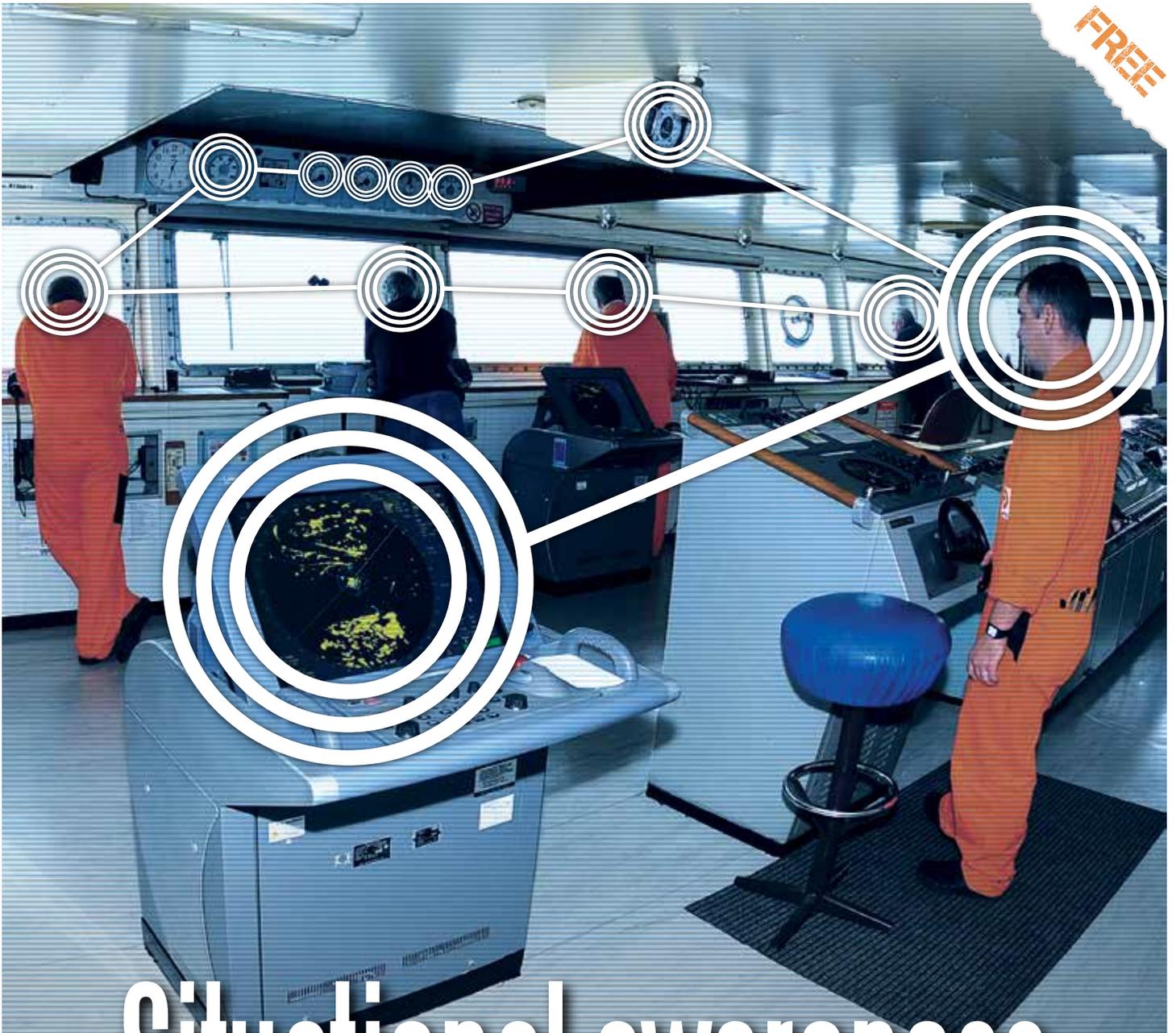


THE NAVIGATOR

Inspiring professionalism in marine navigators

FREE



Situational awareness

The sense of everything



A free publication by **The Nautical Institute** in association with the **Royal Institute of Navigation**

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Situational Awareness

We are always being told about the importance of situational awareness, and it really is absolutely critical for the navigator. So much of Bridge Resource Management is about ensuring situational awareness, and operating as a team to fill in any gaps in our own perception, sharing our mental picture of what is going on and what should happen next.

