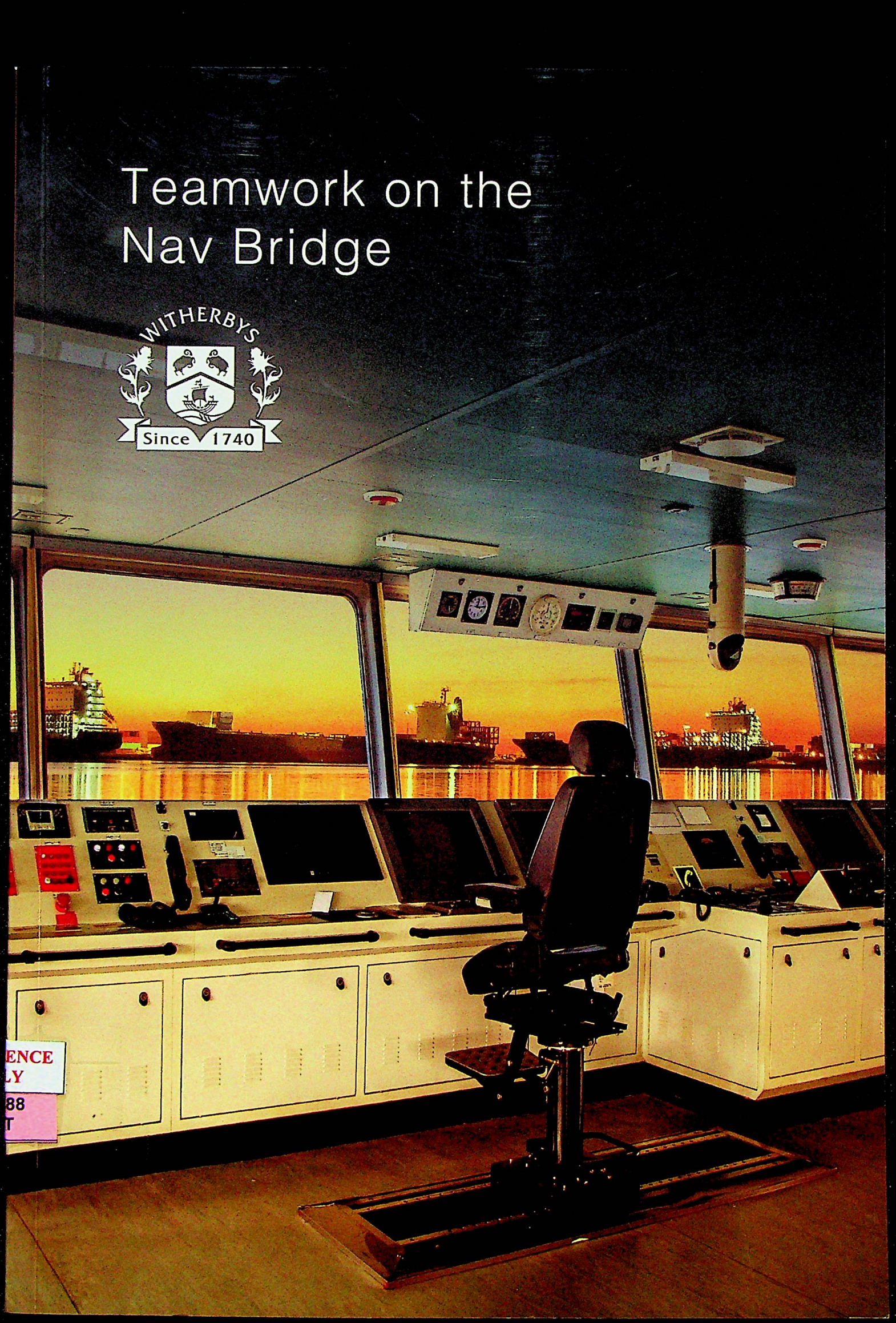
Teamwork on the Nav Bridge



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TEAMWORK ON THE NAV BRIDGE

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1. Introduction

Much of the content of this book is abridged from 'Navigating the Human Element' by Captain Timothy Crowch, who brings over 40 years' experience of commercial aviation and 10 years working with the maritime industry. It has been further developed for inclusion in this publication with the author's permission. As an expert investigator, he was involved in a number of high-profile investigations into aviation-related accidents and incidents. His experience and advanced training led him to develop and produce safety awareness training, education and accident prevention programmes for complex industries including insurance, aviation, maritime and healthcare.

1.1 What do we mean by 'Human Error'?

Human error is another word for 'mistake' – the sort of mistake we all make from time to time, from childhood onwards, as we make sense of the world around us.

