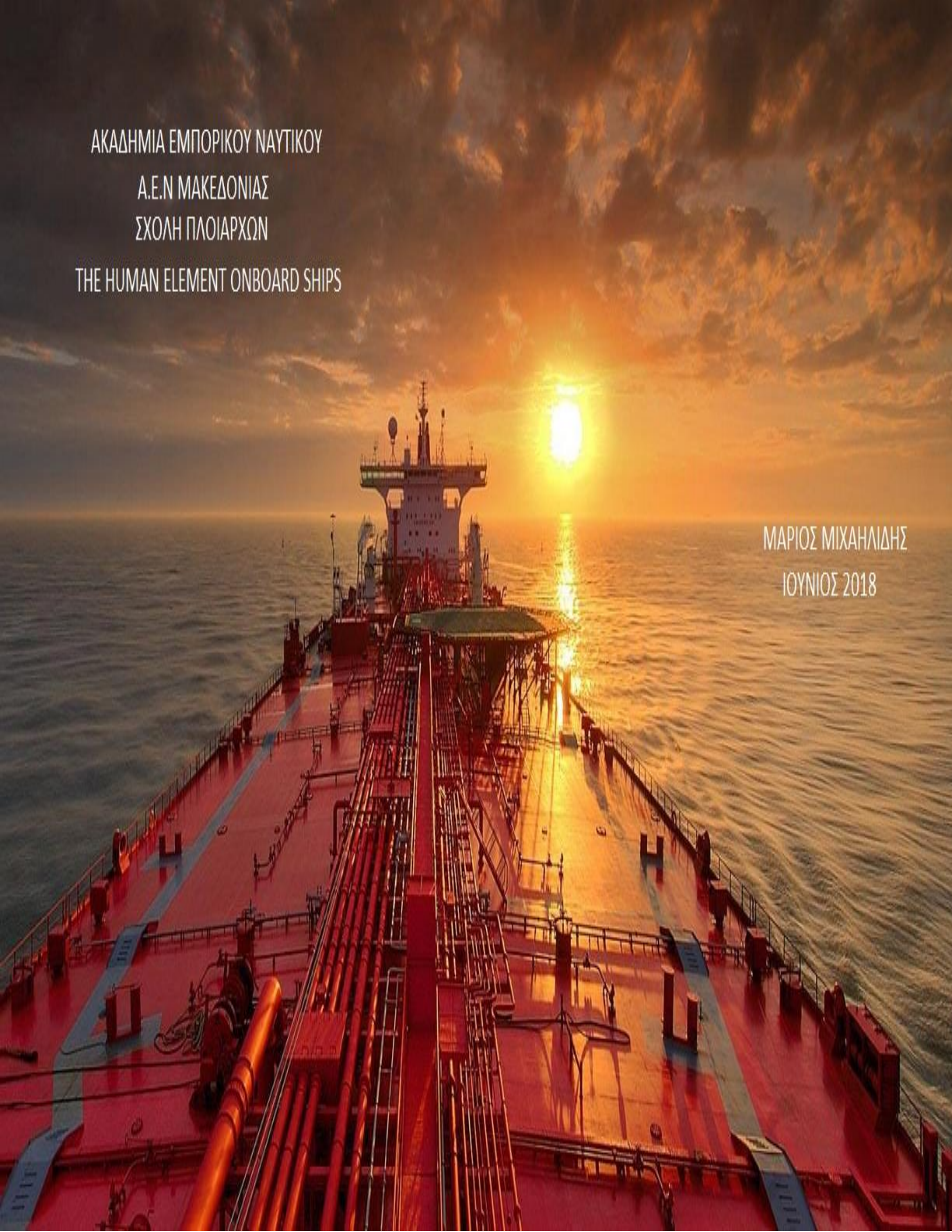

ΑΚΑΔΗΜΙΑ ΕΜΠΟΡΙΚΟΥ ΝΑΥΤΙΚΟΥ
Α.Ε.Ν ΜΑΚΕΔΟΝΙΑΣ
ΣΧΟΛΗ ΠΛΟΙΑΡΧΩΝ

THE HUMAN ELEMENT ONBOARD SHIPS

ΜΑΡΙΟΣ ΜΙΧΑΗΛΙΔΗΣ

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ΕΠΙΒΛΕΠΩΝ ΚΑΘΗΓΗΤΗΣ: ΠΑΠΑΛΕΩΝΙΔΑ ΠΑΡΑΣΚΕΥΗ

ΘΕΜΑ: The Human Element on Board Ship

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<u>Ο ΔΙΕΥΘΥΝΤΗΣ ΣΧΟΛΗΣ</u>: ΤΣΟΥΛΗΣ ΝΙΚΟΛΑΟΣ

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ABSTRACT

This dissertation paper deals with the human element onboard ships and analyzes the factors that make human element the most important agent onboard. In the first chapter, definitions are given for the human relations onboard the vessel and are also some cases of miscommunication leading to misunderstanding and sometimes to accident. Next I describe the term human element on board and I emphasize to human errors and factors that affect them. Thereafter, I refer to maritime safety and the International Conventions that cover it. I also make reference to the maritime model that must be followed for a general safety culture onboard.

Finally, I try by providing with many cases and examples to define the important role of human being onboard ships. This is a guideline for the effective communication onboard ships, among different countries and cultures.

1. Human Relations on Board Ships

1.1 Human Relations

Relationships between employees and management are of substantial value in any workplace. Human relations is the process of training employees, addressing their needs, fostering a workplace culture and resolving conflicts between different employees or between employees and management. Understanding some of the ways that human relations can impact the costs, competitiveness and long-term economic sustainability of a business helps to underscore their importance.

Working Together

Human relations in the workplace are a major part of what makes a business work. Employees must frequently work together on projects, communicate ideas and provide motivation to get things done. Without a stable and inviting workplace culture, difficult challenges can arise both in the logistics of managing employees and in the bottom line. Businesses with engaging workplaces and a well-trained workforce are more likely to retain and attract qualified employees, foster loyalty with customers and more quickly adapt to meet the needs of a changing marketplace.

Improving Retention

The quality of workplace relations is critical to employee retention. Employee retention may seem trivial — especially in a workplace that is used to a high turnover — but managers must remember that turnover is financially very costly. Every new employee requires a substantial investment of time and energy in their recruitment and training. In addition, severing ties with old employees can sometimes be challenging, especially if the circumstances are not particularly amicable. Making sure quality employees remain interested and engaged in the business requires patience, compassion and flexibility, but can actually make the business more financially sound.

Motivation and Productivity

Workplace relationships provide a source of employee motivation, which is important to maintaining productivity. Employees who are interested in their work and in the well-being of other employees tend to be more productive than those who are not. This productivity pays obvious financial dividends to the company, as it can get more done in less time with fewer costs. Building relationships, by both recognizing an employee's value to the company and a concern for their needs, often goes a long way.

Human Relations On Board Vessel

Working on ships is also a “team effort”. A “one-man-show” cannot run the whole ship. In order to perform operations smoothly and safety on board ships, good interpersonal relationship among seafarers is a must.

As the number of people on board ships is limited, there are high chances of ego clashes and dissatisfaction among crew members. As important it is to avoid politics on ships, equally important it is to enhance interpersonal relationship between people on board to ensure that all jobs are done smoothly and safety.

Working on ships is not an easy task and dissatisfaction and demotivation can easily be developed among seafarers as a result of various kinds of stresses.

During such situation, it is the job of chief-engineer/chief officer/captain to get rid of discontentment among people on ship and instill the importance of interpersonal relationship.

Furthermore, the number of people working on board is limited, everyone should try to know each other in order to understand the values, knowledge and skills each one has. This is the first step towards developing interpersonal relationship on board ships.

However, chief engineer/captain/chief officer should take additional steps as mentioned below to ensure that all team members are comfortable with each other both on and off work.

1. Morning meetings (Tool box meeting):

The morning meeting, which is conducted to assign work to team members, is the best time to get all the crew members together. It is necessary that crew members talk to each other during such meetings and discuss their views and opinions.

Each member should be given a chance to provide suggestions regarding improvement of work process and safety precautions to be taken. This activity gives members a sense of responsibility and importance and also works a great deal in enhancing their performance and interpersonal relationship.

2. Tea-Breaks: Tea or coffee breaks if used efficiently can work wonders towards enhancing "team effort". It should be made compulsory to get all crew members together during tea breaks to discuss the work in progress and other important things that they feel are necessary.

3. On board training sessions: On board training session is yet another important opportunity to get crew members together to impart important working knowledge or conduct safety committee meetings. Captain and chief engineer should arrange the meeting in such a way that maximum crew members are able to participate.

4. Spending free time together: It is often seen that post working hours, officers and crew members spend time in their own rooms instead of getting together in officer or crew lounge. Watching movies and playing games in free time is a solid way to know each other and build great relationships both on and off work.

5. Arranging events/sports days: It is necessary to arrange recreational events or sports days which require crew members to participate in teams. This is a great way to inculcate the importance of team spirit and building interpersonal relationship among crew members.

6. Parties and Get-together: Everyone likes to party and unwind once in a while. Party is a great method to bond people together and improve scarred relationships on board ships. However, it is necessary that they are arranged in such a way that maximum crew is able to participate. Festival celebrations are also a great way to enhance interpersonal relationships between people onboard.

1.2. Relations between Persons

Relation between Captain and Deck Officers

"Master" or "Captain" is the commander of the ship. He is reliable to represent the Owner's opinion. Deck Officers, especially Chief Mate, 2nd Mate, 3rd Mate are assistants of captain in the command of the vessel. They are all regulated within the STCW Convention. Seafarers in the deck department work a variety of jobs on a ship or vessel, but primarily they will carry out

the navigation of a vessel, from the bridge. However, they are usually also responsible for supervising and monitoring any maritime cargo handling onboard, as well as ensuring maintenance of the deck and upper hull structure, monitoring the stability of the ship including loading and discharging ballast water, carrying out mooring operations and finally anchoring a ship. This relation must be great, so there is no any missing information between them.
I will give an example of a situation, when the Officer on Watch did not keep his watch properly and his vessel collided with a barge.

Collision While Both OOWs Sitting In Their Chairs

A small oil bunker barge was loaded and underway. Manned only by the Master and a deckhand, the vessel was proceeding on autopilot at 9.5 knots with the Master on the bridge. He observed several AIS targets on the vessel's ECS display and noted the nearest CPA was predicted to be one nautical mile. He adjusted the autopilot to 350° and then left the bridge. Once on the stern deck he noticed a general cargo vessel approaching from astern but was neither surprised nor alarmed. Soon after, he returned to the bridge and sat on a chair on the port side of the wheelhouse.

Meanwhile, the general cargo vessel was approaching the barge's port side at a speed of 14.5 knots with the autopilot set to 034°. The OOW was sitting in the bridge chair on the starboard side of the bridge. There was good visibility and smooth seas.

After about eight minutes, with each OOW sitting in their respective chairs, the cargo vessel's bow struck the bunker barge's port side. The bunker barge was driven sideways and within seconds had heeled over 90º to starboard. Seawater rushed into its bridge, accommodation areas and engine room through the vessel's open watertight doors.

The Master escaped from the - flooded bridge through an open window; meanwhile, the deckhand, who was in the mess room, was fully submerged in seawater. About 15 seconds later the barge broke free, rolled back upright and passed down the cargo vessel's port side. As the barge came upright, the Master found himself clinging to the bridge roof. The deckhand was washed out of the mess room and over the ship's side as the - floodwater rushed back out though the open door. He grabbed hold of the top edge of the bulwark to prevent himself being swept completely overboard. Soon the deckhand was able to climb back over the bulwark onto the vessel's upper deck.

The barge, in danger of sinking, was eventually towed to a nearby port.

By this case, we can understand that:

- A proper lookout was not being kept on either vessel.

- Complacency and poor Watchkeeping practices were systemic on board the cargo vessel. A lack of mentorship and direction from the vessel's Master contributed to this situation.
- Lone Watchkeeping was a normal practice for both vessels. The risks associated with this had not been properly assessed.
- The bunker barge's crew did not have the competence necessary to operate a small coastal tanker; the vessel was also not provided with an effective safety management system

We can say that captain's command constitutes a criminal offence. He should have ensured that the Officer on Watch was not alone on Watch, he should have checked the competence of his Mate and it is also his own carelessness that he was not aware of OOW's slackness.

Relation between Captain and Chief Engineer

In marine engineering, the chief engineer is a licensed mariner in charge of the engineering department on a merchant vessel.

A chief engineer (commonly referred to as"ChEng," "the Chief" or just "Chief") is responsible for all operations and maintenance that has to do with any and all engineering equipment throughout the entire ship.

Under many jurisdictions the chief engineer is of equal rank to the captain, with responsibility being split between the two posts; the chief engineer taking responsibility for engine room and maintenance, and the captain taking responsibility for navigation and deck operations.

I will refer to an incident that happened where the Chief Engineer hurt his finger.

Bent Bolt Squeezes Chief Engineer's Finger

In preparation for a maintenance job by an outside contractor, the chief engineer (CE) and an assisting crew member were to remove some stainless steel bolts and their associated 'nylock' nuts from a piece of deck equipment. Before starting the job, the CE conducted a toolbox talk on how they would proceed with the job.

The assisting crew member was holding the pneumatic rattle gun, which was attached to the bolt. The CE was attempting to locate the socket; he was kneeling down and could not see the location of the socket, so he was trying to line up and grip the 'nylock' nut by feel. Meanwhile, another job was being undertaken on deck nearby and may have caused some distraction.