Maintaining good situational awareness can be challenging and there are many things on a bridge that can cause distraction or overload. 'Look out of the window' is a classic mantra – and one which *The Navigator* continues to emphasise. Remember, though, that human vision is not perfect and needs to be complemented with other tools such as radar, AIS, and even listening to VHF radio traffic. At the same time, it is very possible for navigators to become overloaded with target information, especially if there are also other tasks going on on the bridge. It is important to identify the

risk of overload in yourself and others and to have a plan B such as delegating, prioritising or calling the Master for assistance.

Good situational awareness is not just about observing something in the environment, but being able to correctly identify it and how best to deal with it. This is where experience comes into play, and why it is important to learn from all your encounters. They will prepare you for similar situations in the future. In the accident report on page 8 there is an unfortunate example of how inexperienced officers were not able to identify a tanker coming off its berth as a moving object, leading to huge damages and a sinking.

Navigators must be aware of everything around them. Certainly, you must look ahead – but don't forget to look behind you for overtaking threats. Watch the sky for weather and be aware of what is below your keel and where unseen risks might be lying. A big part of situational awareness

is being aware that you might not have all the facts necessary – or perhaps even noticing and coping with the fact that some of the information you have is incorrect. Chart data can be wrong, particularly if it is old or changed by environmental factors. GNSS systems can be interrupted or even spoofed, AIS data can be incorrect and radar data can be misinterpreted.

Good situational awareness should be a shared activity. When working with a team, share your observations. Don't assume that everyone has the same mental picture as you, or even that your own mental picture is correct. In many instances good situational awareness is just common sense, but it is a sense that can be refined with practice and benefits from experience and a good attitude.

As always, *The Navigator* magazine is about sharing knowledge and starting discussions. Please share this magazine and your thoughts with your team members for the benefit of all.

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Working on board can be very draining. But witnessing the wonder of this colony of birds taking shelter and flying around the ship absolutely lifts the spirits!

Gil Gerarcas
Songa Dream

On the subject of bridge navigation safety, I believe we are starting to turn a corner. This is partly because of bridge management styles changing and partly because the youngsters coming up are far better educated on the dangers of over-reliance on electronics. A lot of the young deck officers are an enormous help to me on the IT front. They know far more than me about running systems of equipment and are keen to help when requested.

Being a Master on any vessel can be highly stressful and how this stress is handled can make a huge difference. Back in the day, the 'Old Man' was someone to be in awe of. They could do no wrong, never made mistakes and, even when they did occasionally, to pull them up on it as a junior was a decidedly dodgy area.

Nowadays, I believe things have changed a lot.

I totally encourage all my crew and especially the bridge team to question me at any time if they are not sure what I'm doing or why I'm doing it. Tool box talks and pre-voyage briefings are a great way of letting everyone know what's expected and what the contingencies are. Just because as Master you have overall responsibility that does not mean you have to shut yourself off from valuable resources, such as a young OOW fresh out of college with all the new innovations and ideas still freshly imprinted.

If one can remember that no-one is infallible and that one is actually not expected to know absolutely everything, it will go a long way towards bringing the whole team together. For instance, I'm a keen student of celestial navigation and regularly use the sextant on board to keep fresh. However, I totally understand that it's a dying art and never berate my junior officers for not always knowing too much about it. That said, I encourage them to have a go if they show an interest and I'm happy to say most do.

Keep up the good work!