It is normal to feel stupid or embarrassed by this, both as children and adults. However, in certain circumstances, these feelings and the fear to speak up may have serious consequences.

The environment on a navigational bridge is dynamic and the demands on the officers are continually changing, so mistakes will be made. However, the environment in which these mistakes are made often determines the reactions to an error and, therefore, the likely outcomes.

By 'the environment' we mean:

- The company cultural environment
  (support structure/openness of communication)
- The physical environment
  (in this case, bridge design and the equipment provided)
- The bridge team working environment
  (degree of cooperation, mutual understanding, interaction).

We all make errors. This is an irrefutable fact, regardless of experience, age, gender, class, nationality and rank. What is key is that we learn from them.

As seafarers progress through the ranks, the errors made as a cadet are, hopefully, less likely to be repeated as a third officer. Errors made as a second officer are less likely to be made as chief officer. If the position of Master is reached, errors may still be made when first faced with a particular situation in that rank.

Effective teamwork on the navigational bridge is all about working together, using past errors to inform others of dangers and, crucially, sharing observations (reinforced by best practice, checklists and knowledge of company procedures) so the proper actions necessary for safe navigation can be taken.

1.2 The Defences Against the Consequences of 'Human Error'

A key philosophy of safety management is the building of defences with the goal of preventing errors from escalating into an incident or accident. There are hard defences that are passive, such as barriers, railings and protective clothing, and soft defences that are active, which include training policies, procedures, checklists and practices.

1.2.1 Technology

Many dull and boring functions that used to be carried out by hand are now automated and accomplished by computers much more accurately and quickly.

While this is often referred to as 'engineering out' human errors, it also creates an environment with new types of error that may be difficult to detect.

While the speed and accuracy of computer processing is desirable, humans are not good at monitoring automated operations. We quickly become bored and our minds start to wander to other more stimulating things, which is when new problems can occur. Be aware that automation forces us out of the 'control loop' where we are no longer so directly involved in the task.

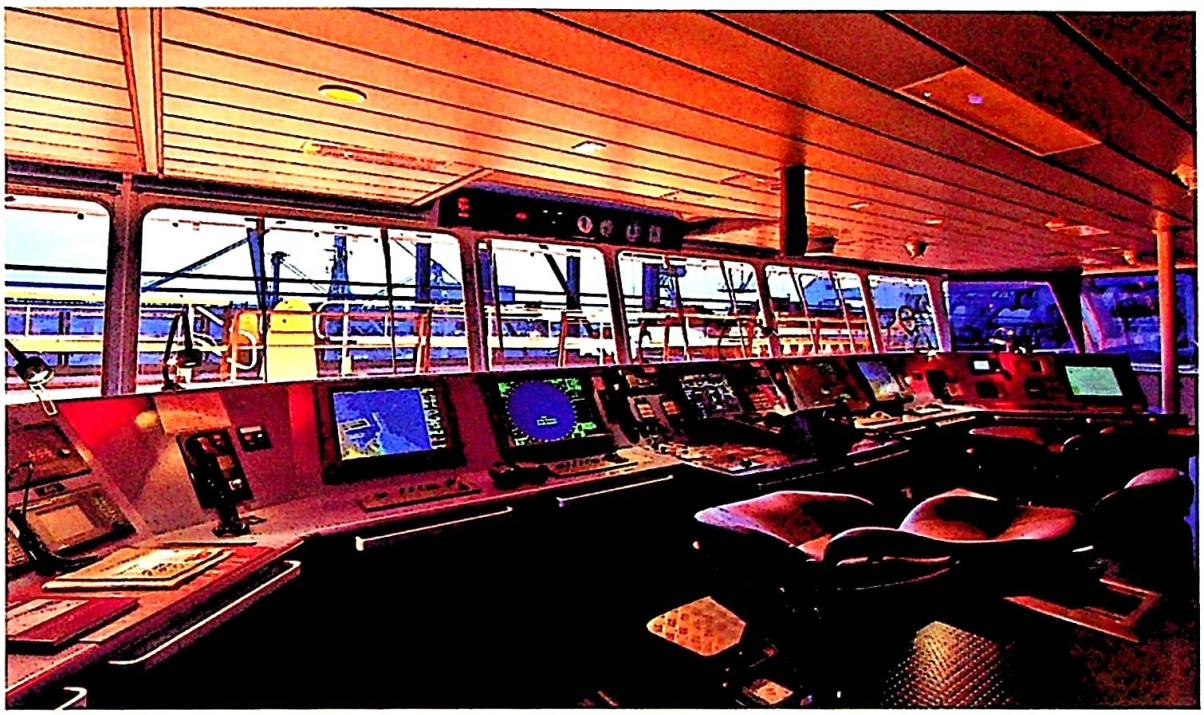
Examples on the bridge are the ARPA and the ECDIS. ARPA helps to identify other ships through the provision of primary returns on a radar screen and also with a range of other useful information shown on screen, such as AIS. However, ARPA is not instant and it is affected by a degree of instrument error (as are all instruments) so there must be constant awareness of this. Remember that the ARPA represents history, ie what has happened, not what is happening and certainly not what is about to happen.

