supervised when undertaking their work and that work is checked on completion.

This good maintenance practice should, of course, extend to work being carried out on all heat producing equipment in the engine room. Boilers and incinerators, for example, also have that heady mix of available fuel and a good ignition source.

Electrical fire

The presence of electrical panels and equipment in engine rooms means that, on occasion, electrical fires can occur. In our experience, these are mercifully rare. Sometimes they are the result of repair and maintenance work being carried out and sometimes a consequence of component failure. If the former, the same engine room training, supervision and checking protocols can help reduce the likelihood of a fire occurring, and if the latter, proper planned maintenance and monitoring, including the use of thermal imaging, can identify developing faults before they become too serious.

Hot work

Hot work is a potent source of ignition, be it welding, cutting or grinding. Where possible, the work piece should be taken to a safe area for working on, but in cases where this is not possible, care needs to be taken that combustible material in and around the work area is removed or shielded. In many cases this combustible material is waste, such as rags, oily or otherwise. As these can be readily ignited by even relatively weak sources of ignition, such as a lit cigarette butt, it goes without saying that good housekeeping in an engine room is always not only preferable, it is a must.

Checking equipment

Most owners have implemented the International Ship Management (ISM) Code on their vessels. This provides a good basis on which to monitor maintenance checking of equipment. But beware, the checks need checking as we know of cases where the paperwork sent to the office has the requisite box ticked but the actual repair, on say a fuel system, was deferred because the engineers were “a bit busy” just then.

2. ACCOMMODATION FIRES

Accommodation fires are generally similar to those found in any dwelling and are most commonly the result of either an electrical fault, or human factor, whether accidental or deliberate. Accidental human factor fires are usually caused by the careless disposal of smokers’ materials but can also be the result of any facet of being human, like leaving fat filled pans on galley stoves, leaving combustible materials too near heaters.

Deliberate fires are typically the result of ill will amongst the crew or a disaffected crewman. Good housekeeping, checks on equipment in cabins and a watchful eye on the wellbeing of the crew are the best ways of preventing such fires.

3. CARGO FIRES

A master has some measure of control over the loading of bulk cargo and can take steps to prevent any fires. The most common causes of fire in agricultural and general product cargoes are the careless disposal of smokers' materials, often by stevedores who are notorious for both open and clandestine smoking, cargo lights being left on, and problems with fumigants.

Self-heating

In some cases self-heating can lead to a fire, but this is relatively uncommon. Vigilance and good working practices when loading are the key to fire prevention of these cargoes; these should extend to any hot work carried out in the way of part filled or full cargo holds.

Self-heating in cargo such as coal, can potentially lead to a fire. By far the most effective means of preventing such fires is to rigorously adhere to the requirements of the International Maritime Solid Bulk Cargoes Code (IMSBC) during and after loading.

Containerised cargo

Regrettably, there is much less that a master can do in relation to containerised cargo. Misdeclaration of a container's contents is very common and, of course, the ones misdeclared are often the ones most likely to cause a problem. It is often the case that a master is given only the Dangerous Goods Manifest and, in any event, it is unreasonable to expect him to review and verify the declared contents of every container on the vessel.

In practice there is little more a master can do other than ensure that those dangerous goods he does know about are carried in accordance with the International Maritime Dangerous Goods (IMDG) Code and that proper checks of the containers are carried out during the voyage.

Oil and chemical tankers

These present their own challenges, as many of the cargoes are flammable and hence liable to fires and explosions. It is no secret that the greatest risks are when loading and unloading, as it is then that there is the greatest likelihood of there being spillage of liquid or vapours from the cargo or there being a flammable mixture of cargo

vapours in the tanks, equipment running and crewmen working on deck. Sources of ignition include running motors and pumps that can provide both electrical and mechanical sparks and heating, static electricity, mechanical sparks as a result of dropped tools or inappropriate footwear and the use of unauthorised or damaged equipment, in one case this being a cigarette lighter used to ‘cut’ a nylon rope!

