



MARS – Lessons Learned

MARS Report No 369 July 2023

■ **Editor's Note:** With all the recent press coverage about the power of Chat GPT-4, I decided to run my own specific test, a question about learning from accidents. While the large-scale multimodal model on which GPT-4 generates its output is far from infallible (GPT-4 has been known to 'hallucinate' facts and make reasoning errors), the answer to the question came back in about two seconds and, in my opinion, was quite good. (March 14 version of Chat GPT-4)

Q: Why is it that even after in-depth investigations into accidents that reveal the contributing factors, the same mistakes are made and similar accidents happen again?

GPT-4 Answer: There are several reasons why the same mistakes are made and similar accidents happen again, even after in-depth investigations into accidents have revealed the contributing factors. Here are some possible explanations:

Human Error: Humans are fallible, and even with the best training, people can make mistakes. While investigations can identify contributing factors and provide recommendations for improvement, it is ultimately up to individuals to implement these recommendations and make changes to their behaviour. Unfortunately, even with the best intentions, people can slip back into old habits and repeat the same mistakes.

Organisational Culture: Organisational culture plays a significant role in safety. If an organisation has a culture that prioritises production or efficiency over safety, then accidents are more likely to occur. Investigations may identify this culture as a contributing factor, but changing an organisation's culture is a long-term and challenging process.

Complexity: Many accidents occur in complex systems, such as transportation or healthcare. These systems involve multiple components and people, and accidents can happen when these components and people interact in unexpected ways. Investigations may identify some of the contributing factors, but it can be challenging to anticipate all possible interactions and prevent accidents.

Lack of Resources: Even when investigations identify contributing factors and provide recommendations for improvement, implementing these recommendations may require additional resources, such as time and money. If an organisation does not have the resources to make the necessary changes, then accidents may continue to occur.

Failure to Learn: Finally, it's possible that organisations or individuals simply fail to learn from past accidents. Investigations may identify contributing factors and provide recommendations, but if these recommendations are not communicated effectively or implemented consistently, then accidents may continue to occur.

In summary, while investigations can provide valuable insights into accidents, preventing similar accidents from happening again requires addressing complex issues such as human behaviour, organisational culture, system complexity, resource allocation, and learning from past mistakes.

To conclude, I would humbly submit that by reading MARS reports, and by contributing your own accidents and incident reports to MARS, we can lend a hand at the fourth element listed by Chat GPT-4, that of Lessons Learned.

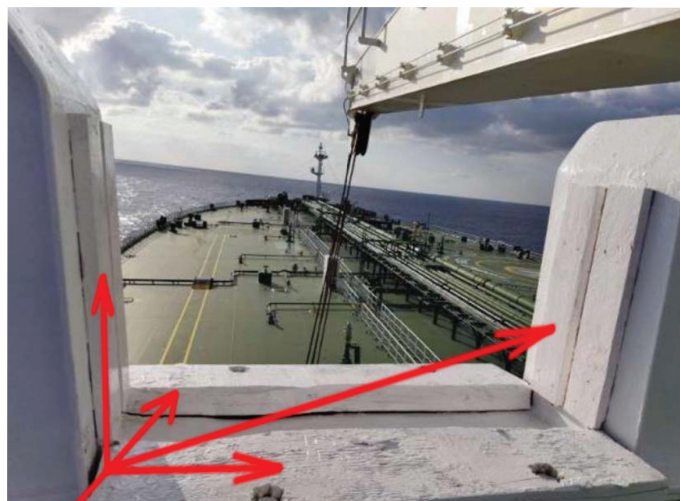
Paul Drouin FNI, Editor, MARS

MARS 202330

Dropped object incident causes minor injury

→ While disconnecting the cargo hose on a tanker with the ship's crane, a member of the shore personnel working on deck suffered a minor injury from a small piece of wood that fell from height. The wooden piece was sheathing placed around the boom's 'parking crutch' to avoid metal-to-metal contact. Over time, the securing arrangement for the sheathing had come loose, and when the boom was lifted, it slipped from position and fell, striking the shore crew. The victim was given first aid and was in good medical condition thereafter.

The company investigation found, among other things, that the monthly maintenance of the crane was not carried out as per the Planned Maintenance System (PMS). Visual inspection of the sheathing would likely have identified the wear and probably avoided the accident.



New wood sheathing as installed after the incident

Lessons learned

- Monthly PMS inspections are established for a reason and should be carried out with due diligence and 'fresh eyes' at each repetition.
- In this instance, no specific PMS task was assigned to checking the condition of the wood sheathing. When new hazards are discovered, risks can be reduced by creating a specific PMS task for the object of the hazard.