The result of human error – a damaged VLCC following a collision in the Singapore Strait

1.2.2 Understanding Human Performance

Human performance is often classified into three levels of activity:

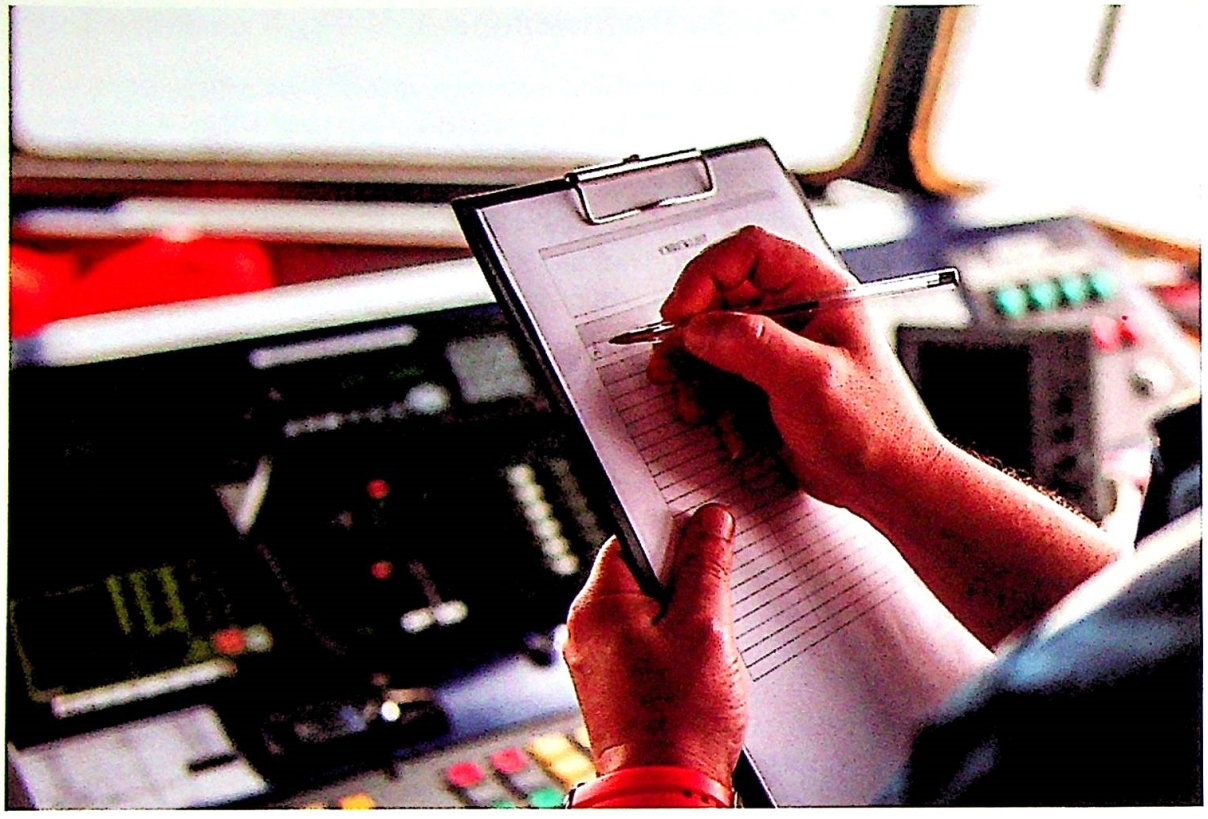
1. **Skill-Based Performance:** This level of performance is where we act in a well-practised or routine manner. Activities or tasks are carried out without thinking too much about them, although there may be an occasional pause to check that everything is all right. They are actions that take place with little conscious attention and to operate at this level takes considerable skill, practice and experience.



The errors that occur during this level of activity, which are referred to as recognition failures, slips and lapses, generally fall into two groups. Because there is not total concentration on the task in hand, distraction by an external factor, such as a phone ringing or a VHF call, comes easily. It is also easy to become preoccupied with internal thoughts, worries or other concerns. While distracted, a 'routine' action may be carried out, but it may turn out to be the wrong action entirely.