As the CE was locating the nut using his fingers (without gloves) he apparently gave the signal to the crew member to activate the pneumatic rattle gun. The crew member squeezed the trigger and the moving bolt crushed the CE's finger against the recessed sleeve in which the nut and bolt were housed.

The subsequent investigation found that the bolt was bent, which was unknown to the crew performing the job. Had the bolt been straight the consequences would have been less severe or nonexistent.

We can learn many things from this accident like:

- The activity on the deck caused by another job being simultaneously undertaken could have been distracting, acting as a barrier to communication for the two men.
- The CE was not wearing gloves, which could have reduced the severity of the injury.
- Whenever possible use tools instead of fingers.
- Pneumatic tools reduce the need for manual labour and limit repetitive strain injuries. However they can also increase risks to the user and those around them due to the energy delivered. When using pneumatic tools or other energy storage devices, crew should be aware of the risks.

I would like to add, that there must be clear communication between the crew members so that there is no any barrier to distract their attention from the necessary safety considerations.

Relation between Deck Officers and Engine Officers

The deck officers on board any seagoing craft have responsibility for the smooth running of all matters above deck. While their colleagues in the engineering department have roles that pertain to ensuring the propulsion and inner working of the ship as a unit, deck officers are involved more with ensuring that anyone working above board can discharge their duties sufficiently.

A ship is successfully run by two different departments- Engine and Deck that work day and night to ensure that the ship delivers its cargo on time. Duties of officers and crew in each of these departments are of great importance and the ship cannot sail if a problem is faced by either of them.

One of the most common and important operations wherein the deck and engine departments come together is the ship's maneuvering. However, in order to ensure utmost safety of the ship, it is important that officers and crew members from each department shun their ego and maintain healthy communication not only during emergency situations but throughout all important ship operations.

Mentioned below are some of the most important situations on board wherein the engine and deck officers must communicate properly and inform each other about the situation.

1. Engine Room Machinery Abnormality: A machinery in the ship's engine room is bound to face problem when at sea. In case of breakdown of any machinery, the duty engineer must inform the bridge officer immediately without any delay. If problem occurs in the main engine, power generator or any associated machinery which can affect the voyage of the ship, the engineer must take all necessary steps and inform the bridge at the earliest.

2. Fire on ship: With implementation of advanced safety and automation systems, detection of fire on board ships has become quite efficient. In case of fire on the ship, the indication of affected location is displayed either on the bridge or in the fire station. In such condition, it is important that deck officer call the engine room to inform about the specific location of fire even after the fire alarm has been sounded. The same rule also applies to the engine officer, who must inform the bridge on how big is the fire and its condition after ringing the fire alarm. However, only informing is not important, it is necessary that all required steps are taken by the ship's crew to stop the fire and inform other department regarding the same.

3. Fog, Traffic or Other Manned Situation: Today, most of the ships have UMS engine room and the engine is controlled from the bridge. If any situation arises wherein the engine is to be slowed down and manned, the bridge officer must inform the duty engineer well in advance. These situation may include: Fog or weather warnings, Canal Crossing, High Traffic Areas, Under-Bridge Crossing etc.

4. Heavy Smoke/ Spark from the Funnel: If the ship's funnel is discharging abnormal black/ white smoke or there are sparks rising from the funnel, the deck officer on the bridge must inform the same to the engine room immediately as it may lead to uptake fire if ignored.

5. Internal Oil Transfer Operation: Any engine room internal oil transfer procedure must be pre-informed to the bridge officer as the transfer of oil from one tank to another may affect the current list/ trim of the ship. Also, an informed deck officer will keep a good overboard watch and revert back to the engine room immediately in case of oil leakage or spill.

6. Pumping Operation: Ballast pumps are high capacity pumps which are used to correct the list, trim or draught of the ship. They are also used in ports for cargo loading/ discharging. In order to save fuel, normally one generator is run at higher load when the ship is at port. Hence deck officer must inform the engine department before starting any pumps including ballast and fire pump as there might be a requirement to start one more generators to accommodate the power requirement.

7. Deck Machinery Operation: Before starting any deck machinery including bow thrusters and winches, the deck officer must inform the engine department so that engineers can check and ensure that the machinery is ready to start and the generator has enough accommodating power available. Also, in case of bow thruster (BT), hydraulic pumps and fans are to be started sequentially before the main operation, which the ship engineer will perform if informed well in advance.

8. OWS Operation: Nowadays, Oily Water Separator is an important ship machinery checked by all PSCs on every visit. It is important for marine engineers to inform the bridge and take position of the ship while starting and stopping the Oily Water Separator (OWS). Also, bridge officers are required to take a note of the same in the bridge log book. An over side check is also required by the bridge officer for any oil sheen in water once the OWS operation has started. Oil pollution from ships is a serious crime which includes huge fines and even imprisonment. OWS operation therefore requires clear and sound communication between officers from both the departments.

9. Manning / Un-manning the Engine Room: Engine officer on duty of a UMS ship must inform the bridge before turning on the unmanned mode and leaving the engine room. Engineer should inform about his visit and manned/unmanned situation every time he/she visits the engine room and switch on or switch off the dead man's alarm. This will help in informing the bridge officer of an engineer's presence in the machinery space. Also, in case of any mishap in the engine room or "no reply" of the dead man's alarm, the deck officer can assist and take immediate action.

10. Pilot/ PSC Onboard: It is the duty of the bridge officer to inform the engine room about the pilot boarding time or whenever any outside authority is about to visit the ship. This will give time to engine room staff to be ready for important situations and prevent any kind of ship delay.

I will now mention a case of miscommunication between Deck Officers and Engine Officers, and what the result was.

No Oil Mist Detector Means a Warning Too Late

An oil/chemical tanker was underway. In the early morning hours a main engine lube oil separator alarm sounded on the bridge and, due to the vessel being UMS [having an unmanned machinery space], in the chief engineer's cabin. The chief engineer called the bridge and informed the OOW that he was entering the engine room. He went to the purifier room and noticed the lube oil separator's discharge pressure was low. He adjusted the discharge pressure but immediately the separator's alarm activated again. On his way to the engine control room to acknowledge the alarm, the chief engineer saw there was now smoke in the engine room. He also noticed that the main engine turbocharger was surging and the main engine was hunting.

He called the bridge and told the OOW to put the engine pitch to zero. He then stopped the main engine by emergency stop. The vessel was blacked out for a short time before a diesel generator came on line. The chief engineer now saw that all the crank case relief valves of the main engine were opened.

Meanwhile, the Master had come on the bridge and the vessel's position, set and drift were verified and the anchors prepared for use. After about 10 hours drifting the vessel reached favourable depths for anchoring, and was anchored. Meanwhile, it was found that the main engine crankshaft had seized, so repair by ship's crew was not feasible. Shortly thereafter the vessel started to slowly drag anchor. The Master and company emergency response team agreed to use tug assistance to proceed to a repair facility. Later that day the tow operation was begun and the vessel brought to a port of refuge.

The company investigation found that a crankpin bearing had turned in place, thereby clogging the oil cooling hole and causing the subsequent cascading sequence of damage that culminated in the crankshaft seizure. The company had always followed engine manufacturer's maintenance recommendations and was using manufacturer's spare parts.

Due to size of the engine (less than 2250 kW), and in compliance with SOLAS, it was not fitted with a crankcase oil mist detector or engine bearing temperature monitors.

- Crankcase oil mist detectors or engine bearing temperature monitors are a very good investment even for smaller ships that are exempt from having them by international regulations; they can give an early warning of engine anomalies that, otherwise undetected, can cause serious damage.
- Planned maintenance should be at least as rigorous as manufacturer's recommendations. Consideration should be given to exceeding those recommendations in order to further reduce risks.

I would also like to add that the Master should have been informed of the defect of mist detector in the engine room. He should have order it and engineers must have placed it in time.

Relation between Captain and Ratings

In my opinion Captain is the leader of the vessel team. He must be kind, polite with the ratings and be interested in everything that happens to a member of his crew.

Working on ships with a very limited number of people is a difficult task, both physically and emotionally. Dealing with the same people everyday for months together within a confined space (not technically) can easily take a toll on seafarers.

Every profession is marred with politics, which leads to immense mental stress among professionals, greatly reducing the productivity. However, when such politics take place among seafarers on board ships, the results can be extremely dangerous.

This is mainly because a seafarer has to deal with the same people everyday irrespective of the number of differences he has with his fellow mates. He cannot get up one fine day and say "I Quit" (Though he can, technically he will have to provide a valid reason for the same, wait for the next port, get approval from the company to send a reliever and also pay for his and reliever's ticker fare, along with that agent's fees). He has to find a way through all the differences, ego clashes, and professional and personal politics to ensure that his work and career does not suffer.

Honestly, it is easily said than done. It takes great determination and mental strength to stay away from all the negativity on board ships. Inculcating genuine qualities, respecting others, and maintaing a cordial relationship are something that doesn't come easy to anyone.

However, developing such qualities it is not difficult. As a true mariner, one must make genuine efforts to stay extremely professional and disciplined on ships irrespective of the type of situation.

Mentioned below are ways to maintain a healthy relationship with your fellow crew members and ensure that you are liked by everyone on board ships:

Avoid forming Groups: This is a very common phenomenon on board ships. If people belonging to the same group or region get together on board ships, they tend to form groups among themselves, avoiding everyone else, intentionally or unintentionally. Many of them from the same group start interacting with each other in their regional or national language even in the presence of seniors and other fellow crew members. This is an extremely bad habit which is not only a grave insult to other professionals but also creates unnecessary indifferences and misunderstanding among seafarers. When on ships, avoid forming groups and involve everyone to form a solid team effort irrespective of color, region, race, or religion. Ensure that everyone talks in only one language which is understood by all on board ships.

No blame culture: In case of any accident or mishap on board ships, it is a common tendency among seafarers to blame others. Technically, as humans, we are programmed to hide our mistakes and shortcomings by default. We are ashamed of them and the consequences they would bring. However, if you are a true mariner bound by disciple and grit, you will come forward and accept your mistake instead of blaming others for the same. There is no need to hide your mistake or feel ashamed of the same. On the contrary, your colleagues will respect and trust you for honesty if you willingly accept your mistakes.

Complimenting Others Often: Have you every noticed how almost all seniors and colleagues never miss a chance to shout, insult, or advice when you make a mistake, but none makes an effort to compliment or appreciate when you do a great job? Complimenting, by human nature, is a difficult task. People tend to get more joy from other's failures than from their accomplishments. As a mariner, one must strive to compliment fellow seafarers when they do a great job. Congratulate them on their great performance, it is not going to become any kind of hindrance in your path to success or hurt your pride.

Avoid putting one's ego on top of the team: Ego is the reason for most of the professional troubles on board ships. Some people put more efforts in cultivating ego than in improving their skill sets. On board ships, keeping ego will only lead to lack of efficiency and massive misunderstanding among seafarers. We often hear people on board talking things such as – “People from the deck department must keep save distances with engine department and vise-versa”. Some officers even consider talking to crew ratings and officers below them against their pride. They would restrict themselves to professionals talk and avoid any other kind of “off-work” interactions. Unfortunately they fail to understand that on board ships no individual rank matters. The only thing that matters is team work. Such people forget the fact that when they are in danger, only their crew members and subordinates will be able to come to their rescue.

Helping Your Crew Members: While working on ships, one often hears stuff such as “I won’t do it, it’s not my job”,” It is not my machinery, why should I bother?”,” It’s my rest hour, I won’t go to the engine room or deck” and so on… It is a common tendency among seafarers to avoid every possible work which is not closely related to their duties. When asked for help, they make excuses, act cocky, or just walk away. But in the process, they make a big mistake of dividing themselves of any future help from their colleagues. Instead, help your crew members irrespective of their ranks. They would go out of their way to return the favor when you badly need some kind of help.

Avoid Mixing Professional and Personal Life: While working on board ships, differences in opinions and small arguments or debates are very natural. However, many seafarers have a tendency to make it a big issue by converting it from professional to personal, unnecessarily spoiling the interpersonal environment. On ships one must learn the art of “letting go” professional differences as they can turn out to be a huge hurdle in ship’s routine operations. Leave back all the differences at the work place before entering the accommodation area. Try to “Kiss and make up” before the issue is blown out of proportion.

Avoid indulging in grapevines, negative gossip and badmouthing: Being a part of small team of people on ships, seafarers need to talk to each other as frequently as possible. However, one must make efforts to avoid grapevine, negative gossip and badmouthing – the three evils on board ships that can lead to lost productivity, erosion of trust and morale, and increased anxiety and hurt feelings. With limited number of people on board ships, even a harmless negative comment can lead to major arguments and differences. Instead, if you have a problem with someone or something, go to the right person and tell it to him directly and make him understand. If you are badmouthing someone, there are high chances that someone is also doing the same about you, behind your back.

Relation between vessel and company’s managers

This is a very important relation in commercial shipping. Company’s managers must be meaningful assistants to the vessel. They are in charge of creating the SMS (Safety Management System) and making it fully understandable to all the crew. They are also responsible to supply every vessel of the company with adequate safety equipment (helmets, gloves, safety shoes, safety goggles, overalls, etc.), to man every vessel with certified officers and crew for each position and finally to periodically inspect every vessel of the fleet to ensure that this is in good working condition and all safety measures have been taken, and Safety and Environmental policy are adopted by the crew.