Paul Kersey
Master, P&O Maritime Logistics



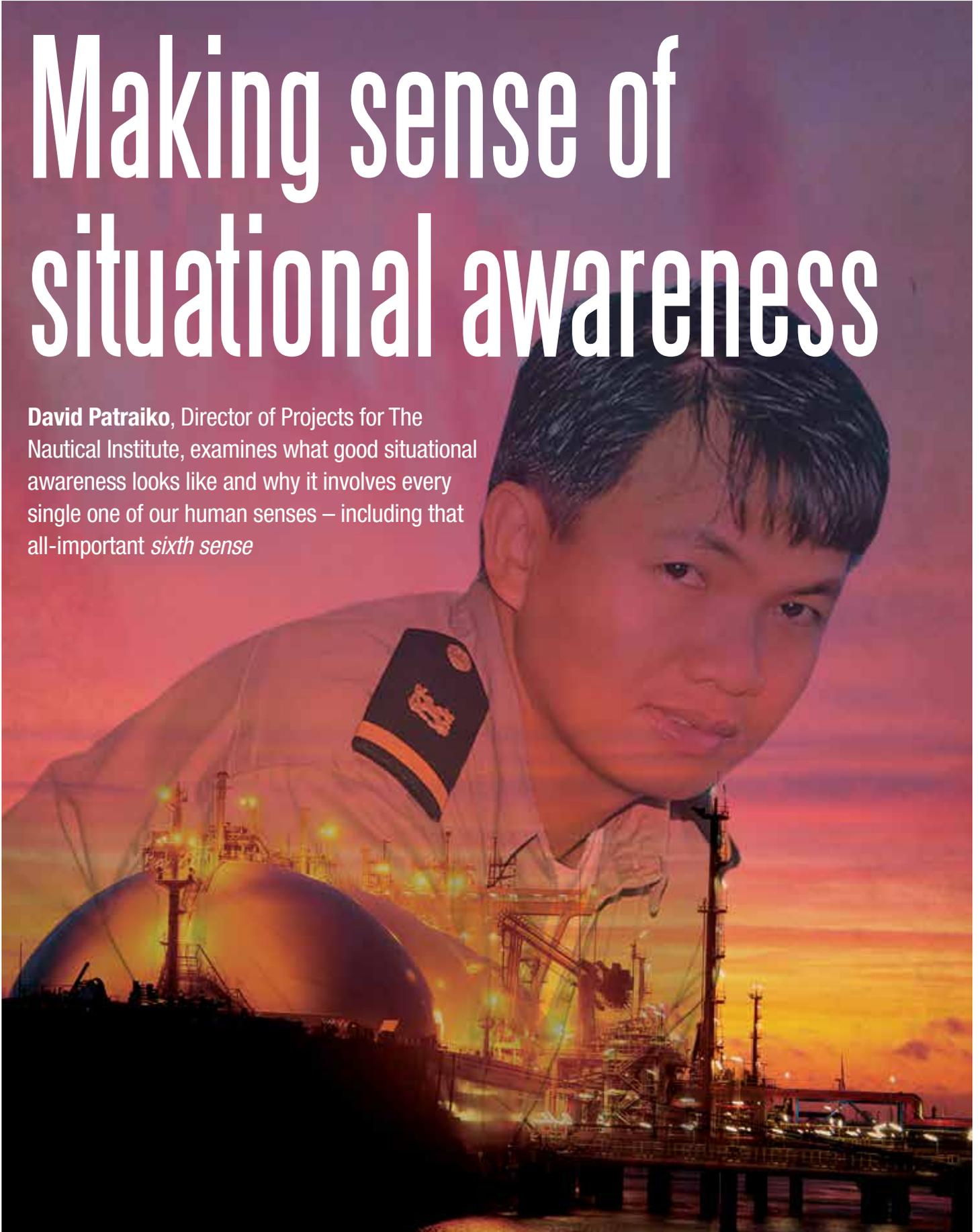
Sharing experience and knowledge builds a stronger team, wherever you are in the world

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Making sense of situational awareness

David Patraiko, Director of Projects for The Nautical Institute, examines what good situational awareness looks like and why it involves every single one of our human senses – including that all-important *sixth sense*



Good situational awareness is about how you perceive the environment around you, how you understand it and how you are aware of the ways in which that environment will change with time. Good situational awareness is important to humans at all times, but it is especially important to mariners, and navigators in particular. Critical decisions for your own safety and the safety of the ship rely on your having good situational awareness.