2. **Rule-Based Performance:** Rule-based activities are known activities that are likely to have been encountered before and for which training may have already been received, eg collision avoidance, entry into enclosed spaces and hot work.

   Rule-based activities require a degree of conscious thought and are normally governed by rules, procedures or checklists. The risk of error lies in the danger of employing the wrong procedure or checklist, or failure to apply the rule or procedure correctly as the result of an incorrect interpretation or assumption.



3. **Knowledge-Based Performance:** This level of performance or activity requires the most conscious thought and this demands effort. Approaching a novel, or even unique, problem demands effort and may be slow. It is here that there is the greatest risk of making a mistake, particularly if there is uncertainty about the situation or if someone is not feeling at their best, because they don't have a well-rehearsed skill or rule or procedure to fall back on. Stop and think, analyse and come to a conclusion based on making sense of what is happening. An example could be a series of complex and inexplicable indications on your navigational instrumentation due to a complex failure of inputs that is in some way linked to the ECDIS, ARPA or other displays. Systems are growing in complexity while, at the same time, they are becoming more reliable. This has created a gap between normal operations (when everything functions as we have learned and come to expect) and abnormal or emergency operations when failures occur. These events require exceptional analytical skills, as many possible 'corrective' actions can prove irreversible and make an already challenging situation potentially worse.

> It is essential to take time in such situations, while avoiding interruptions and seeking as much help as possible from other members of the team. It is well documented that this is the area in which the greatest number of mistakes occur. Accident reports emphasise this and it is, therefore, important to be aware of operating within the area of knowledge-based performance so that extra care can be taken.

All three categories of performance (ie skill based, rule based and knowledge based) are influenced by a number of factors, including:

- **State of health:** Is the team fit and rested? Is any team member taking any medication? Does any team member have personal worries?
- **Experience and training:** Is there sufficient experience and competence?
- **Infrastructure:** Is each officer able to determine when they need to request additional resources to the bridge team?
- **Communication:** Are effective methods and practices used?
- **Drills:** Are drills carried out after crew members have received appropriate and adequate training? If not, the result can be confusion caused by lack of knowledge and/or unclear communication procedures.

Violations

In contrast to other forms of 'human error', a violation involves a conscious thought, resulting in a conscious decision not to observe the rules. The word violation also implies the decision is not in compliance with an established process, procedure or checklist.

Why might such a violation occur? Some reasons are well intended, while others might just be because it seems easier. Such a case might be with a nearly head-on situation, where opening a little more to port is used to increase the passing distance (see Figure 1).