Ownership of a ship involves a whole more than simply buying ships, finding cargoes to transport and eventually transporting the cargoes. In the past, shipowners would undertake all the functions required of shipowning by providing an in-house management department.

Today, the norm has shifted from this. Although shipowners may carry out the whole function themselves, there is a whole sector of organizations offering their services as ship managers. These services started in the late 1960s, when oil companies owned ships that carried their cargoes. Few years later, there was a crisis due to the rapid rise of oil prices and many ships were abandoned to the shipowners creditors-usually banks. These ships then ended up in banks who knew nothing about the operation of ship, still had to become shipowners. The way around this complex situation was to develop a business model wherein independent ship managers were entrusted with managing the day-to-day operations.

Ship management is a business that involves registration with a country or flag, crewing, insuring, maintaining and operating with several laws and regulation to comply with.

Companies can decide whether to operate with the services of an independent shipowner, or subcontracting only a part of the management function such as crewing or for large sized company, creating a department which will perform all the functions.

Where a management company is involved, due to the large capital involved in the asset, there is usually a management agreement between the shipowner and the independent management company. This is to avoid any dispute or misunderstanding as it relates to the management of the ship.

Every agreement is unique and different depending on what the parties agree on, however, BIMCO has created a template- Standard Ship Management Agreement (SHIPMAN) which serves as a first class checklist.

Technical Management

The ship manager must ensure that the structure of the ship remains in good condition and also adequate compliance with international regulation such as Safety of Life at Sea (SOLAS), Prevention of Pollution from ships (MARPOL) and any other relevant convention.

It is also important that the International Safety Management Code is fully complied with to avoid any sanctions that may arise as a result of non-compliance.

The ship management team must ensure that maintenance materials and spares are always available on ships at all times.

Management of Ship's environmental activity

The ship managers are usually concerned with fixing of charters and documentation.

This task can sometimes become complex therefore, a good ship manager must understand the market conditions. It is important for a voyage estimate to be made before making a decision on the viability of a trip. For instance, it could be commercially viable to ignore a nearby cargo and sailing in ballast to a further port if the business there will likely take the ship to a port where it will be easy to get a follow up business.

The adequate management of the commercial activity will determine the success of the entire venture.

Operational Management

This deals with the operation of the ship and ensuring that it can provide the task to which it has committed to perform. This involves bunkering, crewing, employment of port agents and accounting.

Crewing of a vessel is a complex issue and sometimes many different factors may have an influence on crewing matters such as safety, flag of registration etc. A flag of registration is usually important in relation to crewing because minimum safe manning levels are usually set by the law of the country of registration. Crews from some countries are cheaper than others. A ship manager must ensure that crew members of a ship under its management comply with Standards of Training and Certification of Watchkeepers Convention (STCW).

A ship usually needs port agent at every port of call. It is the ship manager's responsibility to choose and appoint the port agent. The port agent shall make necessary arrangement for a ship to enter and leave the port, to discharge or load a cargo, to comply with local regulations and pay for taxes and other services as may be required. However, in voyage charters, many charterers will wish to nominate the agent.

Arranging fuel for a ship is also a task to be undertaken by the ship manager. This is a skill that must not be taken lightly as a lack of skill and attention could have a damaging effect on the ship ranging from loss in profit to a permanent damage of the machinery. A ship manager must ensure that the quantity, quality and cost are favourable to the ship owner.

Insurance being one of the most expensive item of cost must be administered efficiently. The ship owner must ensure that the ship is covered against necessary risk.

This is the job of the managers of each company. They must have so close communication with mainly the Master of the vessel to advise him in many legal cases or incidents.

Relation between vessel and port

PORTS AND TERMINAL OPERATORS

Ports and terminal operators are important actors in the maritime chain of transportation. Most ports are organized in specialized terminals for the different types of cargo. They include general cargo terminals, liquid bulk terminals, dry bulk terminals, car terminals, passenger terminals and container terminals etc. In the maritime chain of transportation the ports secure efficient transfer of cargo from land-based to sea-based transportation and vice versa. Ports may be entirely public or entirely private ventures. Most ports, however, constitute a combination of public and private actors. In most ports the public actors are responsible for the overall planning, facilitating and regulating while private actors act as service providers, operators and developers within this framework (World Bank, 2001). The most important public actors are the port authorities who act as the governing body of the port and usually are responsible for the overall development of the port. Port authorities usually manage the real estate within the port area and secure the upkeep of basic port infrastructure such as berths, and access roads etc. The flow of traffic, allocation of vessels to public berths, maritime safety and protection of the marine environment are usually managed by a harbor master on behalf of the authorities (World Bank, 2001).

The main private actors in the ports are the terminal operators. In the past decades several major shipping operators have taken control of terminals in order to control more stages of the transport chain. This trend has mainly affected containerized operations where a number of carrier alliances have concluded long-term contracts for container terminals in major strategically located ports. Apart from the container lines a number of global stevedore companies operate a large number of terminals all over the world. Their main objective is not to control the transport chain, but to make a profit by offering terminal services.

Now, the vessel as a part of the port chain must be fully operational and comply with the rules of the port. As I refer the port chain, parts of it are also the loading masters, the stevedores, the surveyors. They are necessary parts for the whole operation of the vessel (loading or discharge). So our collaboration with them must be perfect to avoid any incident during any operation of the vessel.

Relation between vessel and pilot

A maritime pilot, also known as a marine pilot, harbor pilot or bar pilot and sometimes simply called a pilot, is a sailor who maneuvers ships through dangerous or congested waters, such as harbors or river mouths. He or she is normally an ex ship captain and a highly experienced shiphandler who possesses detailed knowledge of the particular waterway, e.g. actual depth, direction and strength of the wind, current and tide at any time of the day. The pilot is a navigational expert for the port of call.

Maneuvering a ship through the shallow water to berth / unberth in a port requires teamwork which involves, apart from the port pilot, the ship's captain (jointly responsible), ship's crew, port tugs, and shore linesmen. Since the pilot is on board the ship, he controls the tugs and linesmen through a radio and the ship directly. The ship's captain ensures his crew carry out the pilot's orders.

High skill is required to be a pilot as the channels through which the ships move towards the port is normally too narrow and shallow for the size of the ships, stopping distance of the ships being a few nautical miles and the fact that ships do not steer at slow speed. Even if a ship captain is a regular visitor to a certain port, he cannot match the expertise and experience of the Pilot.

In an unfortunate case of an accident, high pollution is a risk as a ship may carry thousands of tonnes of fuel for her own consumption. (Clean up cost and other damages of the Exxon Valdez disaster was around $5 billion). Also if a ship is wrecked in the channel, the channel and the port could be closed for months until the shipwreck is removed.

Most ports have compulsory pilotage.

Legally, the master has full responsibility for safe navigation of his vessel, even if a pilot is on board. If he has clear grounds that the pilot may jeopardize the safety of navigation, he can relieve him from his duties and ask for another pilot or, if not compulsory to have a pilot on board, navigate the vessel without one. Only in transit of the Panama Canal and in Canada does the pilot have the full responsibility for the navigation of the vessel.

In English law, Section 742 of the Merchant Shipping Act 1894 defines a pilot as "any person not belonging to a ship who has the conduct thereof." In other words, someone other than a member of the crew who has control over the speed, direction, and movement of the ship. The current United Kingdom legislation governing pilotage is the Pilotage Act 1987.

Pilotage is one of the oldest professions, as old as sea travel, and it is one of the most important in maritime safety. The oldest *recorded* history dates back to about the 7th century BC. The economic and environmental risk from today's large cargo ships makes the role of the pilot essential.

I would like to add some historical details about pilots now.

The work functions of the pilot go back to Ancient Greece and Roman times, when locally experienced harbour captains, mainly local fishermen, were employed by incoming ships' captains to bring their trading vessels into port safely. Eventually, because the act of pilotage needed to be regulated and to ensure that pilots had adequate insurance, the harbours licensed pilots. The California Board of Pilot Commissioners was the first government agency created by California's legislature, in 1850.

Before harbour boards were established, pilots known as hobblers would compete with one another. The first to reach an incoming ship would navigate it to the docks and receive payment. In Dún Laoghaire, Ireland, there is a monument to the hobblers who lost their lives. In Kent they were known as "hovellers" and worked alongside and in competition with the licensed pilots, but were sometimes blamed as wreckers. George Byng Gattie defends the hovellers or "hobilers" as lifesavers in his 1890 book about the Goodwin Sands.

Although licensed by the harbour to operate within their jurisdiction, pilots were generally self-employed, and so had to have quick transport to get from the port to the incoming ships. As pilots were often still dual-employed, they used their own fishing boats to reach the incoming vessels. But fishing boats were heavy working boats, and filled with fishing equipment, hence a new type of boat was required.

Early boats were developed from single-masted cutters and twin-masted yawls, and later into the specialist pilot cutter. These were effectively light-weight and over-powered single masted boats with large steeply angled keels, making them deep draft under power and shallow draft in lighter sail. Joseph Henderson was an early American harbor pilot. He is well known for being a Sandy Hook Pilot for the New York harbor and along the Atlantic Coast during the Civil War.

I would like now to refer to an example, where miscommunication leads to a collision.

Communication Difficulty Leads To Collision

A bulk carrier was down-bound in a river waterway. While the vessel was in a lock, there was a change of pilots. During the exchange, the disembarking pilot mentioned that it was difficult to communicate with the bridge crew because of their lack of proficiency in English.

After the arriving pilot had exchanged information with the Master, the vessel left the lock. The pilot requested the assistance of a police patrol boat from vessel traffic services (VTS) in order to clear any pleasure craft in the area below the lock exit, as many small boats were present for a fireworks show. As they progressed downriver, the Master left the bridge. The bridge team now consisted of the pilot, the officer of the watch (OOW) and the helmsman.

At about the same time, a port tug left its berth down-bound to assist another vessel. VTS granted authorization for the tug and gave information on up-bound vessel traffic, but did not mention the downbound bulk carrier exiting the lock.

As visibility was good, the tug Master navigated visually and did not turn on the radar. The ECS was not used either. The bulk carrier, now making way at a speed near 12 knots, was upstream and behind the tug at a distance of approximately 0.9nm. The tug was visible to the pilot.

On the bulk carrier the pilot asked the OOW to turn on the forward deck lights to make the vessel more visible to the pleasure craft and to have someone posted forward on the forecastle deck to stand by at the anchors. The OOW appeared not to understand; at any rate the requests were not acted on. The pilot asked for the Master to come to the bridge. When the Master arrived, the pilot again requested that the forward deck lights be turned on. The Master turned on the lights.

The pilot, now on the port side of the bridge, observed three pleasure craft ahead of the bulk carrier moving towards the vessel. Two of them altered course to starboard in order to meet port to port. The third altered its course to port; in doing so, it disappeared from sight behind the bulk carrier's cranes. The pilot went to the starboard side of the bridge in an attempt to see the third pleasure craft but then lost sight of the tug. Not being able to see the pleasure craft, the pilot altered to port.

When the pleasure craft became visible on the starboard side, the pilot ordered starboard 20° and then hard to starboard. Once the swing of the vessel was stopped, the pilot ordered that the vessel be kept steady at 357°. By this time the tug was less than 100m away on the port side, and the pilot was on the starboard side of the bridge – still without a view of the tug. As the pilot walked back to the port side of the bridge, there was a screeching sound. The pilot now saw the tug on the port bow moving away from the bulk carrier. The Master on the tug had, at the last minute, become aware of the bulk carrier behind him and had engaged both engines in order to move away from the approaching vessel.

Following the collision, the tug's engineer checked for water ingress. The pilot on the bulk carrier and the Master on the tug spoke over VHF radio and confirmed that they had collided and VTS was informed.

The damage sustained by the tug was sufficient to merit a dry dock and it was out of service for almost seven weeks. The bulk carrier was not damaged, but traces of black rubber from the tug's fenders were apparent on the hull.

Some of the findings of the official report were:

- The pilot on the bulk carrier was not monitoring the tug at the time of the collision. The bridge crew was not assisting the pilot by maintaining a lookout or using navigational equipment to advise the pilot of relevant traffic.
- The language barrier between the bridge crew and pilot contributed to communication difficulties and led to ineffective BRM at a critical time during the voyage.
- The VTS officer's high mental workload at a critical time probably caused him to omit the down-bound bulk carrier when reporting traffic to the tug.

The Master on the tug was unaware of the bulk carrier for a variety of reasons:

- VTS had not reported the down-bound vessel.
- The Master was not using all available navigational equipment such as radar.
- No effective lookout had been posted.

Lessons learned

- It bears repeating that all navigational aids should be used not only to help position a vessel but also to give the bridge team the most complete situational awareness possible.
- If there are communication issues within the bridge team that is the time to redouble one's vigilance.
- Vessel bridge crew and the pilot are a team and need to work together for a safer voyage.

2. The Human Element- Human Errors

2.1 Design Issues

As human beings, we all have certain abilities and limitations. For example, humans are great at pattern discrimination and apperception. There isn't a machine in the world that can interpret a radar screen as well as a trained human being can. On the other hand, we are fairly limited in our memory capacity and in our ability to calculate numbers quickly and accurately. Undoubtedly machines can do much better this job. The design of technology can have a big impact on how people perform. Automation is often designed without much thought to the information that the user needs to access. Critical information is sometimes either not displayed at all or else displayed in a manner which is not easy to interpret. Such designs can lead to inadequate apprehension of the state of the system and to poor decision making.