For the best situational awareness, it is important to use all your senses: sight, hearing, smell, touch – even taste. Some would argue that good situational awareness also includes an elusive ‘sixth sense’, where a ‘gut feeling’ based on experience can offer real insights. Not all senses are used equally but they must all be taken into account to help us recognise, organise and understand our environment. One report suggests that 30% of our brain cortex is devoted to seeing, 8% to touch and 3% to hearing.

On an individual basis, all mariners should use all their senses all the time. Observing the weather will give an indication of predicted ship movement and risks. Hearing an odd sound may give an indication of cargo coming loose – the absence of sound has certainly woken me from sleep (ship blackout)! Smells can warn of burning or leaks, while even taste can be used to identify a contaminated water tank.

On the bridge, situational awareness is crucial for safe navigation and collision avoidance. Sight is used both externally (out the window) and internally (Radar, ECDIS, etc.) and is backed up by the sounds of alarms and VHF and the feel of vibrations, for example when running into shallow water. Changes in smell can indicate problems with cargo.

No ‘I’ in TEAM

When things get busy, it may not be possible for one person to maintain good situational awareness alone. There are just too many things to take account of. Instead, the task must be shared among the team. It may be necessary to have people focused solely on lookout, navigation, communication and collision avoidance. In these cases, all members of the bridge team need to communicate effectively so the officer in charge can maintain overall situational awareness. For example, if the ship is picking up a pilot or approaching a dock, is someone monitoring the other sectors to ensure there are no surprises?

Many accident reports cite loss of situational awareness as the root cause. Good situational awareness is not a state of being; it is an activity that needs to be focused on, discussed, and even trained for. It has many enemies, including boredom, distraction and overload. Most ships ban personal mobile phones for this reason.

Situational awareness is a very human activity involving perception, comprehension and projection. Technology can aid us by offering additional sources of information. However, it can also become confusing if too much emphasis is placed on adding more and more technology for its own sake. Today’s ship’s bridge bristles with more information sources than ever before. Automatic plotting, weather/tidal overlays, MSI and even decision support systems for collision avoidance all aim to help navigators improve their situational awareness. Sometimes they do, but sometimes they can distract.

The amount of data and information will only increase, with some ships already using tools like Lidar, sonar, infrared, low light

optics and Augmented Reality (AR) to try to ‘improve’ mariners’ situational awareness. The challenge for the industry will be to develop these systems so they are fit for purpose, and then ensure mariners are well trained in their use and understand their strengths and weaknesses.

Check your understanding

It is important for navigators to focus on ensuring good situational awareness, and to recognise signs of its loss in themselves and others. One positive indicator is that team members are cross-checking systems with other systems or observations. What might this look like in practice?

Do members of the bridge team share information and try to ensure that they have a shared ‘mental image’? For example, when a lookout observes a light, does the OOW check the radar (or vice versa)?

Does everyone try to anticipate risk and compare ideas about contingency plans?

Do bridge officers monitor the weather against forecasts and try to anticipate how a change in the weather may affect other departments on board and the seaworthiness of the vessel?

Situational awareness, and the lack of it, is not limited to the maritime sector. Most car accidents can be traced to poor situational awareness and most industries have some sort of guidance on best practice. However, good situational awareness is vitally important to mariners in all departments for all tasks, even when asleep.

Take any opportunity to consider how you can increase your own situational awareness, how you can check your understanding of your environment and risks, compare event forecasts with reality and reflect on any differences you may find.