MARS 202331

Torque for safety

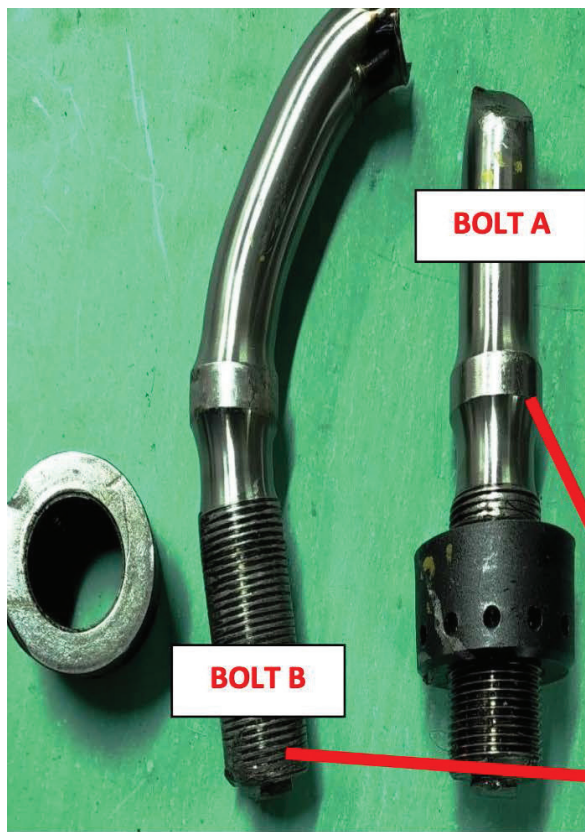
➔ The engine crew started auxiliary engine No.1 for a routine operational test while at anchor. After about two minutes of warm up the engine was connected to the electrical board. A few minutes later, there was a loud noise followed by strong vibrations. Numerous alarms were activated, and the engineers immediately disconnected and stopped the affected engine.

A forensic examination of the damaged engine and reconstruction of the sequence of events suggested that one of the two studs of the cam shaft connecting rod for cylinder two had not been adequately tightened during maintenance. A gap developed due to stud B being under-torqued. This overstressed stud A, which consequently sheared and caused the subsequent damage sequence.

Following this hypothesis, the hydraulic stud tensioning pump used for tightening the con rod mechanism was thoroughly examined. The pressure gauge on this pump read 60 bar higher than actual supplied pressure. This could well have led to the less than adequate tensioning of the connecting rod nuts during maintenance, and could be the cause of premature failure. The company subsequently added periodic calibration of the hydraulic stud tensioning pump as a separate item within the PMS.

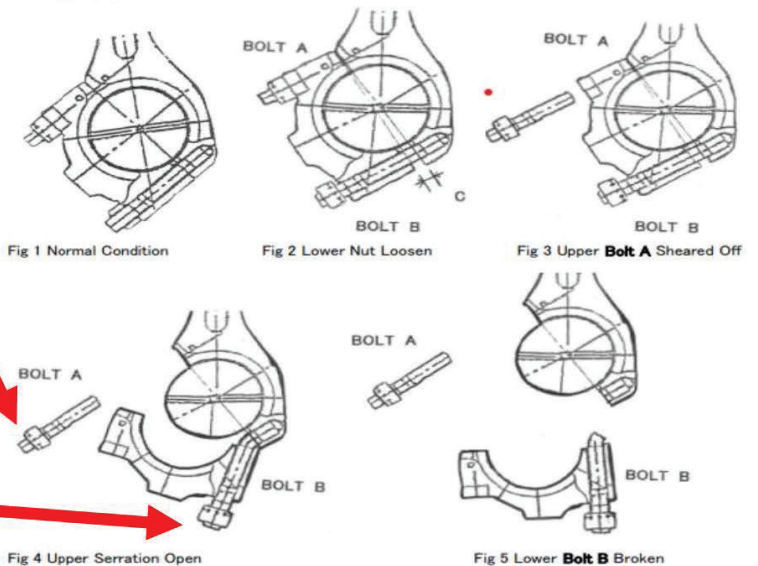
Lessons learned

- Correct stud/bolt torquing of engine parts is a critical feature of maintenance. Many incidents and accidents have occurred in the past due to incorrect torquing. Having a properly calibrated tensioning pump is vital to attain the required specifications.
- Planned Maintenance Systems (PMS) are a lynchpin of safety – use them rigorously and add value to them when the opportunity presents itself, as in this occurrence.