2.1.1 Poor Design

Automation creates new human weaknesses and amplifies existing ones. One challenge is to improve the design of automation. 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. Poor design of equipment, user controls and interfaces, or work procedures, increases workload, response times, fatigue and stress levels. It may also promote the invention and use of dangerous short-cuts. 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 human-centered equipment design and evaluation. The maritime industry needs to follow suit.

2.1.2 Poor Maintenance

A further issue relates to the quality of the maintenance work. Equipment reliability and production can be reduced, and the risk of accidents increased (during or following maintenance), if maintenance work does not meet the desired standard. As maintenance is heavily reliant on human activity, maintenance quality is largely dependent on the performance of the crew. This increases the risk that maintenance tasks are carried out incorrectly, particularly for complex items, where the need for quality maintenance can be very important. In addition, when the maintenance is costly or difficult to carry out, there is a greater risk that it will not be carried out as often as it should or that it will not be done at all. This increases the chance of the item failing in service, often with costly consequences. Finally poor maintenance practices may intensify the design defects and result in a dangerous work environment, lack of working backup systems, and crew fatigue from the need to make emergency repairs.

2.1.3 Inadequate Knowledge of Own Ship Systems

A frequent contributing factor to marine casualties is inadequate knowledge of own ship operations and equipment. Mariners often do not understand how automation works or under what set of operating conditions it was designed in order 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. 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. The lack of ship-specific knowledge was cited as a problem by 78% of the mariners surveyed. 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.

2.2 Personnel Issues

This section deals with human behaviors that may contribute to maritime incidents and evaluates their contribution in accident causation.

2.2.1 Fatigue

Fatigue is not a new issue in the maritime domain. Research has illustrated that there are potentially disastrous outcomes from fatigue in terms of poor health and also diminished performance. Falling asleep on watch or a decrease in alertness because of fatigue is well known and not a new cause of marine traffic accidents. However, the conditions in which seafarers work are becoming increasingly demanding. There are shorter sea passages, higher levels of traffic, reduced manning, extended hours of duty and rapid port turn-around. Additional issues such as rolling, pitching, vibrations, and noise only serve to magnify any present effects of shift work based fatigue causing poorer health and safety performance. Decreased alertness and slowed reaction speed caused by fatigue affects situation awareness. It may also have an effect on communication atmosphere on bridge. When factors contributing to fatigue in bridge work were studied by presenting questionnaires to watch officers, it was found that 17% of respondents had fallen asleep and over 40% had been near nodding off at least once on watch. The most important factors affecting alertness had been the time of day, the length of the previous sleep period and the time since the person had last woken up. In their research, investigating officers were presented with 98 ship casualty reports and identified in 23% of cases that fatigue was a contributory cause. Despite the introduction of work rest mandates by the IMO, there are still occasions where individuals simply have to work for more than 12 hours with a 6-hour break. For instance, during discharging operations, the chief officer must be present at all times. A tanker with a 300,000 tonnage takes approximately 44 hours to discharge, so this means that the chief officer is required to be awake and present throughout this period. In a report attempting to address operator fatigue, seafarers were identified out of the occupational groups included to have the second highest number of maximum work hours in a 30-day period, behind rail operators. A further study surveyed 563 seafarers, 50% of whom indicated that they worked more than 85 hours in a week and 66% felt that extra manning was
Necessary to reduce fatigue. There are the following fatigue causal factors:

• Workload: The harder people work, the sooner they need time to recover from it. Workload itself is influenced by the design of the tools, equipment and procedures people must use and the expertise they have acquired through training and experience.

• Sleep debt: People need enough sleep of the right sort to recover from their wakeful activities. In its absence, they build up a sleep debt which severely affects their ability to stay alert. Sleep debt causes people to misread situations, overlook key information and fall asleep even when they know it will put them and their colleagues at extreme risk.

• Perceived risk or interest: If people are stimulated by their sense of risk or interest in what they are doing, they can stay awake and alert for longer. However, the time they then need to recover from sustained activity will also get longer. If people are engaged on tedious or boring tasks, they will feel tired sooner.

• Time of day: People live by natural daily rhythms which mean that they feel least alert in the small hours of the morning and most alert in the period before midday.

• Environment: People become more fatigued in environments with bad levels of light, noise, vibration, temperature and motion.

These factors have the following effects on human behaviour:

• Decreased attention and vigilance: People become less alert and slower to notice things. They may fail to detect signals or their significance, especially during monotonous tasks or in tedious environments. Tasks requiring sustained attention or surveillance are especially affected by fatigue.

• Communication difficulties: It becomes increasingly difficult to decide what needs to be said, how to say it, or what another person said.

• Inability to concentrate: Maintaining focus on the task at hand, even for a few seconds, is difficult. People cannot follow complex directions or numerical calculations, and are easily confused.

• Omissions & carelessness: People increasingly skip steps, miss checks and make mistakes.

• Slower comprehension & learning: It takes increasingly longer to understand any written or spoken information, or display patterns (e.g. a map or charts).

• Mood changes: Irritability, depression and apathy increases.

• Faulty memory: Recall of recent events or orders becomes faulty. For example, the content of a radio message may be immediately forgotten or recalled incorrectly.

2.2.2 Stress

Stress has been identified as a contributory factor to the productivity and health costs of an organization as well as to personnel's health and welfare. Stress is a physiological response to prolonged situations where the demand on people exceeds their available resources. It is always bad and produces both physical and behavioural signs and symptoms. Stress produces a complicated series of changes in the body's hormone levels and blood chemistry. Over a prolonged period, this can result in a wide range of adverse physical and behavioural changes in people as well as increased vulnerability to illness. While stress is a common part of human life, it is not the same as arousal, and is always bad. One of the first signs of chronic stress is difficulty in sleeping, which can then contribute to the development of sleep debt. The inability of people to repay their sleep debt through stress-induced insomnia can itself become a source of stress. This creates a particularly vicious circle in which stress increases sleep debt which increases stress level, with the result that performance levels decline ever faster. The inability to deal effectively with fatigue can become a source of stress, as can the sleep debt that results. In addition, stress can increase fatigue by stimulating too much production of adrenalin. Stress can be caused by a large number of factors. Some of these factors are work related while others may belong to the private lives of the person affected. Seafarers are particularly vulnerable to both sources since their work brings them into contact with many known work-related stressors as well as removing them from their home lives and countries for long periods. Stressors such as constant noise and vibration, domestic, personal and employment worries, social isolation and loneliness can contribute to sleep debt, which turns fatigue itself into a source of stress. Exposure to elevated stress levels for an extended period of time leads to negative mental and physical health outcomes.

2.2.3 Health

Health is one of the factors that influence professional efficiency of seafarers. Physical and mental health problems amongst seafarers are not uncommon particularly if we consider the type and the difficulties of the work that a seafarer has to face onboard. When thinking of seafarers' health and lifestyle one should always have in mind just few of the following factors:

- Unstable work schedules and long working hours due to operational needs.
- The small community which one should adapt and work with.
- The feeling of being away from home and familiar faces.
- The difficult working environment as well as all the hazards that are involved.
- The restricted medical facilities and limited medical supplies.
- The confined nature of life on board ship.
- The climate of the area where the ship is operating.

Furthermore in some circumstances, psychological problems such as impatience, dissatisfaction and lack of motivation may provoke intolerance between crew members which mostly results in cultural and religion differences.

2.3 Non-Technical Skills

Non-technical skills are an additional set of competencies that are used integrally with technical shipping skills, such as those to maneuver the vessel, or set down the anchor. They encompass both interpersonal and cognitive skills such as situational awareness, communication, team working and leadership. The following analysis focuses on nontechnical skills within the maritime state.

2.3.1 Decision Making

The increasing technological sophistication of ship navigation systems may significantly alter the skills, knowledge, and strategies involved in navigating large ships, degrading rather than enhancing maritime safety. This challenge, combined with the potentially disastrous consequences of incorrect decisions, make the navigator’s job a singularly stressful one. This stress is magnified by the multiple, often competing tasks and responsibilities of navigating a ship, all of which must be carefully coordinated. While technological innovations seek to ameliorate these difficulties, new navigation technologies may also burden the human operator with increased cognitive demands. Mariners are exposed to an increasing number and diversity of supervisory and decision tasks, needing to divide attention between primary navigation displays and secondary tasks such as engine and cargo functions. In a review of 100 shipping incidents regarding cognitive demands it was found that as mental workload increased, collision threat increased and there was a detriment in performance on the secondary task resulting to the 70% of observed human errors. This shows the potential consequences of having to monitor numerous pieces of equipment concurrently. In addition, computer-based decision aids can also introduce new cognitive demands such as the need to monitor more ships during collision avoidance, to form mental models of the new technology, and to perform complex mental scaling and transformations to overcome the limits of electronic versions of paper charts. While technology has the potential to eliminate many simple tasks, historical data concerning shipping accidents indicate that many navigation errors result from misinterpretations or misunderstandings of the signals provided by technological aids such as collision avoidance systems. Moreover, poor judgment in the use of technological aids contributes too many maritime accidents. Further, navigational knowledge and skills may degrade because they are used only in rare, but critical, instances. Advanced technologies may also introduce new phenomena that affect mariner decision making, such as over-reliance on a radar display to steer a ship. In this situation, if the display fails to contain the information necessary to specify operator actions, errors will result. Thus, it is clearly important to understand the cognitive tasks involved with advanced navigation technology in order to guide design and training development.

2.3.2 Poor Communication

Human communication is the process of influencing a human receiver to create thought and action that is consistent with, and responsive to, the sender’s purpose. Communication is one of the core skills central to effective and safe production and performance in all high risk industries that also influences team situation awareness as well as team working and effective decision-making.Communication barriers that occur between seafarers and are presented in all types of ships, especially when there is a multinational crew can cause misunderstandings resulting in marine accidents.

For example, when there is a pilot on board a ship, an important teamwork relationship between the OOW (officer of the watch), master, and pilot shall be established. On the contrary by incidents sampled, 42% involved misunderstandings between pilot and master or the officer of watch due to lack of effective communication. Questionnaires were developed to measure teamwork, communication, and to evaluate the master, pilot, and OOW relationship. When asked whether OOW asks for clarification if he/she is unsure of the pilot's intentions, 90% of OOW, 76% of masters, and only 39% of pilots responded that the OOW always or often asks for clarification. Here appears to be a discrepancy between an individual's self-perception of effective communication and other's interpretations of these interactions. When asked whether bridge officers were reluctant to question a pilot's decision: 92% of masters and 81% of bridge officers said sometimes and 12% of bridge officers said they were always reluctant to question the pilot. These communication issues can often result in errors or accidents. Although these are fundamentally communication issues, this figure could also reflect deficits in other skills such as lack of situation awareness and poor team working. One factor which could be a contributing cause to these findings, are language problems.

2.3.3 Situational awareness

Situational awareness means the person's ability to construct a mental model on what is happening at the moment and how the situation will develop. Particularly is the perception of the elements in the environment within a volume of space and time, the comprehension of their meaning, and the projection of their status in the near future.

Situation awareness consists of three levels:

• In the first level individuals must have the correct perception of the elements in the situation in order to form an accurate picture.

• The second level involves the combination, interpretation, storage, and retention of the acquired information to form a picture of the situation whereby the significance of particular objects and events are understood.

• The third level is projection, and occurs as a result of the combination of levels one and two. This stage is an extremely important component of Situation awareness, as it means possessing the ability to use information from the environment to predict possible future states and events, in order to reduce surprise.

In various studies carried out regarding human error in maritime operations it is found that 71% of all human error types on ships are situation awareness related problems. Situation awareness errors are categorized into three groups:

• Failure to correctly perceive information (59%).

• Failure to correctly integrate or comprehend information (33%).

• Failure to project future actions or state of the system (9%).

2.4 Organizational Issues

There is less research on organizational factors, which may mediate relationships between organizational climate and behavior and then propose measures such as accident data. Therefore in order to complete the picture one must consider this element in accident causation to fully address and reduce the level of incidents in this industry. Organizational factors, both crew organization and company policies, affect human performance. Crew size and training decisions directly affect crew workload and their capabilities to perform safely and effectively. A strict hierarchical command structure can inhibit effective teamwork, whereas free, interactive communications can enhance it. On the contrary, work schedules which do not provide the individual with regular and sufficient sleep time produce fatigue. Company policies with respect to meeting schedules and working safely will directly influence the degree of risk-taking behavior and operational safety. Unfortunately, these same factors also increase the likelihood that any mistakes will lead to serious consequences. This is because the factors also interfere with the ability to recover from mistakes once made. For example, the same fatigue that prevents a watchkeeper spotting a collision course can also interfere with their subsequent response to the emergency situation that develops. A universal finding is that it is combinations of multiple adverse circumstances that create disastrous outcomes. It is not human mistake-making that is the problem, so much as the existing conditions and history of the organisation in which it occurs.

2.4.1 Inadequate Manning

Reduced manning is an organisational policy aimed at increasing efficiency. It is often made possible by the introduction of automation. However, increased efficiency usually means a corresponding decrease in thoroughness. If the number of people fall short of what is required to carry out a task, then workload, fatigue, stress levels and sickness are increased, dangerous short-cuts are taken and the safety culture is compromised by demotivation, low morale and absenteeism. Management efficiencies (in the form of crew cuts) often result in unsafe working efficiencies (short-cuts) and an increase in the number of mistakes, all made worse due to fewer people having less time to prevent those mistakes developing into something worse.