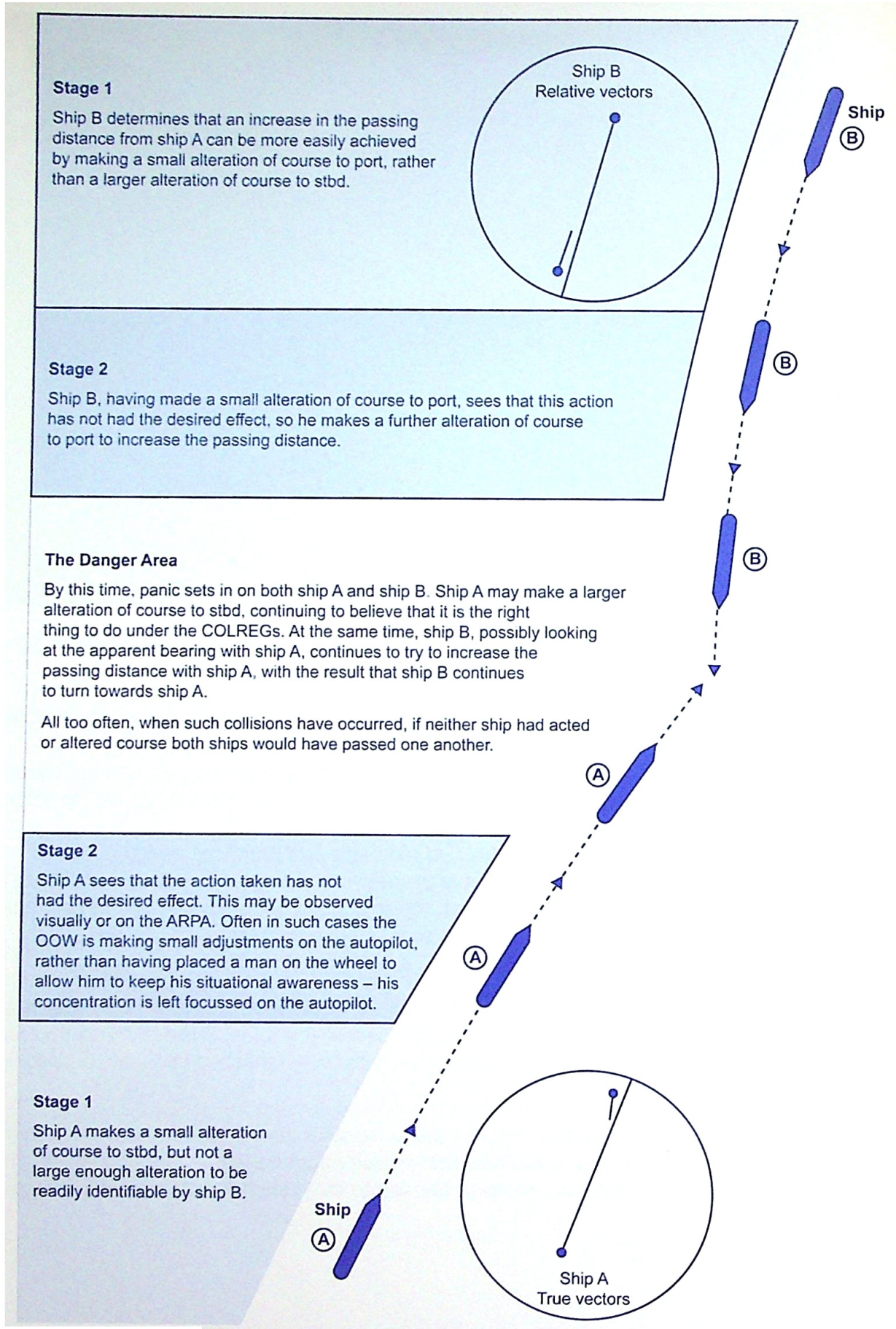


Figure 1: Dealing with a fine head-on situation

A further example of a violation on the bridge might be as follows: Imagine a scenario where, when inserting waypoints into the ECDIS, the company procedure calls for a second deck officer to check the coordinates. On a particular occasion, the coordinates might be quickly loaded but, with the Second Officer busy or absent, the procedure is completed and signed off without the secondary check.

During the waypoint insertion, as a result of the time pressure, a mistake is made in one of the coordinates and this happens to be in the area of some shallow patches near an isolated island in the middle of the ocean.

The ETA at this waypoint is at approximately 03:45 hrs towards the end of the Second Officer's watch. The outcome may be, at best, a sudden realisation by the Second Officer that the ship is heading for the shallow waters or, at worst, due to fatigue at the end of the watch, failure to notice anything until a number of warnings sound.

We can take this hypothetical scenario further by making the depth sounder warning inoperative, resulting in a grounding. This grounding may result in a schedule delay or, worse, an environmental disaster.

Initially, it is likely that all focus would be on the OOW for not noticing the deviation from the planned track and failing to take corrective action. However, the initial error has gone undetected because of a deliberate decision to violate the company's standard operating procedures (SOPs) by another officer.

Another reason for violation of an established procedure is that it may be deemed to be out of date or no longer relevant to the current situation or equipment. Procedures require constant review to accommodate changes to equipment, technology or industry best practice, guidelines or recommendations.

When using procedures on a ship:

1. If the procedure is fit for purpose, it should be followed properly.
2. If a procedure is not fit for purpose and requires deleting or replacing, it should be risk assessed and modified by the method outlined in the company SMS.
3. All procedures must be adapted to be ship specific and reviewed periodically (eg at the 12 monthly review of the SMS).

Masters are responsible for ensuring that their ship's procedures are relevant, ship specific and up to date, in compliance with the ISM Code. The senior officers' experience will allow judgement of the quality or adequacy of the procedures and this professional knowledge can only be passed on to junior officers and crew if it is captured in up-to-date procedures and checklists.

1.2.3 Communication

Between 70 and 90% of all marine accidents involve the human element as a major contributory cause and approximately 60% of those accidents have the theme of communication as their underlying cause. This is because everybody has certain natural limitations to clear and effective communication, ie in how we 'transmit' and 'receive' a message.

An example of a limitation is the influence of other sounds, such as background noise from the funnel or engine room. There may be distortion or interference when communicating via a walkie-talkie or VHF, referred to as electromagnetic interference or EMI. The relationship between the transmitted message and the background noise is known as the signal-noise ratio. The greater the interfering noise, the more difficult it is for us to understand the message being transmitted and the greater the risk that the transmission will be wrongly understood. It is, therefore, important that we do all possible to eliminate background or interfering noise sources when transmitting important messages, either within the ship or to a more remote position. Time must be taken to make completely sure that the receiver has received the message and has fully understood it.