SITUATIONAL AWARENESS IS A VERY HUMAN ACTIVITY INVOLVING PERCEPTION, COMPREHENSION AND PROJECTION



Reviewing the situation

Master and Marine Consultant **Captain Andrew Liebmann AFNI** asks what situational awareness means in reality, and how can we make it work to our advantage



Situational awareness is the opposite of tunnel vision. It's the difference between looking and seeing. To maintain situational awareness, at least one member of the team needs to be looking away from the area of primary focus, and making sure that there's a 'Big Picture' observation.

For instance: when everyone else is looking down at the ship's side while docking, someone should be on the opposite side and reporting anything relevant. When planning an alteration to avoid a close quarters situation, checking astern and further past the immediate area can prevent the vessel from altering away from one danger into another. If there is an emergency inside the ship, someone needs to keep navigating safely while it is addressed.

Ideally, every individual in the team should have good situational awareness, but at minimum, team tasks should be divided so that all relevant areas of focus are given enough attention and there are no surprises. As Master, I try to delegate as much of the detailed work (including conning, communicating, and recording) to the lowest rank person who can handle the job. This leaves the most experienced person free to step back from the hands-on execution of any particular task. That allows both the OOW and, if present, the Master to personally keep good situational awareness, which can then be passed on to the team where appropriate. When I am focused on a specific task (such as manoeuvring the ship onto the dock, or making complex arrangements on the radio), having the OOW look out and around is critical to my peace of mind.

Focus and drive

As we gain more experience and proficiency, we can keep track of more (and more complex) tasks without losing situational awareness. When we start our careers, even a simple task like steering a compass course may require every bit of our focus, and we might lose track of what else is happening around us if we are not part of an effective team. Knowing the abilities of each team member helps keep everyone from being overloaded.

There are many threats to situational awareness, and we should do all we can to combat them. Things that

detract from situational awareness include the multitude of paper log books, nuisance alarms and false alarms, poor ergonomics or sight lines, the expectation that we can 'multitask' items of lesser importance, side conversations, fatigue and uncomfortable environments.

The good news is that there have been many procedural and technical enhancements over the years that help us achieve and maintain good situational awareness. For example, the modern Integrated Bridge System (IBS) puts a massive amount of information where we can understand it visually (primarily on ECDIS and radar screens). When properly configured and well understood, this allows for excellent interpretation of many sensors, giving a much more complete understanding than the bad old days of manual measurements and paper plotting. CCTV cameras allow the quick and accurate assessment of unmanned spaces and monitoring of machines, which is useful for both normal operations and emergency response.

Teamwork works

Procedure can also help us avoid traps. I try to get all my bridge personnel to name out loud the alarm we are silencing or cancelling. When the annoying beep sounds, it is all too easy to just mash the button that makes it go away, especially when there are repetitive, false or irrelevant alarms. This can lead to ignoring an important alarm. Naming the alarm can alert us to whether there is something that needs to be checked before the alarm is dismissed. Of course, the endless quest to remove nuisance alarms also needs more attention from our friends in the design and regulation parts of the industry.

Even standard Bridge Resource Management (BRM) practices are often under-appreciated aids to maintaining good situational awareness. When the OOW announces what he or she sees, and states his or her planned actions, the whole team shares a mental model that ensures we all have good situational awareness. When the OOW corrects my mistakes, it is because they are checking what I am saying rather than just accepting it. Instinctively checking the response from a helm, engine, or thruster order means we catch a malfunction

immediately, instead of when we are already turning into danger.

I believe that the best way to achieve good situational awareness is a team approach. This is partly because individuals have a tendency to see what they expect or want to see, and each of us has our own comfortable areas of focus – acting as a team cancels out these blind spots. That does not relieve any member of the team from keeping the big picture in mind. Even when seafarers operate alone, as is increasingly the case (on the bridge, on deck or in the machinery spaces), we can employ personal techniques such as stopping to scan sensors and surroundings, breaking tasks into smaller intermediate objectives and using appropriate checklists for technically complex tasks. Even setting a simple kitchen timer as a reminder to check on a ballast transfer pump is a useful tool to help us break out of the tendency to get absorbed in other tasks.

