The Impact of Human Element in Shipping Industry

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Abstract:Today there are less number of active seafarers in our midst, "Besides", they are the great important element in shipping and slowly this industry is beginning to realize the central importance of seafarers. The crisis is coming and the industry is awakening to the fact it must deal with the human element in its business. Therefore in this paper it is intended to establish priorities to human factor, According to Ergonomics the scientific study concerned with understanding of interactions among humans and other elements of a system. Furthermore by the exploratory study it was observed that human error contributing to 75% & remaining 25% technical failures, According to the study it is reveal that taking risk in work, inadequate training, not following rules & regulations, habitability issues (engine noise, sea sick, fatigue, vibration, illuminations, sleep disturbance, temperature), No team work, lack of communication, lack of application of safety, inadequate knowledge, crew negligence, inattention, overconfidence, work schedules. A valuable ergonomics will safe the human element & increases the productivity. This paper is to predict the outcome of human impact on marine accidents.

Keywords:Safety at sea, marine accident, Human factor, Human error, Automation

I. INTRODUCTION

In day today life Freight transports 23 million tonnes of cargo and 55,000 cruise passengers every day. The ship possessor and ship designers aim for bigger ships for additional profitability. As the ship size increases, there is a need to install extra powerful engines and other machineries. Shipping industries evolve in bulk carriers to meet demand. so this made large ships, high voltage ships, H.V installations, design standardization, reduced number of crew, increased digitalization & automation.

Therefore this paper studies marine accidents caused by human error resulting from improper human-technology interaction. The aim of the paper is to propose measures to prevent reoccurrence of such accidents and to protect human crucial element. The factors that caused these accidents are examined and categorized.

II. OCCUPATION, DESIGNING OF JOBS & TRAINING

The Marine Industry is high risky & mariners have to work in harsh working environment, often for a long period of time without regular rest. They work at sea for long periods more than 6 months with continuous shift

1.1 HUMAN FACTOR:

The result of this analysis states its prime important for human safety. By reviewing majority of cases the incidents was due to the following taking risk in work, inadequate training, not following rules & regulations, habitability issues (engine noise, sea sick, fatigue, vibration, illuminations, sleep disturbance, temperature), No team work, lack of communication, lack of application of safety, inadequate knowledge, crew negligence, inattention, overconfidence, work schedules. If this deficiency does not exist, then serious accidents would have been prevented.

1.2 HUMAN ELEMENT FATIGUE:

Analysis:

1. After the root cause analysis it is determined many accidents are due to people getting tired.
2. As per the record the resting time is not fully used by the people, instead they work for long time & get fatigue; they should sleep for a period as per record.
3. Fatigue is the main phenomenon, about 11 to 23% of collisions & grounding accidents.
4. Daily watch & excessive work load can lead to fatigue.
5. Ship movement, Engine acoustic noise/vibration, less space, illuminations can lead to fatigue.
6. The workers in ship engaging in drug /alcohol or abuse substance, this addiction could source the person to behave erratically and there by lead to an unwanted maritime accident on board.

Fig 1: Marine Accident

Prevention:

1. Basically there will be a watch alarm installed on each vessel connected with push button that has to be pushed for about every 15 minutes, the time duration can be varied but can't be too long. This ensures the officer in watch can't fall asleep.

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2. If the alarm push button not operated then there will be a flash light, if flash light is ignored then there will be a sound alarm and the captain will be informed.
3. When the captain comes to know the person on watch is tired the captain may replace with another person.
4. Human being presence detecting sensor can be installed with automatic alarm system. During fatigue condition the heartbeat will vary the rhythmic pulsate will be slow. This variation can be detected by the sensor.

1.3 EXPLORATORY FIELD STUDY:

1) ROGUE WAVES:

The high impulsive waves up to 100 feet tall natural occurrence which cannot be predicted.

Case1 (2005):

The Grand Voyager of Iberojet Cruises was Strike by a wave that smacked out propulsion and communications systems and injured 20 passengers.

Case2 (2010):

The Louis Majesty, operated by Louis Cruise Lines, was struck by 26-footwaves off the coast of France, smashing glass and killing two of the 1,400Passengers and injuring another 14.