Tank cleaning

Cleaning crude oil tanks, especially if being carried out manually, presents its own risks, as there is a potential for ignition by static electricity during water hose washing, steaming, mechanical sparks or the use of inappropriate lighting.

Preventative measures against fires

The occurrence of fires and explosions in tankers can be greatly reduced by following the International Safety Guide for Tankers & Terminals (ISGOTT) but, as with all fires, proper maintenance of equipment and ensuring safe working practices go a long way to preventing incidents. In short, it is not possible to prevent fires on vessels entirely; some events are beyond a Master’s control. Nevertheless, most fires are preventable by means that are well understood and can be summarised as good working practice.

- Ensure that the engineers and oilers are properly trained and supervised when undertaking their work and that work is checked on completion so that any problems can be detected and rectified.
- Carry out proper planned maintenance and monitoring, including the use of thermal imaging, in order to identify developing faults before they become too serious.
- During hot work ensure no combustible material is around the work area or that it is shielded.
- Keep good housekeeping in the engine room, no waste or rags.
- Carry out inspections to ensure there is good housekeeping in the accommodation and especially galley. No pans with oils, no dangerous material in lockers or cabins.
- Carry out a two person check to ensure that the filled out checklist has been adhered to.
- Follow the IMDG and IMSBC Code rigorously.
- On a container vessel the Master should ensure that those dangerous goods he does know about are carried in accordance with the IMDG Code and that proper checks of the containers are carried out during the voyage.

- Make sure there are no sources of ignition on open decks, such as running motors and pumps, that can provide both electrical and mechanical sparks and heating, static electricity, mechanical sparks as a result of dropped tools or inappropriate footwear and the use of unauthorised or damaged equipment.
- Ensure that the fire detection system is fully operational.

Grounding

Weakness in bridge organization is the main reason for grounding. Safe navigation requires effective command, control, communication and management. Insufficient voyage planning, overconfidence in pilot and communication problems with pilot can lead to dear occurrences. Loss of power and/or steering is naturally also a cause of grounding and is covered in the machinery section.



Facts & Findings

Most groundings occur due to:

- heavy weather conditions, such as strong tides, currents, winds and heavy rains,
- dragging of anchor,
- evasive actions to avoid collision,
- Navigational errors (not plotting position correctly and/or frequently enough).

Preventive measures

- The crew must understand the importance of adherence to the bridge management procedures.
- Passage planning should be made with detailed plans marking dangers and safe-water limits especially in coastal waters, pilotage areas and port approaches. Review weather, current and tide conditions.
- Position must always be verified through proper use of charts, radars and other position fixing devices as well as cross checking navigational information using available means. If possible bearings should be taken.

- Always keep updated official charts for area of voyage.
- Whilst at anchor, keep a 24h bridge watch and monitor the position of the vessel to detect dragging. Second anchor should be prepared and lowered to sea level for immediate use in case of emergency.
- The master is in command of the ship at all times and may delegate the conduct of the ship to a pilot if he finds him experienced and competent. The master should not hesitate to supervise, question or overrule the pilot's decision if any indications of problems arise.
- Master and pilot should agree on a pilotage passage plan and language to be used between ship, pilot and shore.
- The pilot should be presented a completed pilot-card. The vessels manoeuvring characteristics should also be communicated.
- Participation at the Maritime Resource Management (MRM) Course is recommended in order to foster positive attitudes, favouring good personal communication, excellence in leadership skills and compliance with operating procedures