Say what you see

When there is no one to check your work, verbalising observations and plans, as you do in BRM, is a good way to remain conscious of what you are going to do. For instance, I was recently bringing a newbuild ship on sea trials into a berth. During the manoeuvre to get the ship lined up for final approach, I was looking astern and to starboard from one corner of the bridge, so I had my Chief Mate looking ahead and to port from across the bridge.

As I manipulated the controls and monitored the way the wind was setting the ship, I reported what I was seeing, doing, and planning through long-established habit even though none of my team could hear me. Noting distances, speeds, and planned actions out loud kept me in the routine of thinking through my cycle of observation, intention, execution and back to observation.

Losing situational awareness can be catastrophic. I have had the experience of being surprised by something that could have been noticed earlier. By adopting good design, policy, and practice we can develop and maintain good situational awareness. That should make those surprises rarer and less severe. Finally, to the old salts who actually remember plotting positions on a chart, good situational awareness is a sign that you have not 'lost the plot!'

WATCHOUT

In this series, we take a look at maritime accident reports and the lessons that can be learned

Inexperience and poor situational awareness led to collision

What happened?

A frigate was heading south through confined waters at approximately 18 knots. It was dark, but visibility was otherwise clear and weather conditions good. The frigate's officers notified the local VTS that they were entering the area. However, the vessel's AIS system was set in passive mode, meaning that no AIS signals were being transmitted.

About an hour after the frigate entered the VTS area, an oil tanker was preparing to leave a terminal in the same stretch of water and move northwards. VTS assumed that the two vessels were aware of each other and would work together to avoid collision. The operator did not inform other nearby vessels of the tanker's intention to depart.

The tanker's bridge officers spotted the frigate moving towards them but assumed that the OOW had seen them too and would change course. Unfortunately, the OOW and two other key members of the bridge team mistook the deck lights on the tanker for a stationary object. They did not make use of the technical tools at their disposal to double check this, and proceeded as if the tanker was not moving. This brought them right into the path of the vessel.

No-one on the frigate was aware of the mistake until it was too late. The two vessels collided, causing damage, water ingress and some minor injuries.

Why did it happen?

- > The OOW and other bridge officers on the frigate were young and inexperienced. Poor overall communication, organisation and teamwork further exacerbated the situation
- > The deck lights on the tanker obscured its navigational lights, making it harder for the frigate to identify it as a moving vessel
- > The frigate officers did not use technical aids to inform and correct their flawed situational awareness, relying instead on their own perceived view of the situation
- > The VTS operator received the report of the frigate entering the area, but did not monitor the area closely enough, nor inform vessels in the area of the tanker's intention to depart.
- > The frigate's AIS was in passive mode, preventing the tanker or any other vessels from seeing transmitted signals.

What changes have been made?

- > Improved training around situational awareness, watch-standing and teamwork on the bridge has been implemented
- > Career paths for officers on the frigate have been reconsidered to allow officers to gain time for training and experience before they are promoted
- > The use of AIS on the frigate has been reviewed, as has the use of deck lights on the tanker to avoid obscuring navigational lights in future

There is an excellent summary and animation of the incident at <https://www.youtube.com/watch?v=HVGe6ltlxQs> – we recommend having a look!

THE FRIGATE OFFICERS RELIED ON THEIR OWN PERCEIVED VIEW OF THE SITUATION, INSTEAD OF USING TECHNICAL AIDS THAT COULD HAVE HELPED HIGHLIGHT THE DANGER.

Like father, like daughter: life on the ocean wave

Navigation officer, **Anna Carofano**, discusses how her father's career inspired her to follow her sea-faring dreams, what it's like to work on a cruise ship and how fatigue can often be the biggest threat to effective situational awareness

What interested you in a career at sea?

You know the saying, 'follow in your father's footsteps'? Well, that's what I did! My father is a bosun on board ferries and I have always been fascinated by his job. I think he found it hard at first to have his only daughter away from him, but I'm sure that now he is very proud of me! I love the sea and I love to travel and share my culture with different nationalities, so this is the perfect job for me.