It is important to note that speed and volume has a great bearing on the success or failure of communication. A message may need to be repeated, which creates even more time pressure or stress. At the same time, the meaning and importance of a communication can be lost or seriously distorted, which will most probably lead to the receiver not responding in the way expected or intended, further increasing stress levels.

Some nationalities naturally speak very quickly and there is absolutely nothing wrong with this when speaking amongst themselves in their own language and environment. However, once in the complex environment of a ship, working in a team with colleagues from other countries, often in a hectic, dynamic atmosphere, we may all need to change our 'natural' way of speaking in consideration of and with respect to the person we are speaking with. This is an important part of 'clear and unambiguous' communication.

Closed-Loop Communication
Closed-loop communications are when the receiver (or listener) reads back or repeats aloud what they have heard, to the sender, so that the sender is certain that the message has been received and understood (see Figure 2).

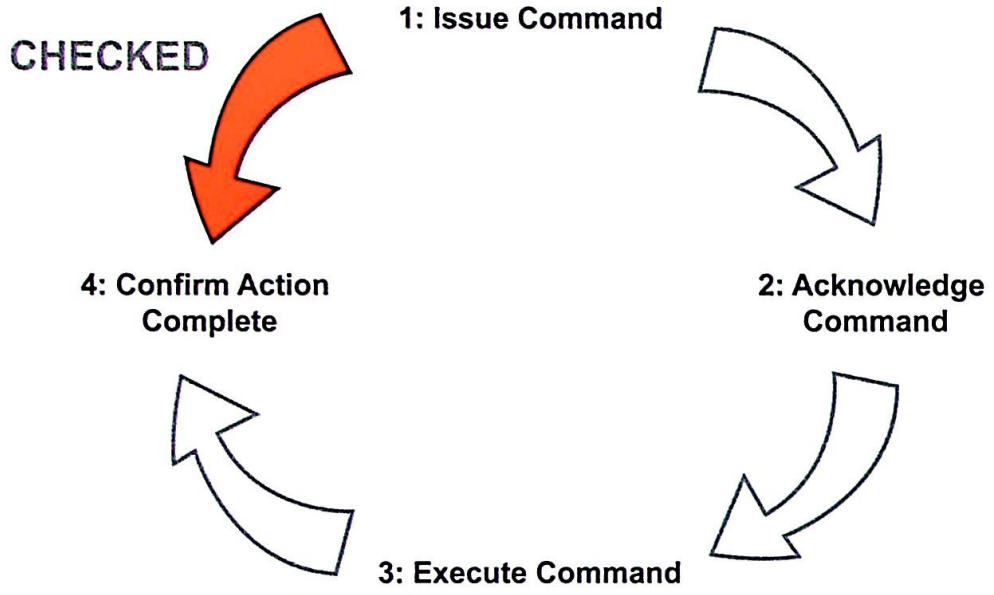


Figure 2: Closed-loop communication

This procedure is of little use if the original sender does not carefully listen to the message being repeated to check for any errors or misunderstandings. This applies equally in emergencies and in normal operations.

A typical example of closed-loop communications is as follows:

Step 1 (Issue command):	Pilot – 'Starboard 5'
Step 2 (Acknowledge command):	Helmsman – 'Starboard 5'
Step 3 (Execute command):	Helmsman places the wheel 5° to starboard
Step 4 (Confirm action complete):	Helmsman 'Starboard 5'. At this stage, the Master/OOW should sight the rudder angle indicator to confirm that the rudder is 5° to starboard.

Use of VHF
All officers who may be called upon to use the VHF must be familiar with the standards laid out in the IMO's *'Standard Marine Communication Phrases (SMCP)'*. They must be able to recall them and use them in every situation. It is too late to have to go and consult the document at the point it is needed.

'Pan Pan' and 'Mayday' Calls
Are you clear about the difference between a Pan Pan and a Mayday message?

A **'Pan Pan'** is an urgency call and is made when a situation that has developed on board a ship is causing concern and needs to be dealt with urgently. When the transmission is made, there is not necessarily any immediate danger to the ship nor to life on board. It forms an advisory to other ships that may be in the vicinity and also to the authorities that an urgent situation could develop further and that they should be aware of this.