Sinking & capsizing

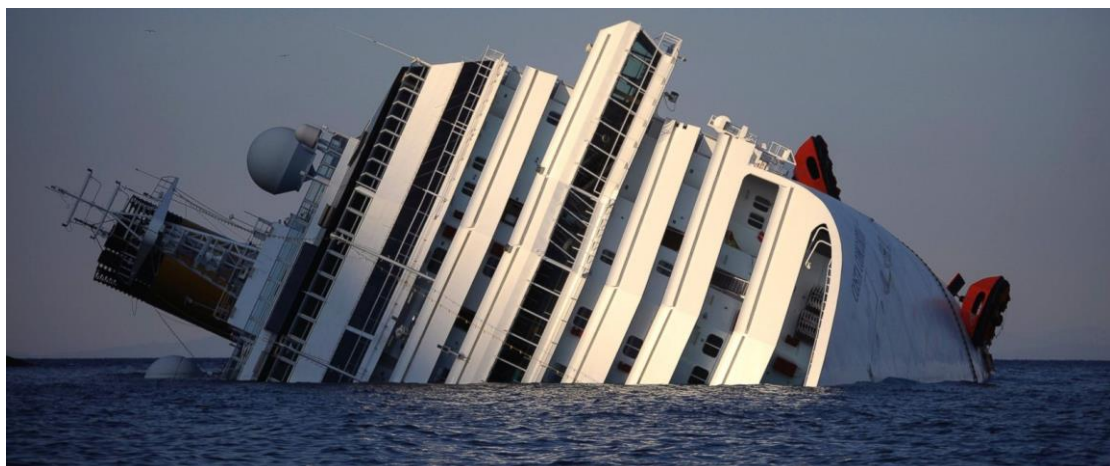
Sinking or capsizing are two of the worst case scenarios for anyone working in the maritime industry. If you work on any kind of ship in any waters you take risks every day. There are all kinds of hazards in this industry, but when a ship sinks or capsizes, the results can be devastating. These kinds of events lead to injuries, illness, and in the worst situations drownings and fatal hypothermia.

News stories about devastating accidents at sea prove that ships, even very large ones, can capsize and sink in the right conditions. It can be hard to believe that such well-engineered and massive vessels can fail so spectacularly, but they do and there are many reasons why this might happen. Unfortunately, in many cases the underlying cause is negligence. Many ship sinkings, and the resulting fatalities, could have been prevented.

- **Weather.** Bad weather is a major cause of capsized and sunken ships. Modern ships are much better at coping with storms and rough waters than ships of the past, but they are still vulnerable. The few cases in which a sinking is a complete accident, weather is often to blame. Even when bad weather is the cause, a capsizing can be sometimes be prevented. Storm tracking and navigation should allow captains to change course to avoid hazardous situations. Even so, some ships get caught in rough waters and high winds and lose control.

- **Collisions and running aground.** Collisions with other ships, docks, bridges, rocks and reefs, and with the ground in shallow waters represent another common cause of a ship capsizing and sinking. Navigation and piloting should be able to avoid these errors, but sometimes accidents happen, especially in crowded harbors. A collision can rip a hole in the hull of a ship and cause it to sink quickly.
- **Human error.** A captain guiding a ship has a heavy responsibility and any error he or she makes could cause the ship to sink. A captain sometimes has to make quick decisions, and when those decisions prove to be wrong, the result can be disastrous.
- **Flooding.** When a ship takes on water, it becomes less buoyant and it may start to take on more water as a result. The effect is a chain of events that often leads to a sunken or capsized ship. Flooding may occur because of bad weather, but also because of a leak in the ship or from a collision with an object.
- **Shifting cargo.** When cargo isn't stored correctly it may shift around below decks on a ship. This shifting can cause all kinds of safety problems, including falling objects that injure workers. In some rarer instances, shifting cargo can upset the balance of a ship and cause it to roll. When this effect is extreme it may even cause the ship to take on water, capsize, and sink.

It is possible that these causes of a sinking ship can be purely accidental. Bad weather, poor visibility, or a judgment call that seemed prudent at the time can all lead to sinking. On the other hand, many of these accidents can be avoided with precautions. For instance, human error can be nearly eliminated with proper training of workers. Collisions can be avoided in most situations when navigation is done correctly. Shifting cargo should not be a problem if it is stored and secured correctly. Flooding caused by leaks can also be avoided when ships are maintained and repaired regularly.



Flooding

Ship Flooding Emergency Procedures is a very important part of a ships emergency literature. It is available at all areas of the ship from the deck to the engine room, it is there everywhere. This is to ensure that all the crew members in the ship know their roles and what is expected out of them when they are on duty.