What career path has led to your current position?

I started at nautical school when I was 13. After finishing my studies, I sailed on a chemical tanker as a deck cadet. I remember my first day on board, when I was the happiest person in the world, but also the most scared! After working for a while on tankers, I joined the cruise ship family, where my life changed completely, once again.

What do you like best about working at sea?

Usually on board ship we have more than 100 different nationalities and thanks to this, I now know more about many different cultures and mentalities. Working for a cruise ship also gives you the chance to explore different parts of the world and to share some amazing experiences with other people. What a wonderful job!

How does your current position differ from your previous role?

I'm currently a Third Officer, which is very different from being a deck cadet. When you are a cadet, your goal is to learn as much as you can because, once you are in my current position, there is far less time to ask questions! We usually have three Third Officers on board, who must



Name: Anna Carofano

Current Position: Third Officer

Vessel: *Caribbean Princess*

WORKING FOR A CRUISE SHIP... GIVES YOU THE CHANCE TO EXPLORE DIFFERENT PARTS OF THE WORLD AND TO SHARE SOME AMAZING EXPERIENCES WITH OTHER PEOPLE

all be in different watches with senior officers. During the watches we must focus and be able to multitask without being worried to speak up and give our opinion as necessary.

What do you think is the biggest threat to good situational awareness on board?

When an officer is affected by fatigue or an overdose of information, this can

lead to a lack of situational awareness. Eliminating tiredness is impossible, but monitoring how people are coping with it is the best way to avoid accidents. On our ship, fatigue levels are monitored continuously, making sure that everyone has enough hours of rest, opportunities to spend time with other people and the chance to go out and explore the ports we are visiting.

How do you personally ensure you practise good situational awareness?

I try to maintain high situational awareness by knowing what is going on around me and using the three 'levels' of perception, comprehension and projection. I always ask myself: 'What is happening? What does it mean and what might happen next?' Today's bridges are highly advanced with lots of screens and information, but I always remember to watch what's going on outside in the 'real world' as well, and to share my thoughts with the rest of my team.

What do you think the wider maritime industry could do to help navigators hone their situational awareness skills?

The maritime industry is doing a lot for young navigators, improving our skills with specific training and investments in our future. What could be improved further, however, is the background. We only begin much of our main training after our time as a cadet, which doesn't allow us a lot of time to understand what situational awareness is like in a real-life situation. It would be much better to learn more about situational awareness during nautical college, even before joining a ship for the very first time.



WAYPOINT

Dr Andy Norris FRIN FNI

Critical positioning

Dr Andy Norris, an active Fellow of The Nautical Institute and the Royal Institute of Navigation, examines the significance of relative position-based sensors for improving situational awareness

Information based on absolute position – knowing where you are on the surface of the earth – is highly important to safe navigation. So, too, is relative position – where you are in relation to everything else in the area, including other vessels, navigational aids and any hazards to navigation. Good situational awareness should make use of both.

The concept of absolute position was developed some centuries ago, with the realisation that the Earth was near-spherical, and that astronomical objects, such as the Sun, stars and planets, could be used (when visible) to determine the unique position of the observer on the Earth's surface.

GNSS is based on a very similar basic concept to astronavigation but, of course, gives massively higher accuracy and availability. Not least, AIS allows vessels and navigational marks to transmit their own determined absolute position to all vessels in the vicinity, greatly aiding safe navigation for everyone.

However, we should never rely too much on the integrity of any information that is solely referenced to absolute position. Even when using multiple satellite services, there are many possibilities for significant inaccuracies when estimating our own absolute position. These include failure to receive signals from satellites in certain areas and the ever-growing menace of GNSS jamming and spoofing.

Proceed with caution

Positional information received by AIS should always be treated with caution. We have no knowledge of whether the equipment on the vessel sending the signal has been properly set up and maintained.