Fig 2: Impulsive Wave

Root cause Analysis:

Windows of the ship are being strengthened. By the prevalence of rogue waves across the ocean so, those ships can be warned to avoid high-risk areas. But the unpredictable nature of these waves can make them difficult to forecast.

2) AUTOMATION RELATED ACCIDENT:

Description:

[5]Case1: 2009

In the vessel Big Orange XVIII was approaching installation Ekofisk 2/4 X. .The autopilot mode was engaged by the captain and forgot to switch it off. He could not control the vessel manually as he intended to do. Instead of slowing down, the vessel struck the installation at a speed of 9.5 knots.

Analysis:

The crew failed to see that the autopilot was engaged and made a wrong decision in Operating the vessel.

Prevention:

The autopilot System will automatically deactivated when the crew operates the joystick.

Fig 3: Uncontrolled Vessel due to autopilot

III. EXPLOSION DURING TANK CLEANING:

Loss of Life and Serious Injury during tank cleaning operation

Description:

The tank cleaning operation was going in the chemical tanker .before entering the charging port. The crew was cleaning the No. 2 Cargo Tank (P) by spraying toluene from the top through tank cleaning hatch opening. A flash back explosion occurred, killing member of the crew, and seriously injuring another. Vessel's hull structure was damaged in way of No. 1 and 2 cargo tanks (P).

Analysis:

Static electricity is occurred due to Toluene liquid. The vapour pressure of this liquid is sufficiently high that creates explosion in normal temperature. The probable cause of the flashback explosion was an accumulation of static electricity that ignited the flammable toluene vapour.

Prevention:

The ICS Tanker Safety Guide (Chemical) makes it clear with strict warnings against the usage of solvents for tank cleaning – unless such cleaning is carried out in an **inert** atmosphere (Nitrogen).

IV. ACCIDENTAL RELEASE OF LIFEBOAT: LIFE LOST

Description:

During a drill, a lifeboat accidentally released from the falls and dropped from stowed position with six members of crew onboard. Unfortunately, one of the crew members was killed.

Root cause Analysis:

Several life boat accidents have been taking place, resulting in loss of life and limb. Several factors have been contributing to these tragic accidents during drill .Example – wrong adjustments of release cables, relatively complex design of release mechanism and understanding of their operation, and insufficient maintenance.

V. FIRES:

Description:

Case1 (2001):

An engine room caught fire on MS.Nordlys passenger ship & killed two members. Also further injured 16 people in ship.

Case2 (Mar7 2017)

A large container ship Maersk line, caught fire in the Arabian Sea which forced the 27 crew members to jump out into the sea.

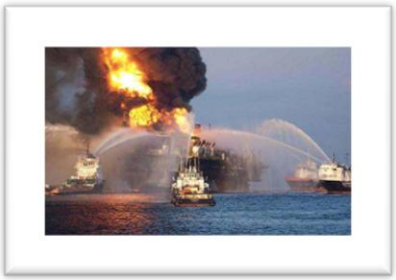

Fig 4: Fire Accident in container ship

Prevention:

1. A smoke detector must be installed throughout the ship with alarms.
2. firefighting teams should be alert in all time with emergency alarm
3. sprinkler piping should be kept all set and organized.

VI. COMMUNICATION ERROR

A constant alertness and vigilance is required for navigating a ship in approaching port, berthing & shallow waters.

According to study there are several factors that creates accidents due to communication. The paramount factors are: Abundant communication, language speech disorder, inadequate structure of communication, erroneously transferred messages, invalid information, inconsistently provided information, too much of other verbal communication and overflow of information.

Fig 5: Abundant Communication

VII. CRANE MISHAPS

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

VIII. STORM

Description:

Case1 (1999) - MALTESE ERIKA

The heavy fuel oil tanker cargo ship broke in two in a storm in the year 1999 December, About 20,000 Tonnes of oil spilled and she sank.

Root cause Analysis:

Several accident of the accident are because of external factors bad weather, such accidents are due to combination of human factor & external factor.