This ensures that in times of emergency the least number of casualties happen. A ship floats in sea water so it is quite possible that the sea water enters the ship and causes damage to it. When the ship is flooded with sea water it might drown and cause a lot of loss of life and property. When there is a sudden flow of water into a ship then it is quite important that the source of the flow of this water is ceased.

The Ship Flooding Emergency Procedures clearly states that when is it that the ship might get flooded with water. Well the reasons can be many. The first one is collision. When to ships collide then the hull of the ship might get damaged as a result it can let water gush in. Nowadays the water tight bulk heads are used right up to the level of the main deck. This ensures that overflowing of water does not happen easily. In the olden days this was a very important reason for many ship accidents. The crude oil tankers have hulls that are double skinned this ensures that very little or no oil leaks out in case of collision. This ensures less pollution too.

Collision with ice bergs can also lead to huge damage to the hull of the ship and lead to flooding eventually. The modern hulls as already explained above are designed in such a way that they will not let any water get in easily. However, the experts believe that regular check must be done by the watch keepers. The gauges cannot be relied on completely as by the time they show signs the damage must have been done already. Another very common reason for flooding of a ship is hurricane or storms that we have no control on.

The best way to avoid this situation is to batten down the hatches. Changing the course to avoid the storm can also be a good idea. Reducing the engine speed can also avoid flooding and sinking. In the past many ships have been lost to storms and hurricanes as we have no control over the forces of nature. However, these points that are mentioned in the Ship Flooding Emergency Procedures can definitely be of great help.

The Ship Flooding Emergency Procedures also states some more things that can be done in a bad weather. First compile the reports and inform the technical team who are trained to look into these situations, secondly closely monitor the weather conditions, practice damage control so that you can reduce damage to the crew and the vessel, you can also look at jettison of cargo to save the vessel, the last method is to use ballasts/deballast method to get the ship back on track.

The emergency and damage control team is a must in all the ships. They ensure that the crew members are safe in times of emergency and they help the crew members to work as a team at times of such crisis. They basically ensure that the ship operates fine even under situation of emergency. They also have a support team the gives first aids and prepare life boats.

If the engine room is flooded then the bilges must be controlled to ensure that the sea water does not enter the main power generators. The Ship Flooding Emergency Procedures also states that the bilge suctions should be opened and bilge pumps activated. If the water enters the main power room the situation will go out of control as the loss of main power and main engine will happen. It gives a detailed guide on how the bilge should be operated.

The most important factor is that the crew members must keep calm and work as a team. Ship Flooding Emergency Procedures are indeed a good source of information to survive a flooding ship.



MAIN REASONS OF MARITIME ACCIDENTS

Working in the maritime industry comes with many risks and dangers. Many times, accidents and injuries happen seemingly out of nowhere, leaving behind devastating results. There are several factors that contribute to maritime accidents, some more common than others.

Equipment Failure

Maritime equipment is usually well-designed and built to tolerate the stresses that all vessels undergo while navigating the world's oceans and waterways. However, it is also increasingly complex and contains a myriad of moving parts.

Many maritime accidents are caused by engine breakdowns, problems with electronic systems, and other types of equipment failure. Sometimes equipment failure is a result of natural phenomena such as bad weather or heavy seas, but in many instances, there are other causal factors that come into play.

Common causes of equipment failure include:

- Lack of proper and constant maintenance to prevent equipment failure
- Failure to monitor a ship's systems in order to ferret out potential problems before they occur
- Lack of the necessary equipment and/or protective parts or gear
- Breakdowns in operating procedures
- Breakdowns in communications procedures

Another major cause of equipment failure is a language barrier, especially when it comes to operating manuals. Per the Institute of Seatransport, even though ship design and building methods have improved over the years, there is a need for well-written and properly translated operating manuals. In many cases, the documentation that comes with maritime is generic and written in languages that many ships' crews can't read. This problem can be remedied by the use of readily-available translation software, but many shipping companies don't exercise this option.