2.4.2 Working Environment

The environment affects performance, too. 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 physical work environment directly affects one's ability to perform. For example, the human body performs best in a fairly restricted temperature range. Performance will be degraded at temperatures outside that range, and fail all together in extreme temperatures. For example, at temperatures of below 16ºC dexterity can be adversely affected. At high temperatures the capacity for physical work reduces with the increasing risk of heat stress. This problem is increased with high relative humidities. The need to wear certain types of PPE can also increase problems of heat stress. The influences of temperature, therefore, need to be considered both in terms of the basic task demands (dexterity and physical workload) and the need for and implications of wearing PPE. High sea states and ship vibrations can affect locomotion and manual dexterity, as well as cause stress and fatigue. By the term environment we are including not only weather and other aspects of the physical work environment (such as lighting, noise, and temperature), but also the regulatory and economic climates. For instance tight economic conditions can increase the probability of risk-taking (e.g., making schedule at all costs).

2.4.3 Insufficient Training

Organisations often claim that people are their greatest asset. People form attitudes towards their organisation, and the industry as a whole, about the quality (low or high) of the effort to provide them with the information they need. And whatever people learn, they in turn transmit to others, helping to define and maintain the nature of the overall culture to which they belong.

But if the organisation has not made arrangements for the focused learning and development of its staff, its people may represent an unknown and potentially catastrophic liability and risk to the organisation, rather than an asset. Poor training or lack of experience may result in attempting to do tasks with insufficient knowledge which is a dangerous thing or else a failure to prevent a dangerous situation developing. Lack of investment in training and structured experience contributes to a poor safety culture by sending strong signals to the workforce that they are not valued. So the question for safety-critical organisations like the maritime industry is not whether people learn, but what they learn and by what means. The answer to these questions is more or less in the control of their managers and employers for without the right guidance, people learn the wrong things. As a result, in the absence of effective formal training, people informally learn what their colleagues do, what the shortcuts are, what seems to make sense to them, and what behaviours are rewarded. However, informal learning may or may not result in safe behaviour.

2.4.4 Safety Climate and Safety Culture

The following section details human factors issues arising as a result of decisions or policies made at the organizational level, such as safety climate and safety culture (management values and practices).

• Safety Climate: Interest in safety climate has now diversified into the maritime domain as it will influence whether or not an individual engages in safe behaviours or not. Organization safety climate is like a snapshot of selected aspects of organization safety culture at that particular point in time. Although there is some debate on the definition of safety climate, definitions proposed consistently feature either employee's attitudes or perceptions of safety. Essentially climate perceptions relate to procedures as patterns, whereby consistent procedures represent patterns that reflect the importance and prioritization of safety over competing goals. In the adoption of a safety climate model, there should be a distinction between two levels: the organizational level of policies and procedures and the group level of supervisory practices in implementation and prioritization of these procedures.

• Safety Culture: Interest was generated in safety culture in the maritime industry after an address of the IMO stated that safer shipping requires a safety culture. Safety culture is defined as the assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, safety issues receive the attention warranted by their significance.

The most influential source of a good safety culture is the seriousness with which senior management approaches it via training, crew investment and the implementation of work processes that accommodate the time that safe practices take. Crew mistakes increase not just because of the absence of this investment, but also because of the meaning people attach to the absence of the investment by their senior management.

2.4.5 Complacency

The reasons of maritime accidents can partly be explained by the influence of the notion of Complacency as a special influential socio-psychological factor.

Where rules and procedures collide with the need to be efficient due to economic considerations, people find ways to work around them. If the efficiencies that they use to meet their schedules and targets do not result in an accident over a long time, the organisation may drift, often unnoticed, towards and across safety limits. This is sometimes referred to as complacency.

Inappropriate communication and poor cooperative relationships on board a ship represent one of the basic causes of Complacency that is reflected in inadequate decisions and inefficient action. The genesis of this notion is rooted not only in the model of ship's organisation and management style but also in an interactive relation of the ship to external factors.

From the analysis of different maritime accidents the following autonomous and interactive negative influences of the above mentioned notion have been noted:

• Management Complacency: The negative influence of the Shipping Company (Management) expressed through the dominant communication company, ship in which process the crew meet the interests of the Company against their own beliefs and attitudes which are eventually lost, or become passive and transform into submissive attitudes.

• Leadership Complacency: The negative influence of leadership expressed through domination in which case the crew meets the requirements of the authority suppressing personal attitudes and beliefs.

• Self-Induced Complacency: The negative influence of the acquired feeling of superiority and personal significance to the change of personal, previously positive attitudes.

Complacency marks the above mentioned influences such as self-sufficiency or selfsatisfaction. In a wider sense, it means too much self-confidence or egoistic pleasure. Complacency is also translated by the consecutive form of its basic meaning as lack of motivation, lack of discipline, lack of concentration, or feeling that somebody and/or something else will take care of the problems on board.

From the psychological point of view the meaning of the notion of Complacency represents a process of gradual change of attitudes that transforms a good seaman into a bad seaman. In this connection, the change of attitudes is caused by the influence of hierarchical authority and subordinating influence of the Company (Management).

In that sense, the change into inhibition begins as a spontaneous reaction to bad communication or unpleasant environment (hierarchical relations) within which the individual can feel insignificant.

Such a reaction is visible after a longer period from the way such a person adapts to the circumstances. The way of adaptation can be seen through gradual change of personal attitudes that finally results in unconscious refusal of existing knowledge and skills.

Therefore, Complacency applied to the tasks and procedures performed by seamen on board refers to the modified mental state in which the seamen’s behaviour derives from unconsciously formed attitudes as the result of adaptation in the conditions of bad communication and unpleasant environment.

3. Maritime Safety

Introduction

Since the initial adoption of maritime safety standards, the focus was always on the ship's design and equipment. Nevertheless, many studies revealed later that human factors and human error were the main reasons contributing to marine accidents.
The Sinking of S/S Titanic on 1912 was the initial incentive for the international maritime community to set up safety standards in order to reduce accidents at sea, and that resulted in the adoption of Safety Of Life At Sea (SOLAS) convention and later led to the establishment of the International Maritime Organization (IMO).
By the mid 1980's the IMO gave attention to the role of human factors in the maritime accidents by adopting the concept of implanting the safety culture in shipping industry.
The most significant instruments which were introduced to create safety culture and improve human performance in ship operations are the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) convention and the International Safety Management (ISM) code.
Furthermore the International Labour Organization (ILO) focused on seafarers' employment and welfare by setting minimum standards on issues such as seafarers' conditions of employment and accommodation recreational facilities.
Finally the International Organization for Standardization (ISO) focused in the application of ergonomics on board ships to address the human issues and eliminate error-inducing situations.
It is worth mentioning that some of the issues covered in the different conventions overlap since there is an effort to regulate important aspects from different perspectives. I have chosen to present them here depending on their special point of interest, but I do recognize that the regulations are intertwined in order to promote safety in a holistic way.

3.1 International Maritime Organization (IMO)

A resolution adopted by IMO in 1997 elucidates the Organization's approach in human error. It admits that human element is a multidimensional and complex issue and encourages the development of non-regulatory solutions as it believes that regulatory approach creates a culture of compliance which is far from a safety culture.
IMO recognizes 3 types of shipping companies; first those which not only comply with the regulations but take additional steps toward safer shipping, then those which just comply with the requirements but for them safety is not a priority and finally those that do not comply and run substandard ships. Unfortunately adoption and enforcement of regulations do not turn non-compliers into compliers.

3.1.1 Minimum Safe Manning

The principles of minimum safe manning introduced by IMO Resolution A.1047 (27) are sensible and, if followed, should provide a robust foundation to help determine the manning level. The resolution goes on to list the functions on which the safe minimum manning levels should be based, including:

- Size and type of ship.
- Number, size and type of main propulsion units and auxiliaries.
- Construction and equipment of the ship.
- Method of maintenance used.
- Cargo to be carried.
- Mooring and unmooring the ship safely.
- Safe navigational watches to be carried out in accordance with STCW requirements.
- Frequency of port calls, length and nature of voyages to be undertaken.
- The number of qualified personnel required to meet peak workload situations.
- Trading area(s), waters and operations in which the ship is involved.
- Extent to which training activities are conducted on board.
- Applicable work hour limits and/or rest requirements.

3.1.2 Standard Maritime Communication Phrases (IMO SMCP)

IMO's Standard Marine Communication Phrases (SMCP) were adopted by the 22nd Assembly in November 2001 by the resolution A.918 (22) recommending that all seafarers and those involved in maritime training shall use a common set of English language phrases.

SMCP have been developed to be a comprehensive body of standardized language, focusing primarily on all predictable communication scenarios relating to health and safety. These include verbal communications made shore-to-ship (and vice-versa), ship-to-ship and on-board communications. The objective was to overcome language barriers among international crew and avoid misunderstandings which could cause accidents.

The IMO SMCP builds on a basic knowledge of English and has been drafted in a simplified version of maritime English. It includes phrases for use in routine situations such as berthing as well as standard phrases and responses for use in emergency situations.

Under the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978, as amended, the ability to understand and use the SMCP is required for the certification of officers in charge of a navigational watch on ships of 500 gross tonnage or above.

There's no doubt that SMCP has made a big difference. Having an agreed set of phrases allows seafarers from many different nationalities to communicate with each other predictably, in key areas of health and safety.

3.2 The International Safety Management Code (ISM)

The high number of maritime incidents prompted IMO to produce a unified safety management code called the ISM code. The ISM guidelines were developed to provide a framework for the proper development, implementation and assessment of safety and pollution prevention management in accordance with industry best practices.

The ISM code is often linked to litigation cases involving maritime incidents. This prompted shipping companies to further understand the legal implication of ISM code and hence it became more evident to companies that full demonstration of the requirements is vital.

The ISM Code establishes an international standard to enhance the value of safety management and operation of ships by focusing on system and structural issues and also addressing human issues so that maritime companies shall operate in a profitable manner and also grow organically.

Almost all-shipboard systems and operations are heavily dependent on human intervention and the human link will constantly remain a weak link in this equation. Therefore these elements of human aspect needed to be continuously managed and improved.

So the implementation of ISM renewed strategies in managing human capital and led to the improvement of work practices that will form the basis for a safer operation of vessels and the economic viability of companies.

3.2.1 Safety Management System (SMS)

A Safety Management system (SMS) meeting the requirements of the ISM code requires a company to document its management procedures and record its actions to ensure that conditions, activities and tasks that affect safety and the environment are properly planned, organized, executed and checked.

An SMS is developed and implemented by people and clearly defines responsibilities, authorities and lines of communication. A SMS allows a company to measure its performance against set criteria hence identifying areas that can be improved.

The increase in Safety Management skills improves morale and can lead to a reduction in costs due to an increase in efficiency and a reduction in claims. The functional requirements for a safety management system are:

- Safety and environmental policy
- Instructions and procedures to ensure that safe operation of the vessel in compliance with relevant international and flag state legislation.
- Defined levels of authority and communication between shore and ship personnel.
- Procedures for reporting accidents and non-conformities with the code.
- Procedures for responding to emergency situations (drills etc.)
- Procedures for internal audits and regular management reviews
- A system is in place for the on board generation of plans and instructions for key shipboard operations.

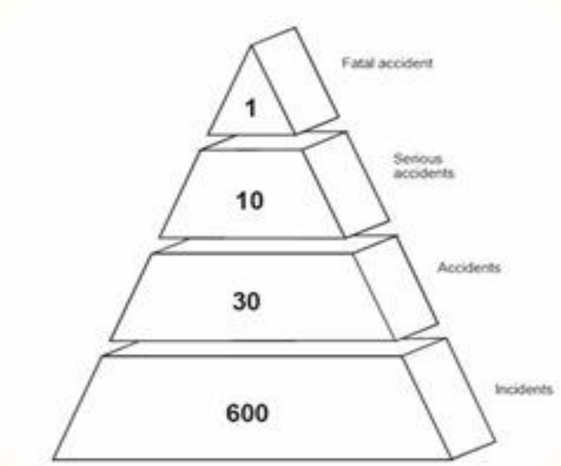
3.2.2 Near misses

A near-miss is defined as an extraordinary event that could reasonably have resulted in a negative consequence under slightly different circumstances, but actually did not. Essentially, a near-miss is an accident that almost happened. It has been estimated that for every accident, there are about 600 near-misses.

Near-misses and accidents have the same causes, so studying near-misses can help us understand safety problems and make corrective changes before an accident takes place. In addition, since near-misses do not result in full-blown casualties, studying near-misses can help us learn how to develop early-warning systems to detect when conditions have become non-normal and also show us what steps to take in order to avoid the accident.

The ISM Code requires that the safety management system should include procedures ensuring that non-conformities, accidents and hazardous situations are reported to the Company, investigated and analyzed with the objective of improving safety and pollution prevention.

Near misses, accidents and incidents shall be reported by everyone without the fear of punishment indicating that companies do welcome incident reports in order to understand the precursors to events that were detrimental to safety and the marine environment and to promote a no blame culture to improve the safety and environmental management on board.



I will add an inquest by the National Safety Council about Near Misses.

How Do Near Miss Reporting Systems Prevent Future Incidents?