Prevention:

1, The crew will be informed about the weather through **satellites** and **buoys**.

2, Ships can easily avoid the dangerous weather by new modern weather surveillance technology which is highly effective at charting and **predicting storm paths.**

3, Masters after understanding the weather condition must take proper measures such as reduce **speed**, **distress signals** can be sent ,being is a **safer place**, changing the coursecan easily avoid ship accidents due to weather.

4, The master can decide whether to sail or not in worst weather condition.

IX. ACCIDENTS IN SHIPYARDS

The shipyards the place where the ship is assembled and constructed in its entirety.

1, welding and fitting accidents are common in the shipyards during the manufacturing of ship.

2, poisonous gases, fumes are produced in those areas inhaling those gases can become hazard to the human element, proper oxygen analyzers', oxygen cylinders can be used to avoid such accidents.

X. ACCOMMODATION FACILITIES

1, Operating moving hook can hit the person in head due to confined place.
2, Workers squeezed between moving containers.
3, Illumination
4, person getting twisted foot, fall in less space
5, Autopilot interface system poorly designed.
6, The crew members expect adequate levels of privacy

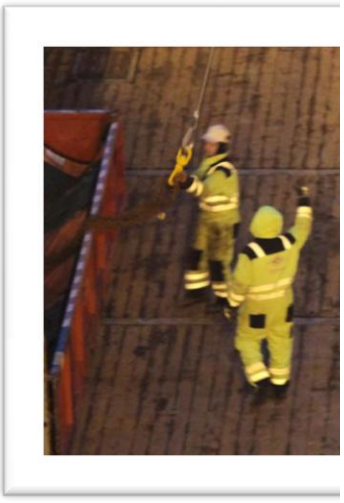

Fig 6: Confined Area

XI. CONFINED SPACE LEADS TO ACCIDENTS

1, Several casualties and severe injuries happens on board due to confined /enclosed space.
2, Near deck areas in the tanker ships toxic/flammable gases may be present.
3, Proper safety measures gas analyzers' with alarm systems can be used to avoid suffocation while inhaling.
4, The mariners must be cautious in entering such areas.

Fig 7: Enclosed Space

XII. COLLISION

Description:

Ship collusion is a structural clash between two ships (vessel collisions), single ship and also Ships get collided due to rock, reefs, and icebergs, vessels collisions. Ships are fitted with a receiver for a global navigation satellite system (GPS / DGPS or GLONASS Global navigation satellite system), or a terrestrial radio navigation system (LORAN-C), or AIS automatic identification system ,or other suitable means, for use at all times throughout the intended voyage to establish and update the ship's position automatically. Recent collision is due to improper use of collision avoidance aids & over –reliance on navigational equipment.

Case1:

The most serious accident occurred in 1992, when a Greek cruise ship hit a fishing trawler, killing more than 30 passengers.

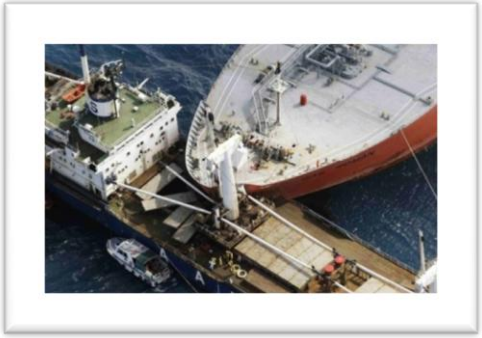

Fig 8: Collision of ships

Case2: (2012) costa Concordia

The cruise ship strikes the rock, **Reef** and started to flooded water in the engine room and she ran aground with 4229 people on board.

Analysis:

About **32 lives** lost in the collision, captain makes unauthorized departure from intended route.