Human Error

Maritime accidents that occur due to natural factors such as a ships being caught in an unexpected storm, unfavorable tides, strong winds etc. are totally beyond human control and also make up rather small part of the causes for maritime accidents.

The causes that top the list like collisions, fires, explosions, ships being lost, tanker accidents etc are all results of human errors in one way or the other. It is a rather amazing result of studies conducted looking into maritime accidents and their causes. These studies were aimed at finding out root causes of these accidents in a bid to improve maritime security. The results indicated that in most cases (almost 96%) the reason for maritime accidents was human error.



Human error can occur in many forms and can even lead to fatal situations. There have been reports of maritime accidents that have occurred solely due to human errors. From small fires that can lead to big explosions to full on collisions, the scale of accidents that can result from human errors is uncomfortably large. The classic example of this would be the grounding of Torrey Canyon that occurred in broad daylight with seemingly no reason to have met that fate. But it still did so, just because the captain decided to take an unconventional path.

The reason why human errors play such a vital role in marine industry despite of excessive mechanization and technical advancement is that even with everything, marine industry remains a people's industry. There are machines running on software programmed into a computer but you need a person on that computer to be looking into it. Error on part of that person means the entire chain reaction of errors is put into action ultimately leading to a not-so-good outcome. Even in case of a natural calamity, there is a human hand somewhere that faltered to some extent .May it be the environment or the technology or the entire system of a ship, it all comes down to their interaction with human element involved.

The extensive studies looking into human errors and their implications have categorized few reasons that mostly lead to a mistake somewhere, the top most reason being fatigue. The studies have revealed that in most cases, it is an overworked tired and somewhat disoriented crew that fails to make the right decision which maybe as small as pulling the correct lever.

Another of the top reasons for human error is insufficient communication. Where the crew fails to communicate effectively with each other, the risks of maritime accidents increase manifold. Another important reason for human error that is detrimental to marine industry as a whole is insufficient knowledge. High-tech gadgets around people who have not been provided with sufficient training to use them would be equivalent to nothing. This is a seemingly minor thing but ships have been sunk because someone couldn't operate the emergency alert system.

Other reasons include improper hazard management training, faulty managerial decision, insufficient knowledge, lack of maintenance of standards etc which result in a mistake being made somewhere. But whatever the reason maybe, the fact remains that there is a human hand in each major accident.

➤ **Fatigue**

Fatigue can be defined in many ways. However, it is generally described as a state of feeling tired, weary, or sleepy that results from prolonged mental or physical work, extended periods of anxiety, exposure to harsh environments, or loss of sleep. The result of fatigue is impaired performance and diminished alertness. The effects of fatigue are particularly dangerous in the shipping industry. The technical and specialised nature of this industry requires constant alertness and intense concentration from its workers. Fatigue is also dangerous because it affects everyone regardless of skill, knowledge and training. Fatigue is a problem for all 24-hour a day transportation modes and industries, the marine industry included. However, there are unique aspects of seafaring that separate the marine industry from the others. It must be recognized that the seafarer is a captive of his/her work environment.

Fatigue may be caused and/or made worse by one or a combination of the following:

- Lack of sleep
- Poor quality of sleep
- Insufficient rest time between work periods

- Poor quality of rest
- Stress
- Boring and repetitive work
- Noise or vibration
- Ship movement
- Food (timing, frequency, content and quality)
- Medical conditions and illnesses
- Ingesting chemicals
- Jet-lag
- Excessive work load

There are a number of steps that can be taken to prevent fatigue. Many of the measures that reduce fatigue are unfortunately beyond a single person's control, such as voyage scheduling, ship design, and work scheduling.

- Guidelines
- Sleep
- Rest
- Strategic Napping

➤ **Inadequate Communication**

As crew members of one ship can belong to various nationalities, they are bound to face certain difficulties in communication, in an environment where misconstruing a meaning can lead to accidents in the performance of various tasks on board ships. However, receiving a comprehensive education and training in cross cultural differences can help crew members reach a common ground of understanding, thus ensuring safer and effective ships. Addressing the problems of communication between multilingual and multicultural ship crew members, and studying the problems that may arise due to cross cultural differences are important aspects for consideration in any education programs.