Many safety activities are reactive and not proactive, and some organizations wait for losses to occur before taking steps to prevent a recurrence. Near miss incidents often precede loss producing events but may be overlooked as there was no harm (no injury, damage or loss). An organization may not have a reporting culture where employees are encouraged to report these close calls. Thus, many opportunities to prevent the incidents are lost. History has shown repeatedly that most loss producing events (incidents), both serious and catastrophic, were preceded by warnings or near miss incidents. Recognizing and reporting near miss incidents can significantly improve worker safety and enhance an organization's safety culture.

What are Best Practices in Establishing a Near Miss Reporting System?

• Leadership must establish a reporting culture reinforcing that every opportunity to identify and control hazards, reduce risk and prevent harmful incidents must be acted on.

• The reporting system needs to be non-punitive and, if desired by the person reporting, anonymous.

• Investigate near miss incidents to identify the root cause and the weaknesses in the system that resulted in the circumstances that led to the near miss.

• Use investigation results to improve safety systems, hazard control, risk reduction, and lessons learned. All of these represent opportunity for training, feedback on performance and a commitment to continuous improvement.

• Near miss reporting is vitally important to preventing serious, fatal and catastrophic incidents that are less frequent but far more harmful than other incidents.

Why Should Employers Implement Near Miss Reporting Systems?

Near miss reporting systems:

• Capture sufficient data for statistical analysis, correlation studies, trending, and performance measurement (improvement over baseline).

• Provide convenient opportunity for "employee participation," a basic component of a successful safety management system.

• Create an open culture whereby everyone shares and contributes in a responsible manner to their own safety and that of their fellow workers.

• Can be considered to be a leading indicator of performance used in balance with other leading and lagging measures of performance.

How Can Employers Encourage Workers to Participate in Near Miss Reporting?

• Create a policy and procedure that is communicated to all employees with the backing of senior management.

• Promote a culture of reporting with the support and help of all managers and supervisors.

• Educate employees on the reason why near miss reporting is a necessity, the important role that they play, and the process for reporting.

• Ensure that the near miss reporting process is easy to understand and use.

• Continue to communicate on the importance of near miss reporting encouraging the participation of all employees.

• Use the near miss reporting as a leading indicator and report back to the organization on the positive steps taken to improve workplace safety.

• Reinforce with employees that near miss reporting is non-punitive.

• Consider incentives that encourage reporting and enhance the culture. (Incentives that have the potential to discourage reporting must be avoided.)

- An example of a good incentive is one that recognizes the participation of workers in the recognition and reporting of hazards. This activity helps to enhance a reporting culture, engage workers in meaningful safety activities, and continue a process of risk reduction.
- An example of a poor incentive is one that recognizes supervisory and management performance based on outcome OSHA recordable rates. This type of incentive has been shown to suppress reporting and can lead to punitive actions that further undermine safety efforts.

• Include training for new employees as a part of their orientation.

• Celebrate the success and value of the near miss reporting process with all employees!

Other Resources on Near Miss Reporting Systems:

• American National Standards Institute (ANSI) Z10 – 2012 Occupational Health and Safety Management Systems.

• NSC Safety+Health Online "Everybody gets to go home in one piece – How reporting close calls can prevent future incidents",

• OSHA Safety and Health Management Systems eTool: Accident/Incident Investigation,

3.2.3 Incident Investigation and Analysis

An incident is defined as including all accidents and all near-miss events that did or could cause injury, or loss of or damage to property or the environment.

Incident investigation and analysis is the study of accidents and near-misses and is squarely in line with the intent of the ISM Code. ISM requires that a company provide for a safe work environment and safe practices in maritime operations and establish safeguards against all identified risks. Incident investigation helps the company to identify its risks and to understand the underlying causes of incidents.

Establishing a human factors incident investigation program in maritime companies and analyzing the data collected, they can learn from incidents and identify how to improve their policies and work practices to achieve a higher level of safety.

These programs often follow well-grounded investigative practices, providing investigation team members with training in the basics of incident investigation, gathering and documenting evidence, and interviewing techniques. An incident database may also be kept so that frequency and trending analysis shall be made.

However, where most of these programs fall short is in the areas of identifying human factors causes and determining how best to correct these problems. While a number of companies attempt to consider operator errors during incident investigations, these operator errors represent only the tip of the human factors iceberg.

Most human factors causes originate further up the organizational chain, taking the form of poor management decisions, inadequate staffing, inadequate training, poor workplace design, etc. Simply identifying the mistake an operator made, and not drilling down to identify the underlying, organizational causes of that mistake, will not help to prevent reoccurrences of the incident.

On the contrary, when a focus on human error is incorporated into existing incident investigation, analysis, and intervention program, it can produce great benefits for a company, including fewer incidents, fewer lost-time accidents, improved employee morale, greater productivity, and an overall improvement in operations.

3.2.4 Internal Audits

After July 2010 it became mandatory to carry out internal audits annually under the ISM code. Clause 12.1 of ISM code states that internal safety audits are now required to be carried out on board and ashore at intervals not exceeding 12 months. In extreme exceptional cases it can be extended to 3 months.

The objectives of an ISM internal audit are:

• It acts as a tool to monitor how well the SMS system is implemented on board regarding the safety practices and pollution prevention activities.

• It helps in checking whether company safety and environmental policy is continually in compliance with the requirement of this code. Provides an opportunity to possible changes in the SMS system.

• Shows the evidence of the SMS working and that the procedures are being followed.

• To determine compliance with regulatory requirement.

The internal audit is carried out as per the procedure laid down in company's SMS annually. It is conducted by company's person who is the field of audit. By conducting an internal audit the following are checked for proper order:

• Plans/procedures being followed.

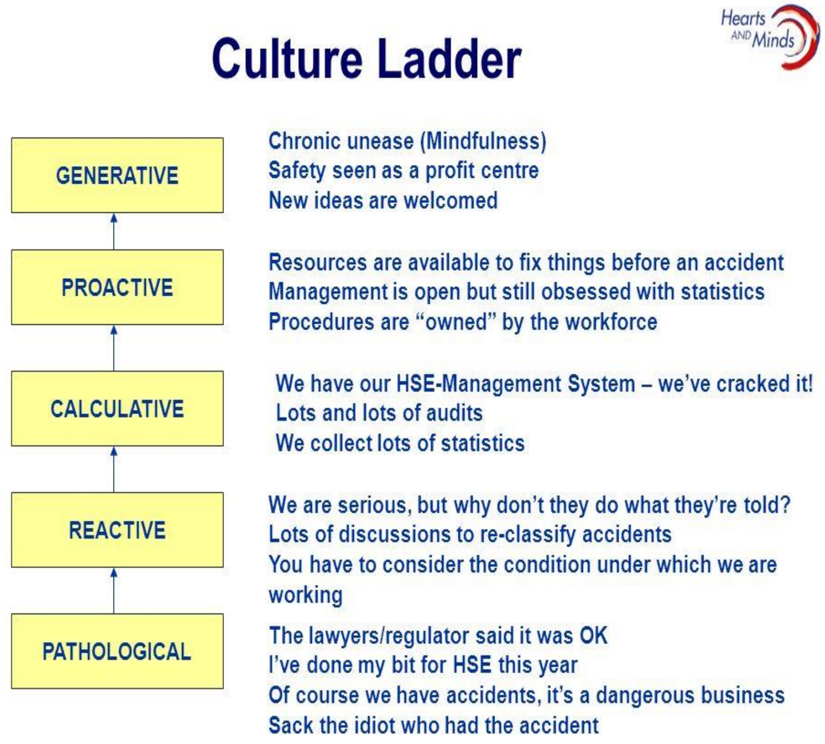
• Laws and regulations being followed.

• Records/documentations are being maintained to provide adequate and accurate information.

• Deficiencies are identified and corrective actions taken.

• Personnel are familiar with the use of SMS.

3.2.5 The Safety Culture Ladder



A model which was proposed to enhance maritime safety and is related to ISM is the safety culture ladder.

Programmes have been initiated within the maritime industry which describes a journey or ladder, together with supporting tools designed to change the safety attitudes of the entire workforce. The journey is typically depicted as moving through a number of organisational approaches to safety. This may start with the pathological stage, where people don't really care about safety at all and expect someone to get fired if there is an accident. At the end of the journey is the generative stage where people actively seek information, and failures lead to far reaching reforms.

The five stages and their characteristics of the safety culture ladder are:

Level 1: Pathological

• We leave it to the lawyers or regulators to decide what's OK.

• There are bound to be accidents – this is a dangerous business.

• If someone is stupid enough to have an accident, sack them.

• Bad news is unwelcome – kill the messenger.

Level 2: Reactive

• Safety is taken seriously every time there is an accident.

• Managers try to force compliance with rules and procedures.

• Many discussions are held to re-classify incidents.

• Bad news is kept hidden.

Level 3: Calculative

• There are lots of audits and lots of data to describe things.

• The new Safety Management System is assumed to be enough.

• People are surprised when incidents still happen.

• Bad news is tolerated.

Level 4: Proactive

• Resources are allocated to anticipate and prevent incidents.

• Management is open to bad news, but still focused on statistics.

• The workforce is trusted and feels involved in safety.

Level 5: Generative

• Managers know what's happening – the workforce tells them.

• Bad news is sought out so failures can be learned from.

• People are constantly aware of what could go wrong.

• Safety is seen as a profit centre.

3.3 Safety of Life at Sea (SOLAS)

The SOLAS Convention in its successive forms is generally regarded as the most important of all international treaties concerning the safety of merchant ships. The first version was adopted in 1914, in response to the Titanic disaster, the second in 1929, the third in 1948, and the fourth in 1960. The 1974 version includes the tacit acceptance procedure - which provides that an amendment shall enter into force on a specified date unless, before that date, objections to the amendment are received from an agreed number of Parties.

As a result the 1974 Convention has been updated and amended on numerous occasions. The Convention in force today is sometimes referred to as SOLAS, 1974, as amended.

Technical provisions

The main objective of the SOLAS Convention is to specify minimum standards for the construction, equipment and operation of ships, compatible with their safety. Flag States are responsible for ensuring that ships under their flag comply with its requirements, and a number of certificates are prescribed in the Convention as proof that this has been done. Control provisions also allow Contracting Governments to inspect ships of other Contracting States if there are clear grounds for believing that the ship and its equipment do not substantially comply with the requirements of the Convention - this procedure is known as port State control. The current SOLAS Convention includes Articles setting out general obligations, amendment procedure and so on, followed by an Annex divided into 14 Chapters.

Chapter I - General Provisions

Includes regulations concerning the survey of the various types of ships and the issuing of documents signifying that the ship meets the requirements of the Convention. The Chapter also includes provisions for the control of ships in ports of other Contracting Governments.

Chapter II-1 - Construction - Subdivision and stability, machinery and electrical installations

The subdivision of passenger ships into watertight compartments must be such that after assumed damage to the ship's hull the vessel will remain afloat and stable. Requirements for watertight integrity and bilge pumping arrangements for passenger ships are also laid down as well as stability requirements for both passenger and cargo ships.

The degree of subdivision - measured by the maximum permissible distance between two adjacent bulkheads - varies with ship's length and the service in which it is engaged. The highest degree of subdivision applies to passenger ships.

Requirements covering machinery and electrical installations are designed to ensure that services which are essential for the safety of the ship, passengers and crew are maintained under various emergency conditions.

"Goal-based standards" for oil tankers and bulk carriers were adopted in 2010, requiring new ships to be designed and constructed for a specified design life and to be safe and environmentally friendly, in intact and specified damage conditions, throughout their life. Under the regulation, ships should have adequate strength, integrity and stability to minimize the risk of loss of the ship or pollution to the marine environment due to structural failure, including collapse, resulting in flooding or loss of watertight integrity.

Chapter II-2 - Fire protection, fire detection and fire extinction

Includes detailed fire safety provisions for all ships and specific measures for passenger ships, cargo ships and tankers.

They include the following principles: division of the ship into main and vertical zones by thermal and structural boundaries; separation of accommodation spaces from the remainder of the ship by thermal and structural boundaries; restricted use of combustible materials; detection of any fire in the zone of origin; containment and extinction of any fire in the space of origin; protection of the means of escape or of access for fire-fighting purposes; ready availability of fire-extinguishing appliances; minimization of the possibility of ignition of flammable cargo vapour.

Chapter III - Life-saving appliances and arrangements

The Chapter includes requirements for life-saving appliances and arrangements, including requirements for life boats, rescue boats and life jackets according to type of ship. The International Life-Saving Appliance (LSA) Code gives specific technical requirements for LSAs and is mandatory under Regulation 34, which states that all life-saving appliances and arrangements shall comply with the applicable requirements of the LSA Code.

Chapter IV - Radiocommunications

The Chapter incorporates the Global Maritime Distress and Safety System (GMDSS). All passenger ships and all cargo ships of 300 gross tonnage and upwards on international voyages are required to carry equipment designed to improve the chances of rescue following an accident, including satellite emergency position indicating radio beacons (EPIRBs) and search and rescue transponders (SARTs) for the location of the ship or survival craft.

Regulations in Chapter IV cover undertakings by contracting governments to provide radiocommunication services as well as ship requirements for carriage of radiocommunications equipment. The Chapter is closely linked to the Radio Regulations of the International Telecommunication Union.

Chapter V - Safety of navigation

Chapter V identifies certain navigation safety services which should be provided by Contracting Governments and sets forth provisions of an operational nature applicable in general to all ships on all voyages. This is in contrast to the Convention as a whole, which only applies to certain classes of ship engaged on international voyages.