A **'Mayday'** call implies that you are in distress and encountering serious difficulties that pose a direct danger to life and to your ship and that you are in need of immediate assistance. Any party receiving this message is obliged to act immediately in either offering or organising assistance, or relaying the message to other parties should your ship be out of range. In an emergency, you become the focus of everyone's attention and assume the highest priority.

When using VHF, you should be aware of the following:

There are few established standard procedures: The marine industry currently has relatively few standard procedures for VHF transmissions and they largely consist of a few standard formats. In other industries, where VHF's role is more prominent, message formats are fixed and followed by the users. Without a fixed format, users will naturally resort to 'free speech', effectively just carrying out a conversation. It is imperative that you keep in mind that the other party may not understand your first transmission, that you may have to repeat it and that you should always speak slowly and clearly.

There is limited established standard phraseology: While the SMCP is extensive, the phrases are not generally adhered to. Their use demands a high level of professional discipline. They were introduced to address the issue that the more standardised transmissions become, the more easily they will be understood by the receiver.

Low level of practice and experience: When using VHF, you should concentrate not only on using the system, but also on what you want to say. In a similar manner, you should listen very carefully to what you are receiving, keep a pen and paper to hand and write down exactly what was said. Using the VHF requires uninterrupted concentration, which is often rare on a bridge, and, therefore, you should guard against errors and interruptions being made. Be aware that communication with another ship or the shore authorities is more complex and more demanding than conversing with a colleague on a walkie-talkie and it requires more self-discipline. Potentially, small errors can lead to the most disastrous consequences.

Poor English skills exist within some crews: Until another ship is contacted by VHF, it is not possible to know about the characteristics of the crew of that ship, their nationality, their experience or their proficiency in the English language. Attempting to establish contact may create a complex situation that only adds to the mental workload, creating a situation with more confusion than clarification.

There will be an increased requirement to 'listen out': With the increase in traffic densities in many seaways and ports, there will be an increased need to 'listen out' to the radio traffic on the VHF to maintain situational awareness. This, of course, is traffic dependent and is of greater importance in coastal waters, in a TSS or in the vicinity of ports and anchorages. Turning down the volume of the VHF too low removes a potentially valuable source of information, but it can be very tiring to listen out for a vital piece of information amongst all the unimportant and, at times, illegal 'chatter'. A balance has to be struck and the VHF should not be ignored completely.

Dangers posed by music and other background noise on the bridge: Noise on the bridge can have a detrimental effect on the ability to hear the VHF. Noise might come from equipment, people talking loudly, other communication devices or music being played. It is everyone's responsibility to see that nothing impedes the ability to monitor the VHF and understand what is being transmitted. While not all information will be relevant to the ship, there will occasionally be transmissions taking place, even between other ships, that may affect the way your own navigation is conducted.

Listen out before transmitting: You may be breaking into another conversation. If information is required or needs to be broadcast, the first reaction should not be to take hold of the VHF microphone and talk!

The first action is to listen out for radio traffic. This also shows respect for others using the same channel and is correct radiotelephony behaviour.

Formulate your message before transmitting: Consider the message before transmission and plan what you wish to say or ask.

Split up transmissions; if there is too much information or too many questions in one transmission, it is likely that the other party will be overloaded, negatively affecting their understanding.

Shorter messages reduce the risk of misunderstanding and ambiguity.

Press the transmit button before speaking: The first part of a message will be lost if the button is not fully depressed, which is likely to be the name of the ship/party you are calling. This is a surprisingly common mistake.

Speak slowly and clearly into the microphone: Keep the microphone close to your mouth and move the microphone as your head moves. Do not talk away from it or your message will become inaudible and the transmitted signal will become too weak. Slow and clear speech reduces the need for repetition and saves valuable time.

Use simple and unambiguous English: The SMCP is provided for this purpose. Always consider the native language of the listener and use clear and unambiguous language to aid their understanding.

Always use the phonetic alphabet and transmit numbers as single digits: When transmitting long coordinates, it is easy to slip into stating figures in a normal manner. The correct way is to say 'one one' and not 'eleven'.

Numbers 5 and 9 may cause problems and should be pronounced clearly. The number '0' should be pronounced as zero.

Never accept uncertainty: Always ask for a clarification and/or a confirmation. If there is any uncertainty about the other party's meaning or intentions, ask a 'closed' question, ie requiring a one word answer. These will generate a response such as 'negative' or 'affirmative' to clarify any point of possible uncertainty. To make certain that the other party has fully understood your message, either use the phrase 'I repeat ...' or 'I confirm ...'.

1.2.4 Intervening with Senior Officers

The FACE Model

In the 1990s, an American airline developed a simple strategy to help their more junior officers intervene with their superiors. This method was adopted by a number of other companies and subsequently adapted to their cultures.