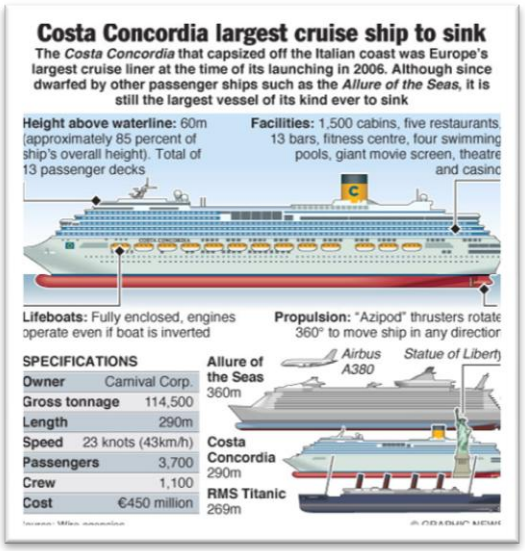

Fig 9: Cruise ship strikes Rock

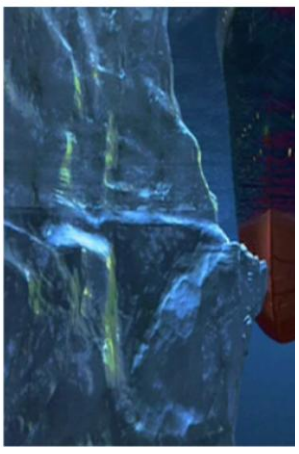

Fig10: Hitting at iceberg

2, Improper mooring may leads to extremely dangerous situation taking lives/serious injuries of several officers & crew members.

Prevention:

1, Crew using outdated charts can lead to collisions.
2, Crew must upload accurate charts in the system so that it will be better effective.
3, Proper radio communication & navigational aids that use GPS and maritime charts to plot location.
4, must avoid taking short cuts, unauthorized routes.
5, we must be alert and always stick to the safety procedures, rules & polices.

Fig 11: Mooring

XIII. LIFE LOST IN MOORING

1, mooring operations needs proper skills and knowledge to the workers

Table 1: TABULATION SHOWNG SAFETY FACTORS

	Factor							
	1	2	3	4	5	6	7	
It is easy to do maintenance of the vessel	0,91							Reliability & maintaining
It is easy to operate the equipment on board	0,76							
The system on the bridge is quite informative	0,73							
The vessel has a good layout	0,71							
Most systems have good reliability	0,69							
We have too many alarms on board		0,92	0,31					Complex Interfacing
We have too much automation on board		0,79						
The computer menu system is too complicated		0,77						
Sometimes the alarm system is confusing		0,71						
It's not easy to manoeuvre the vessel			-0,91					Manoeuvrability
The vessel has a good manoeuvring capability			-0,85					
The vessel has a good and reliable DP system			-0,79					
It is easy to manoeuvre the vessel			-0,74					
Sometimes we cannot rely on the autopilot			-0,65					
There are so many forms & checklists to fill in				0,89				Procedure
We have too many procedures to follow				0,77				
Some areas of the vessel are very noisy					-0,82			Deck condition
The cargo deck is well designed					0,80			
The ECR is designed so it can be monitored and operated easily						0,81		ER & ECR
The ER can be maintained without any trouble						0,77		
Sometimes I can't sleep well on the vessel							-0,93	Habitability
Sometimes we can feel that the vessel is moving too much							-0,84	
Extraction Method: Principal Component Analysis Rotation Method: Oblimin with Kaiser Normalisation								

XIV. RESULT:

The seafarers be obliged to reduce taking risk& need to analysis the root-cause, As per the record resting time are not taken but recorded, so proper slack off time should be taken, We must learn from other peoples blunder, Always enhancing or improving safety, Disciplined approach, effective auditing and safety targets, adherence to safety and to empower crew to take ownership.

Shipping companies can provide added availability of communication services with the family, human elements can be given entertainment Services. This may improve healthy morale. To further improve the safety it is required to a great extent of dedication, skill & knowledge. The crew members should have adequate knowledge about the system. By the evaluations of the accident reports it is confirmed unproductive relationship between human & technology is one of the factors that contribute in human error.

Confused/unable to understand about the technology will create error which leads to serious accidents. Standardization of bridge is a challenge, it is essentially significantly important to conduct training on the similar systems which is installed on board. Also the crew members should be provided with safety information.

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