< Mechanism of Con Rod Failure > / 6N21 (A) L

1. The con rod is tightened normally as Fig 1 and rotates 12(720min⁻¹) or 15(900 min⁻¹) times in a second.
2. In the case of the lower Bolt B is improper tightened, the Bolt B is gone to loose. The serration part B is going to open as Fig 2 with opening C.
3. The all combustion load F goes to Bolt A, the Bolt A is exceeded its strength. Then brake and shear off Bolt A in strait shape as Fig 3, the serration part A open freely as Fig 4. The tightening seats Bolt B and cap B side get the fretting and pitting marks.
4. The all combustion load F goes to Bolt B, the break and shear off Bolt B with bended shape, caused by opened serration part A hit several places, liner, cylinder block and balance weight of crankshaft as Fig 5.



MARS 202332

Paltry PPU position predictor

As edited from TSB (Canada) Report M14P0014

➔ In darkness and with visibility further reduced to about 150m in fog, a container vessel was being brought to a tidal river berth under pilotage. To monitor the vessel's progress, the pilot had set up his portable pilotage unit (PPU). He had connected the rate-of-turn generator to the vessel's pilot plug and had set a variable range marker on the radar with a radius of 0.5 nm. The PPU had a predictor that continually self-updated to display the vessel's next six predicted positions at intervals of 30 seconds.

The pilot and the Master had exchanged their respective information; the passage plan, local traffic and berthing procedure (pilot) and the vessel's condition and manoeuvring data (Master). The pilot increased the vessel's speed in order to overcome cross-currents at the mouth of the river and then commenced a starboard turn to enter the river as normal. Soon, the vessel's speed was about 16 knots. At this point, the Master was using the ECDIS located at the starboard conning position to monitor the vessel's progress, while the OOW was using a paper chart.

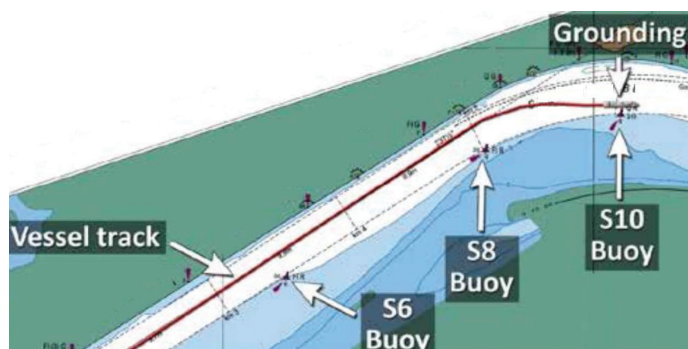
At 2150, the pilot ordered half ahead. About two minutes later the pilot ordered 15 degrees of starboard helm to initiate the turn through the next bend in the river. He then used the predictor to assess the vessel's rate of turn. Soon he ordered the rudder angle to be reduced to 10 degrees to starboard, then to 5 degrees and finally to midships.

At 2153:20 the vessel's speed was near 14 knots and the rate of turn was about 25 degrees/minute to starboard. About a minute later, with the speed now 13 knots, the pilot cross-checked information from the PPU predictor with the radar. The radar information showed the vessel was not proceeding as indicated on the PPU so he ordered counter rudder to port and full ahead on the engine to stop the turn to starboard and correct the vessel's position in the channel. This action

was insufficient and the vessel grounded at 2156, within the navigable channel but in an area where silting had been reported and that the pilot knew was present. With the rising tide the team were able to re-float and dock the vessel about two hours later.

The official investigation found, among other things, that;

- The pilot's PPU was obtaining information from the vessel's AIS, which was subject to GPS 'smoothing'. As a result, the predicted vessel positions displayed on the PPU were not accurately reflecting the vessel's future positions, but the pilot was unaware of this. Also,
- The pilot did not inform the bridge team about the extent of silting within the navigable channel nor had the bridge team taken steps to obtain this information. As such, the bridge team was unable to identify or to assist the pilot in resolving the developing unsafe situation.



Lessons learned

- Had the pilot used an independent DGPS antenna for his PPU the predicted positions would probably have been more accurate than those represented by the vessel's AIS pilot plug.
- Communication and planning is everything! The silting in the channel was not communicated to the bridge team by the pilot – but neither did the vessel's team take the time to research this fact which was readily available via on-line sources.
- Speed changes everything! In this case the vessel was proceeding at near 13 knots (6.68m/sec) in a narrow channel in near zero visibility. Proceeding at nine knots (4.63m/sec) would have given them extra time, about one minute, to reevaluate the circumstances and manoeuvre. This would likely have prevented the grounding.