NEVER PUT 100% RELIANCE ON THE POSITIONAL ACCURACY OF CHARTED FEATURES. THE SITUATION MIGHT HAVE CHANGED SINCE THE LAST SURVEY



Some transmissions could even be spoofs. Even when this information is accurate, AIS does not tell the whole story. Numerous navigational hazards do not transmit AIS information, including many small craft and navigational marks – and, not least, floating or submerged wreckage. Never put 100% reliance on the positional accuracy of charted features, either. The situation might have changed since the last survey.

Real-time hazard avoidance is fundamentally based on relative position: how far away are any potential hazards in the area, and what is their bearing and relative speed? Key navigational aids, such as the human eye, radar and sonar, all give independent estimates of the presence and relative motion of potential hazards, with no fundamental dependency on GNSS and/or knowing their absolute position. Neither do they need any additional information from the target, although detecting the target can be greatly aided by lights and radar reflectors, etc.

Navigation aids based on relative position provide a totally independent



check on the integrity of displayed absolute position data, including most charted features. However, you should also bear in mind the particular weaknesses of such aids when assessing the complete scene. Not least, the further away the target is, the more their performance degrades, declining steadily to zero. It is possible to jam or spoof most relative position sensors available today, but in reality this is rarely encountered outside of war zones.

Into the future

In the future, inertial sensors will increasingly contribute to the safety of maritime navigation, including enhancing the accuracy of transmitted AIS data. They are relative position based aids that determine the actual movement of the vessel from any known position and are achieving ever greater accuracy. This enables an estimate of the vessel's current absolute position to be independently and automatically determined, potentially over hours or even days. Importantly, they are totally immune to jamming and spoofing.

Unfortunately, they will not prevent spoof data being transmitted from other vessels. Therefore, the optical, radar and sonar scenes will remain just as important as they are today.

GNSS, when sensibly used, makes a valuable contribution to the safety of navigation, but we must always bear in mind its weaknesses and the fact that collision avoidance is fundamentally based on the concept of relative navigation. The importance of always using information from relative position based sensors when making real-time navigational decisions must never be overlooked.

TAKE 10

Ten top tips for improving and enhancing your situational awareness on board

1

Most important

Situational awareness is absolutely critical to navigators. You need to be aware of your environment at all times, understand it and then act correctly.

2

All available means

Use all available means, all your senses (eyes, ears, touch, nose etc...) and all available tools (Radar, AIS, GNSS, radio, etc...)

3

Always question

Always seek to test your understanding of the environment by cross checking. Try never to trust just one sense or tool.

4

Share with others

Share your observations and interpretations with others in your team, never assume that they have seen something as well, or that your interpretation is the best.

5

Overburdening

It is easy to become distracted and lose situational awareness on the bridge of a ship. Know how to spot it in yourself and others and have a plan to deal with it.

6

Under burdening

It is possible to lose situational awareness when things become quiet. Find ways to keep yourself focused and alert. Unforeseen events at sea can be devastating!

7

Fake news

Not all information is correct. Chart data can be inaccurate, AIS data can be wrong and, in this cyber age, misinformation can be given.

8

Be aware on board

Situational awareness is just as important off the bridge. A good mariner is always alert to unexpected smells, vibrations, noises, and ship movements. Learn to trust your sixth sense and don't ignore the sense that something just isn't right.

9

Learn from others

Poor situational awareness is often cited in accident investigation reports. Learn from these reports, whether they are from The Nautical Institute in MARS, other industry schemes such as Maritime CHIRP, or national reports such as the UK MAIB, US NTSB or Australia's ATSB.

10

Mentoring

Situational awareness can be continually improved and taught to others. Work with your team to improve your skills. Experience is key to making sense of your environment and making good decisions.

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AND THE WINNER THIS ISSUE IS...

Our Navsnap winner for this issue is George. He sends us this photo from the bridge of LNG tanker *LNG Akwa Ibom*.



ARE YOU A MARITIME PROFESSIONAL?



Are you, or do you support those, in control of sea-going ships?
Can you keep up with new technology & new regulations?
Want a direct line to IMO decision making?
Want to network & improve your job prospects?
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