The subjects covered include the maintenance of meteorological services for ships; the ice patrol service; routeing of ships; and the maintenance of search and rescue services.

This Chapter also includes a general obligation for masters to proceed to the assistance of those in distress and for Contracting Governments to ensure that all ships shall be sufficiently and efficiently manned from a safety point of view.

The chapter makes mandatory the carriage of voyage data recorders (VDRs) and automatic ship identification systems (AIS).

Chapter VI - Carriage of Cargoes

The Chapter covers all types of cargo (except liquids and gases in bulk) "which, owing to their particular hazards to ships or persons on board, may require special precautions". The regulations include requirements for stowage and securing of cargo or cargo units (such as containers). The Chapter requires cargo ships carrying grain to comply with the International Grain Code.

Chapter VII - Carriage of dangerous goods

The regulations are contained in three parts:

Part A - Carriage of dangerous goods in packaged form - includes provisions for the classification, packing, marking, labeling and placarding, documentation and stowage of dangerous goods. Contracting Governments are required to issue instructions at the national level and the Chapter makes mandatory the International Maritime Dangerous Goods (IMDG) Code, developed by IMO, which is constantly updated to accommodate new dangerous goods and to supplement or revise existing provisions.

Part A-1 - Carriage of dangerous goods in solid form in bulk - covers the documentation, stowage and segregation requirements for these goods and requires reporting of incidents involving such goods.

Part B covers Construction and equipment of ships carrying dangerous liquid chemicals in bulk and requires chemical tankers to comply with the International Bulk Chemical Code (IBC Code).

Part C covers Construction and equipment of ships carrying liquefied gases in bulk and gas carriers to comply with the requirements of the International Gas Carrier Code (IGC Code).

Part D includes special requirements for the carriage of packaged irradiated nuclear fuel, plutonium and high-level radioactive wastes on board ships and requires ships carrying such products to comply with the International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships (INF Code).

The chapter requires carriage of dangerous goods to be in compliance with the relevant provisions of the International Maritime Dangerous Goods Code (IMDG Code).

Chapter VIII - Nuclear ships

Gives basic requirements for nuclear-powered ships and is particularly concerned with radiation hazards. It refers to detailed and comprehensive Code of Safety for Nuclear Merchant Ships which was adopted by the IMO Assembly in 1981.

Chapter IX - Management for the Safe Operation of Ships

The Chapter makes mandatory the International Safety Management (ISM) Code, which requires a safety management system to be established by the shipowner or any person who has assumed responsibility for the ship (the "Company").

Chapter X - Safety measures for high-speed craft

The Chapter makes mandatory the International Code of Safety for High-Speed Craft (HSC Code).

Chapter XI-1 - Special measures to enhance maritime safety

The Chapter clarifies requirements relating to authorization of recognized organizations (responsible for carrying out surveys and inspections on Administrations' behalves); enhanced surveys; ship identification number scheme; and port State control on operational requirements.

Chapter XI-2 - Special measures to enhance maritime security

Regulation XI-2/3 of the chapter enshrines the International Ship and Port Facilities Security Code (ISPS Code). Part A of the Code is mandatory and part B contains guidance as to how best to comply with the mandatory requirements. Regulation XI-2/8 confirms the role of the Master in exercising his professional judgement over decisions necessary to maintain the security of the ship. It says he shall not be constrained by the Company, the charterer or any other person in this respect.

Regulation XI-2/5 requires all ships to be provided with a ship security alert system. ,Regulation XI-2/6 covers requirements for port facilities, providing among other things for Contracting Governments to ensure that port facility security assessments are carried out and that port facility security plans are developed, implemented and reviewed in accordance with the ISPS Code.

Other regulations in this chapter cover the provision of information to IMO, the control of ships in port, (including measures such as the delay, detention, restriction of operations including movement within the port, or expulsion of a ship from port), and the specific responsibility of Companies.

Chapter XII - Additional safety measures for bulk carriers
The Chapter includes structural requirements for bulk carriers over 150 metres in length.

Chapter XIII - Verification of compliance

Makes mandatory from 1 January 2016 the IMO Member State Audit Scheme.

Chapter XIV - Safety measures for ships operating in polar waters

The chapter makes mandatory, from 1 January 2017, the Introduction and part I-A of the International Code for Ships Operating in Polar Waters (the Polar Code).

Amendments

The 1974 Convention has been amended many times to keep it up to date. See History of SOLAS.

Amendments adopted by the Maritime Safety Committee (MSC) are listed in MSC Resolutions.

3.3.1 Common Language

As navigational and safety communications from ship to shore and vice versa, from ship to ship, and on board ship must be precise, simple and unambiguous so as to avoid confusion and error, there is a need to standardize the language used.

This is of particular importance in the light of the increasing number of internationally trading vessels with crews speaking many different languages, since problems of communication may cause misunderstandings leading to dangers to the vessel, the people on board and the environment. Where language difficulties arise, a common language should be used for navigational purposes.

Paragraph 4 of Regulation 14, SOLAS Chapter V requires the establishment of a common working language on board, to ensure effective crew performance in safety matters.

On all ships, a working language shall be established and recorded in the ship's logbook. Each seafarer shall be required to understand and, where appropriate, give orders and instructions and report back in that language. If the working language is not an official language of the State whose flag the ship is entitled to fly, all plans and lists required to be posted shall include a translation into the working language.

English shall be used on the bridge as the working language for bridge-to- bridge and bridge-to-shore safety communications as well as for communications on board between the pilot and bridge Watchkeeping personnel unless those directly involved in the communication speak a common language other than English.

The regulation also draws attention to the use of the IMO Standard Marine Communication Phrases. (SMCPs).

3.3.2 Bridge Navigational Watch Alarm System (BNWAS)

Navigating a giant vessel is not at all an easy job and when it comes to a situation of emergency, wherein the navigational officer has to make some quick decisions, the safety of the entire ship and its crew depends on that officer and if he is not capable to handle that situation or take a decision at the correct time it can lead to devastating scenarios.

Thus according to the amendments made to SOLAS Chapter V Regulation 19 that were adopted by the IMO on 5th June 2009 in Resolution MSC.282 (86) it was made mandatory to have a Bridge Navigational Watch Alarm System (BNWAS) fitted to all passenger and cargo vessels.

The BNWAS is a safety alarm system that monitors bridge activity and detects operator's disability. The system includes a series of indications and alarms to monitor the awareness of the Officer of the Watch (OOW) and if he is not responding it automatically alerts the Master or another qualified OOW if for any reason the OOW becomes incapable of performing the watch duties efficiently which can lead to maritime accidents.

We could say that BNWAS acts similar to a dead man alarm in the engine room. Additionally, it provides the OOW with a means of calling for immediate assistance if required.

3.3.3 Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) may be defined as "equipment designed to be worn or held by an employee for protection against one or more hazards likely to endanger the employee's safety and health at work, and any addition or accessory designed to meet this objective".

PPE is technically sophisticated, designed, built and tested to exacting standards of performance. The equipment must be properly selected and fitted, and workers must be properly trained in its use, application and maintenance. Its selection demands professional skill, knowledge of the workplace and understanding of the potential hazards.

In fact, there is no replacement for PPE in many situations. And in many others, it is the logical first choice, or an affordable alternative to costly engineering and administrative controls. Because few, if any, workplaces can be cleared of all hazards, PPE is an essential component of any occupational safety and health program.

The use of quality, properly-selected PPE by workers trained in proper fit and use in tandem with other control methods is a time-proven, cost-effective method of protecting workers from hazards in the workplace.

It is the duty of every employer to provide personal protective equipment for use by their employees, where the risks cannot be avoided or sufficiently limited. Thus all employees are obliged to wear the PPE they have been provided with. No person shall intentionally or recklessly interfere with or misuse any appliance, protective clothing or other equipment provided in the workplace for health and safety purposes.

3.3.4 Life-Saving Appliances (LSA)

International Life-Saving Appliance (LSA) Code (referred to as "the Code" in this chapter) means the International Life-Saving Appliance (LSA) Code adopted by the Maritime Safety Committee of the Organization by resolution MSC.48(66), as it may be amended by the Organization, provided that such amendments are adopted, brought into force and take effect in accordance with the provisions of article VIII of the present Convention concerning the amendment procedures applicable to the Annex other than chapter I.

LSA is a part of the chapter III of SOLAS.

LSA CODE RESOLUTION MSC.48 (66) AND RESOLUTION MSC.81 (70)

General

Approval of Life Saving Appliances

In addition to the requirements of Resolution MSC.48(66) and Resolution MSC.71(7) all appliances shall comply with the Canadian Modifications set out in TP 14475: Canadian Life Saving Appliance Standard. In addition to the requirements of Resolution MSC.48(66) and Resolution MSC.71(7) all appliances shall be approved in accordance with TP 14612: Procedures for Approval of Life-Saving Appliances and Fire Safety Systems, Equipment and Products.

3.4 International Labour Convention (ILO)

Until recently, little comprehensive statutory (or regulatory) guidance had been offered related to habitability. Although a few class societies had been quite active in this area, compliance with their guidance was optional.

Now we have the International Labour Organization's Maritime Labour Convention (MLC 2006) which covers owner/ operator related management systems and the vessel's accommodations design.

The Maritime Labour Convention 2006 (MLC 2006) has been described as the fourth pillar of maritime regulation covering international shipping setting out seafarers' rights to decent working conditions, covering almost every aspect of their work and life on board.

3.4.1 Habitality

In terms of habitability, minimum standards are established on board vessels constructed after the date that the Convention entered into force for a particular flag state to ensure that any accommodation for seafarers, working or living on board, or both, is safe and decent and are inspected to ensure initial and ongoing compliance.

This relates to:

- The size of rooms and other accommodation spaces
- Heating and ventilation
- Noise and vibration and other ambient factors
- Sanitary facilities
- Lighting
- Hospital accommodation

Looking at habitability from a human factors perspective, designing for appropriate levels of ambient environmental factors is crucial to work task performance, whether that task is communicating on the bridge, viewing displays in a control room, or resting.

Here are some reasons why:

- Noise: Inappropriate levels of noise can degrade vigilance during watchkeeping tasks, interfere with complex mental tasks, delay the onset of sleep or awaken one from sleep, and generally interfere with rest.
- Whole-body Vibration: Controlling levels of whole-body vibration can establish a safe environment with respect to human response to excessive vibration, including; motion sickness, vibration induced injury/illness and motion induce instabilities and interruptions. Vibration can also alter worker perception (e.g., reading text and instruments, depth perception) and influence control movements (e.g., tactile sense, head/ hand movements, manual tracking).

• Indoor Climatic Qualities: The objective here is to provide conditions that are suitable to facilitate human performance with regard to factors such as increases in energy expenditure, decreases in work capacity, reduced hand/arm control manipulation capability, and a decreased capacity for cognitive functioning.

• Lighting: Vision is essential to information transfer, as well as general safety. Inappropriate lighting levels can result in visual task difficulty, distraction, perceptual confusion (such as misreading a display) and failure to detect visual targets. Improperly designed lighting systems can also contribute to eye fatigue, human error, unsafe conditions, and increases in reaction/ response times.

The intent of good habitability design is to apply appropriate criteria or limits that will provide the best overall shipboard or structure conditions for the crew, given design constraints and budget. Additionally, it is crucial that all habitability design characteristics be considered concurrently and early in the design to help meet potential resource constraints.

A psychologically satisfying and desirable work environment leads to the safe performance of tasks and activities as it is a place where the workers are encouraged for performing their best.

Workers are free for participating in identifying and solving work problems. The management system permits their workers to define goals for themselves and also let them innovate methods of achieving their goals. Management can improve the environment of work for workers by managerial techniques, participative methods, setting defined goals for workers etc.

The MLC establishes a new (and improved) baseline related to crew accommodation requirements. Even though it is basically a health and safety conservation standard, it is a definite step forward for seafarers.

3.4.2 Hours of Rest

The International Labour Organization including the ILO Maritime Labour Convention (MLC) covers seafarers' minimum rest periods to prevent fatigue and ensure that seafarers are fit for duty.

1. The limits on hours of work and rest shall be as follows:

(a) Maximum hours of work shall not exceed:

(i) 14 hours in any 24-hour period

(ii) 72 hours in any 7-day period

Or

(b) Minimum hours of rest shall not be less than:

(i) 10 hours in any 24-hour period

(ii) 77 hours in any 7-day period

2. Hours of rest may be divided into no more than two periods, one of which shall be at least six hours in length, and the interval between consecutive periods of rest shall not exceed 14 hours.
   Seafarers will need to review and sign a record of their work/rest hours periodically (typically at least once a month) to ensure they comply with the minimum rest hours stipulated.
   Similar, but less stringent, requirements regarding minimum hours of rest are contained in Section A-VIII/1 of the International Convention on Standards of Training, Certification and Watchkeeping (STCW) for Seafarers.

3.5 Standards of Training, Certification and Watchkeeping for Seafarers (STCW)

The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (or STCW), 1978 sets qualification standards for masters, officers and watch personnel on seagoing merchant ships. STCW was adopted in 1978 by conference at the International Maritime Organization (IMO) in London, and entered into force in 1984. The Convention was significantly amended in 1995.

The 1978 STCW Convention was the first to establish basic requirements on training, certification and watchkeeping for seafarers on an international level. Previously the standards of training, certification and watchkeeping of officers and ratings were established by individual governments, usually without reference to practices in other countries. As a result standards and procedures varied widely, even though shipping is extremely international of nature.