MARS 202333

TSS crossing with crossed signals

As edited from MAIB (UK) report 20/2008

In darkness and good visibility a car carrier under pilotage entered the south-west traffic lane of a busy traffic separation scheme (TSS) at a speed of 17 knots. There was a container ship 1.7 nautical miles (nm) ahead on a similar course and speed. At 02:49 a target was acquired by radar at a range of 5nm. Four minutes later, the ARPA alarm sounded, warning the bridge team on the car carrier that this target was a danger. It was now 2.89nm away, with a CPA of 0.21nm in 5.12 minutes.

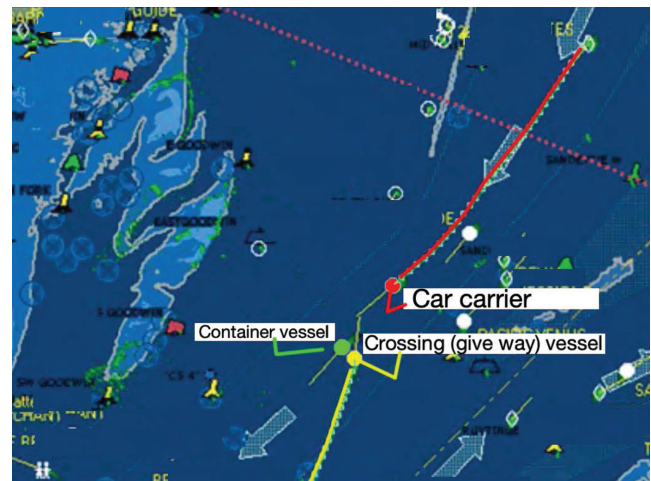
The pilot of the car carrier attempted to call the target vessel on VHF to no avail. Hand steering was soon engaged and, even though they were the stand-on vessel, 10 degrees of starboard helm was ordered. When the vessel had turned about 30 degrees to starboard, the wheel was returned to amidships. The pilot then called Vessel Traffic Services (VTS) to inquire about the intentions of the target vessel. During the next two minutes there was an exchange on VHF radio between VTS and the two vessels, but the give way vessel was not clearly communicating their intention to alter course. Soon, the pilot on the car carrier ordered the helm hard-a-starboard. The give way vessel was now 1.16nm away, with a CPA of 0.13nm in 2.9 minutes. The pilot on the

car carrier informed the give way vessel on VHF radio: 'You are the give way vessel. Now I am going hard-a-starboard sir. Hard-a-starboard!'. The car carrier completed a 360 degree turn to starboard. As a result of this evasive action, the CPA with the other vessel was now 1nm.

The crossing (give way) vessel had originally planned to cross the TSS at near 90 degrees to the direction of the traffic flow but they had not yet altered course due to traffic. They entered the south-west traffic lane against the traffic flow at a shallow angle. This was far from the 90 degrees as planned or as required by the Colregs. The Master instructed the OOW to carry out a trial manoeuvre on the ARPA radar to accurately assess the situation before committing to an alteration of course. The OOW followed the instructions, but did not enter a time delay.

The CPA information displayed at the bottom right hand side of the screen indicated the container vessel ahead of the car carrier had a CPA of 0.87nm in 13.5 minutes. The Master and OOW understood this to be the results of the trial manoeuvre – where it was in fact real-time data. In line with the company's recommended practice, the Master intended to alter course to port using a slow rate of turn to achieve a 3nm radius. The Master estimated that, by the time own vessel had completed the turn to port, the CPA of the container vessel would have reduced significantly. Accordingly, the OOW was told to initially adjust the course to pass close astern of the container vessel, and continue the alteration to port to pass ahead of the car carrier.

The investigation found, among other things, that in conducting the 'trial manoeuvre' without a time delay, and evidently mistaking the real time CPA data at the bottom right hand corner of the radar display for the CPA following the intended alteration, the information on which the Master based his decision to adjust course to pass between container vessel and the car carrier was inaccurate. It also demonstrated that neither the Master nor the OOW were familiar with the 'trial manoeuvre' function. Also, the slow alteration to port of give way vessel during the crossing of the south-west traffic lane was confusing, and the intentions of the bridge team were not readily apparent to other vessels.



Situation one minute before 360 loop undertaken by car carrier

Lessons learned

- Always cross a TSS at as close to 90 degrees as possible. This allows for unambiguous identification of your intentions.
- Being in a TSS does not give you an automatic right-of-way. In this case, the car carrier in the TSS had the right-of-way. However, had the crossing vessel been coming from the other side of the TSS the car carrier would have been the give way vessel.
- The golden rule for the give way vessel when risk of collision exists: 'take early and substantial action to keep well clear'. Making small, incremental course changes in the hopes of increasing CPA will only add uncertainty and danger to the situation.

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