➤ **Lack of general technical knowledge**

The main contributor to this category was a lack of knowledge of the proper use of technology, such as radar. Mariners often do not understand how the automation works or under what set of operating conditions it was designed to work effectively. The unfortunate result is that mariners sometimes make errors in using the equipment or depend on a piece of equipment when they should be getting information from alternate sources.

➤ **Inadequate knowledge of ship's system**

A frequent contributing factor to marine casualties is inadequate knowledge of own ship operations and equipment. Several studies and casualty reports have warned of the difficulties encountered by crews and pilots who are constantly working on ships of different sizes, with different equipment, and carrying different cargoes. A combination of better training, standardized equipment design, and an overhaul of the present method of assigning crew to ships can help solve this problem.

➤ **Automation Error**

Poor design pervades almost all shipboard automation, leading to collisions from misinterpretation of radar displays, oil spills from poorly designed overfill devices, and allisions due to poor design of bow thrusters. Poor equipment design was cited as a causal factor in one third of major marine casualties. The “fix” is relatively simple: equipment designers need to consider how a given piece of equipment will support the mariner's task and how that piece of equipment will fit into the entire equipment “suite” used by the mariner. Human factors engineering methods and principles are in routine use in other industries to ensure humancentered equipment design and evaluation.

➤ **Decision based on incomplete information**

Mariners are charged with making navigation decisions based on all available information. Too often, we have a tendency to rely on either a favored piece of equipment or our memory. Many casualties result from the failure to consult available information (such as that from a radar or an echo-sounder). In other cases, critical information may be lacking or incorrect, leading to navigation errors (for example, bridge supports often are not marked, or buoys may be off-station).

➤ **Faulty standards and procedures being followed**

This is an oft-cited category and covers a variety of problems. Included in this category is the lack of available, precise, written, and comprehensible operational procedures aboard ship (if something goes wrong, and if a well written manual is not immediately available, a correct and timely response is much less likely). Other problems in this category include management policies which encourage risk-taking (like pressure to meet schedules at all costs) and the lack of consistent traffic rules from port to port.

➤ **Poor maintenance**

Published reports and survey results expressed concern regarding the poor maintenance of ships. Poor maintenance can result in a dangerous work environment, lack of working backup systems, and crew fatigue from the need to make emergency repairs. Poor maintenance is also a leading cause of fires and explosions³

➤ **Hazardous Working Environment**

The marine environment is not a forgiving one. Currents, winds, and fog make for treacherous working conditions. When we fail to incorporate these factors into the design of our ships and equipment, and when we fail to adjust our operations based on hazardous environmental conditions, we are at greater risk for casualties

The window for human error is small if you consider it singly in the bigger picture but this single little window is where the sole of ship lies. Maritime industry depends on its manpower to keep it running smoothly. Hence, even seemingly minor errors by a single person can lead to a series of errors, something marine industry can definitely not afford. As such, it is important that implications of such minor things should be understood.

Under manning of ships, insufficient marine training, inadequate knowledge about entire technology present on this ship, lack of emergency drills are all the levers that can widen the window for human error. It is important that the implications of such errors should be understood right up to the management level of marine industry so that desired actions can be taken right from the top to the final leg.

➤ **Poor Maintenance**

Maritime vessels are essentially a collection of interlinked systems that must work together in order to operate and navigate safely on the water. Every part of a ship is essential, no matter if it's the ship's engines or a watertight hatch. Even the most solid pieces of a ship are affected by wear and tear, so sticking to a proper maintenance plan helps to prevent maritime accidents.

Many seamen have been injured or killed, and many vessels damaged or lost, as a result of poor maintenance. Trip and fall accidents occur frequently when loose or corroded metal ladders are not properly secured or replaced. Seamen have lost fingers and other body parts to malfunctioning watertight doors, and poorly maintained fuel lines have caused fatal shipboard fires. These maritime accidents were not inevitable. They could have been avoided if proper steps were taken to keep the vessels safe and seaworthy.

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