The IMO Convention on Standards of Training Certification and Watchkeeping for Seafarers adopted a new set of amendments in Manila in 2010 called The Manila Amendments. These amendments were necessary to keep training standards in line with new technological and operational requirements that require new shipboard competencies. The Manila Amendments were effective as of 1 January 2012. There is a transition period until 2017 when all seafarers must be certified and trained according to the new standards.

A detailed review of STCW code section A-II/2 indicates the Mandatory minimum requirements for training and certification that professional mariners must have based on the capacity they serve in the type of vessel they work on.

3.5.1 Training Requirement

It is known that 80% of transport accidents are due to human error. It is the human element on board ship that can either provide the skills that may prevent a disaster, or the frailty or lack of competence that can cause one. And, while the capability, complexity and sheer power of technology seems to be accelerating exponentially, the human element remains a basic component with all its strengths and all its weaknesses.

That is why the international maritime community has now evolved from an approach, which traditionally seeks technical solutions to safety-related problems and is focusing instead on the role of human factors in maritime safety.

The STCW Convention is one of several key initiatives that underpin this new philosophy at IMO. It seeks to establish a baseline standard for the training and education of seafarers throughout the world and, by placing an emphasis on quality control and competence-based training, and practical demonstrations of competency in the form of training record books and assessments conducted by qualified assessors onboard the ship or at maritime schools.

The primary purpose of the STCW 2010 Manila Amendments are as follows:

- To enhance the requirements for refresher training in safety related certificates every five years.
- To require additional security training for all levels of seafarers.
- To require Human Element Leadership and Management Level training for deck and engineering officers.
- To require additional training in Chapter V for tank vessel personnel.
- To require formal training for all officers in modern technology.
- To consolidate the training in Chapter V for all passenger vessels to include RO-RO vessels.
- To introduce modern training methodology (e.g. Web-based learning).
- To harmonize the rest periods with the provisions established by the Maritime Labour Convention 2006.

These amendments went into force in January 2012 with a five year phase in and implementation plan and a 1 January 2017 deadline for all mariners. New mariners beginning their sea service after January 2013 must be in compliance with the amendments at the start of their training.

3.5.2 Bridge Team- Resource Management (BTM-BRM)

Weakness in bridge organization and management has been cited as a major cause for marine casualties worldwide. Accidents in operations are frequently caused by resource management errors.

Better procedures and training can be designed to promote better communications and coordination on and between vessels. Bridge Resource Management (BRM) is a first step towards improvement and it was a concept introduced by STCW (Chapter VIII, Part 3-1). [1] BRM reduces the risk of marine casualties by helping a ship's bridge crew anticipates and correctly respond to their ship's changing situation.

Bridge Resource Management (BRM), or as it is also called Bridge Team Management (BTM), is the effective management and utilization of all resources, human and technical, available to the Bridge Team to ensure the safe completion of the vessel's voyage. BRM focuses on bridge officers' skills such as teamwork, teambuilding, communication, leadership, decision-making and resource management and incorporates this into the larger picture of organizational and regulatory management.

BRM addresses the management of operational tasks, as well as stress, attitudes and risk. It also recognizes that there are many elements of job effectiveness and safety, such as individual, organizational, and regulatory factors, and they must be anticipated and planned for. BRM begins before the voyage with the passage plan and continues through the end of the voyage with the passage debrief.

When BRM is correctly practiced onboard a vessel the result should be a Bridge Team that:

- Maintains its situational awareness.
- Continually monitors the progress of the vessel making appropriate adjustments and corrections as necessary to maintain a safe passage.
- Acquires relevant information early.
- Appropriately delegates workload and authority.
- Anticipates dangerous situations.
- Avoids becoming pre-occupied with minor technical problems and losing sight of the big picture.
- Undertakes appropriate contingency plans when called for.
- Recognizes the development of an error chain.
- Takes appropriate action to break the error-chain sequence.

3.5.3 Electronic based Training

As the maritime industry make efforts to mature in its use of learning technologies, it emphasizes on how to best use the tools that we have at hand, both to maximize efficiency and to optimize training outcomes. One step forward regarding additional training for mariners is the use of Computer-Based Training (CBT) modules (e.g. Seagull) on board ships.

Each CBT module is a dedicated multimedia program consisting of a number of chapters of learning material followed by an assessment section. The final assessment chapter contains a database of multiple choice questions from which final assessment tests can be randomly generated.

Lessons are delivered with a sequential text and normally include a mixture of illustrations, animations and video clips as appropriate to the text. A training session can be interrupted at any time and continued at a later date. However, the final assessment can only be performed once.

All CBT Courses:

- Are comprehensive industry-based courses.
- Include practical tasks and stimulating visuals.
- Incorporate computer-based assessment.
- Produce records of the training time and the user identification.

• Can be used for self-study purposes or in a trainer-led environment.

• Provide printable certificates showing pass / fail status.

• Allow users to choose their material and study at their own pace.

3.6 International Organization for Standardization (ISO)

ISO is an independent, non-governmental international organization with a membership of 161 national standards bodies.

Through its members, it brings together experts to share knowledge and develop voluntary, consensus-based, market relevant International Standards that support innovation and provide solutions to global challenges.

You'll find our Central Secretariat in Geneva, Switzerland. Learn more about our structure and how we are governed.

International Standards make things work. They give world-class specifications for products, services and systems, to ensure quality, safety and efficiency. They are instrumental in facilitating **international trade**.

ISO has published 22071 International Standards and related documents, covering almost every industry, from technology, to food safety, to agriculture and healthcare. ISO International Standards impact everyone, everywhere.

ISO began in 1946 when delegates from 25 countries met at the Institute of Civil Engineers in London and decided to create a new international organization 'to facilitate the international coordination and unification of industrial standards'. On 23 February 1947 the new organization, ISO, officially began operations.

Since then, we have published over 22071 International Standards covering almost all aspects of technology and manufacturing.

Today we have members from 161 countries and 780 technical committees and subcommittees to take care of standards development. More than 135 people work full time for ISO's Central Secretariat in Geneva, Switzerland.

3.6.1 A Human-Centre Approach

While human errors are all too often blamed on inattention or mistakes on the part of the operator, more often than not they are symptomatic of deeper and more complicated problems in the total maritime system. Human errors are generally caused by technologies, environments, and organizations which are incompatible in some way with optimal human performance. These incompatible factors set up the human operator to make mistakes.

Traditionally, management has tried either to cajole or threaten its personnel into not making errors, as though proper motivation could somehow overcome inborn human limitations. In other words, the human has been expected to adapt to the system. This does not work. Instead, what needs to be done is to adapt the system to the human.

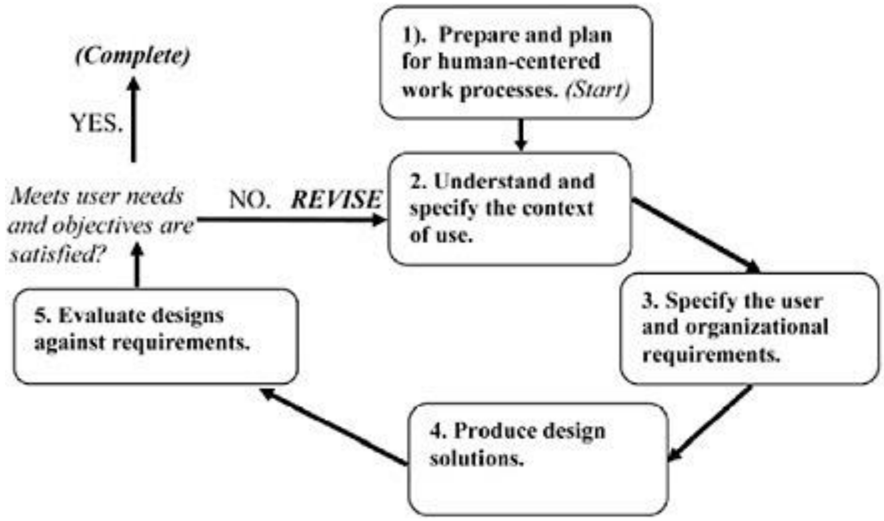
An international standard ISO 9241-210: Ergonomics of human-system interaction provides guidance on achieving quality by incorporating user centred design activities throughout the life cycle of interactive systems. With its introduction in 2008, it revised ISO 13407, Human-centred design processes for interactive systems, 1999.

ISO 9241-210 describes user centred design as a multi-disciplinary activity, which incorporates human factors and ergonomics knowledge and techniques with the objective of enhancing effectiveness and productivity, improving human working conditions, and counteracting the possible adverse effects of use on human health, safety and performance.

Human factors are all those things that enhance or improve human performance in the workplace by focusing on their inherent characteristics. The discipline of human factors is devoted to understanding human capabilities and limitations, and to applying this information to design equipment, work environments, procedures, and policies that are compatible with human abilities.

Human factors apply scientific knowledge and principles as well as lessons learned from previous incidents and operational experience to optimise human wellbeing, overall system performance and reliability. In this way we can design technology, environments, and organizations which will work with people to enhance their performance, instead of working against people and degrading their performance.

This kind of human-centered approach (that is, adapting the system to the human) has many benefits, including increased efficiency and effectiveness, decreased errors and accidents, decreased training costs, decreased personnel injuries and lost time, and increased morale and also the development of sustainable and safe working cultures.



3.6.2 Risk Assessment Matrix

ISO 31000 was published as a standard on the 13th of November 2009 with the purpose to provide generic guidelines for the implementation of risk management. [61] Risk assessment is an effective means of identifying process safety risks and determining the most cost-effective means to reduce them. Risk assessment uses a matrix that has ranges of consequence and likelihood as the axes. The combination of a consequence and likelihood range gives an estimate of risk or a risk ranking.

An effective risk assessment matrix should have the following characteristics:

• Be simple to use and understand.

• Not require extensive knowledge of quantitative risk analysis to use.

• Have clear guidance on applicability.

• Have consistent likelihood ranges that cover the full spectrum of potential scenarios.

• Have detailed descriptions of the consequences of concern for each consequence range.

• Have clearly defined tolerable and intolerable risk levels.

• Show how scenarios that are at an intolerable risk level can be mitigated to a tolerable risk level on the matrix.

• Provide clear guidance on what action is necessary to mitigate scenarios with intolerable risk levels.

Construction of a risk matrix starts by first establishing how the matrix is intended to be used. Some typical uses for risk ranking are process hazard analyses, facility siting studies, and safety audits. A key initial decision that has to be made is to define the risk acceptability or tolerability criteria for the organization using the matrix. Without adequate consideration of risk tolerability, a risk matrix can be developed that implies a level of risk tolerability much higher than the organization actually desires.

Another key aspect of risk matrix design is having the capability to evaluate the effectiveness of risk mitigation measures. The risk matrix should always allow the risk ranking for a scenario to move to a risk tolerable level after implementation of mitigating measures. Otherwise it may be difficult to determine the effectiveness of mitigation measures.

The next step is to define the consequence and likelihood ranges. A typical risk matrix is a four by four grid. First determine what the consequences of interest are. These can include personnel safety, public safety, environmental impact, property damage/business interruption, corporate image and legal implications. Each consequence of interest may have a different definition for a specified consequence category consequence range.

Dealing with safety risks includes:

- Avoiding the risk by deciding not to start or continue with the activity that gives rise to the risk
- Accepting or increasing the risk in order to pursue an opportunity
- Removing the risk source
- Changing the likelihood
- Changing the consequences
- Sharing the risk with another party or parties (including contracts and risk financing)
- Retaining the risk by informed decision.

RISK ASSESSMENT MATRIX				
SEVERITY / PROBABILITY	Catastrophic (1)	Critical (2)	Marginal (3)	Negligible (4)
Frequent (A)	High	High	Serious	Medium
Probable (B)	High	High	Serious	Medium
Occasional (C)	High	Serious	Medium	Low
Remote (D)	Serious	Medium	Medium	Low
Improbable (E)	Medium	Medium	Medium	Low
Eliminated (F)	Eliminated			

LIST OF ABBREVIATIONS

ALARP: As Low As Reasonable Practicable

BRM: Bridge Resource Management

BTM: Bridge Team Management

BNWAS: Bridge Navigational Watch Alarm System

HFE Human Factors Engineering

ILO: International Labour Organization

IMO: International Maritime Organization

ISM: International Safety Management code

ISO: International Organization for Standardization

MLC: Maritime Labour Convention

M/S: Motor Ship

MSC: Maritime Safety Committee

OOW: Officer Of the Watch

PPE: Personal Protective Equipment

SMCP: Standard Marine Communication

SMS: Safety Management System

SOLAS: Safety Of Life At Sea

SOP: Standard Operating Procedures

S/S: Steam Ship

STCW: Standards of Training, Certification and Watchkeeping for Seafarers

CONCLUSION

Recapitulating, this dissertation has introduced the concept of human element on board the vessel, in an attempt to deal with this issue and prove the importance of the human factor on board ships.

We have seen that human error (and usually multiple errors made by multiple people) contributes to the vast majority (75-96%) of marine casualties, making the prevention of human error of paramount importance if we wish to reduce the possibility of maritime accidents.

People are important and ships need competent, qualified, and motivated seafarers to operate well. So, humane treatment and human centre orientation must be promoted on board the vessel.

To summarize with, it is seen that the role of the human being is all-important. If both seafarers an ship management follow the above steps and implement the International Conventions we can prove in practice that the human element is the master of the sea environment.

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