The FACE model is a very simple communication method that is easy to learn, understand and use. It helps to present ideas and understanding of a situation and also helps to overcome the natural resistance of someone changing their mind.

The model is a four stage structured progression of enquiries designed to reduce the risk of failure at each level. Under normal circumstances, it is realistic to believe that it should not have to proceed beyond the second stage. However, that possibility does exist and so understanding stages three and four is necessary.

The aim of the model is to improve efficiency and raise the standards of operational safety by building the assertiveness of junior officers when dealing with their superiors.

The model takes the form of a gradual progression, from general enquiries to a final statement, which implies a change of strategy and a change of control and even command in the most extreme of cases. Each step follows a specific format, which is designed to ensure that the statements will not have any adverse effect on the individual or the situation.

The four stages of the model are:

- **F – Find out**
- **A – Alert**
- **C – Challenge**
- **E – Emergency.**

Find Out
This stage is an attempt to discover whether there is any information that we are not already aware of.

It is possible that the reason for feeling uncertain about a situation is that we do not have all the relevant information. There may have been a slight change of plan or strategy that you were not made aware of, for whatever reason. At this stage, a question or questions should be asked, with the aim of ensuring a comprehensive understanding. This is done by asking the other person how they perceive a situation to be, how they interpret what they see and what they anticipate happening next.

By doing this, you achieve two things: first, you make sure your situational awareness is complete by having all the relevant information and second, you are providing a discreet prompt to the other person. This may make them decide to recheck their position or their calculations or to review the entire situation altogether.

When you are sure that the information you possess is complete, you are in a position to describe your own perception of the situation, your interpretation and how you anticipate the scenario developing. At this stage, there is still plenty of opportunity for both you and the other person to update or modify thoughts. If the other person's interpretation appears correct, you have the opportunity of thanking them for clarifying the situation for you.

Phrases you may choose to use when addressing the person concerned are:

"*Captain, can you help me understand ...*"

"*Pilot, can you help me understand ...*"

"*Pilot, am I correct in saying ...*"

"*Captain, I was under the impression that ...*"

"*Captain, I thought that we ...*"

Finding out what may be new information provides the chance for you to verify your understanding and compare it with the other person's. If you have misunderstood something, you have avoided conflict.

However, to re-emphasise the key message, you have also presented the other person with a very subtle prompt and you may have encouraged them to reassess the situation.

Alert
While you now have an up-to-date understanding of the situation, your interpretation now differs from those of the senior officer. This could be as a result of additional knowledge that you have, a different perception of risk or previous experience.

During this stage, it is necessary to become a little more assertive, while still being able to adapt your position based on new information, with no embarrassment or loss of credibility to either party.

It is at this stage that, instead of politely enquiring and finding out, you make some subjective statements, which will clearly indicate that you are of a different opinion and that your interpretation of the facts or the events differs from those of a senior officer.

> Here you will state your perception of the situation followed by your understanding of the end result if no change is made.
>
> Please remember: you are doing no more than stating an opinion and this is completely normal behaviour in an effective team.

Phrases that you might employ here could be along the lines of:

> *"Pilot, it appears to me that we are ... (a mile to the west of the course line, on a course directly for that shallow patch, entering a dangerous close-quarters situation, etc.)"*
>
> *"Captain, I'm concerned about ..."*
>
> *"Chief, can I draw your attention to ..."*

Again, everything you are saying here is from your point of view, from your perspective and reflects your interpretation of the situation. In no way are you criticising the other person, nor are you accusing them of anything. You are merely making what is, in your eyes, a valid and important statement.

In the vast majority of cases that you will encounter, the other person will respond to you by either clarifying the situation or rectifying their course of action. This is particularly true on the bridge, where you are working in a team of fellow professionals and where there is a common goal and sense of purpose. It will take a very stubborn or single-minded person to ignore completely your interventions at these two stages.

However, you may discover that the other person is not responding in a satisfactory manner and you now have no alternative but to proceed to the next stage. This is a rare event.

Challenge
This is the first stage in which you seriously challenge the other person's actions or thinking. However, by this time, you know that you have all the relevant information, you know what the other person is thinking and intending and, based upon your knowledge and experience, you know that you are headed into an area of high risk or even a clearly identified danger.

You must make a very clear statement referring to the other person's actions, as by now there should be no doubt of the probable consequences of those actions. To reinforce

this challenge, you must add a further statement, effectively a demand, that the other person alters course and changes their strategy or the actions that they are currently undertaking.

Examples of statements that you might use at this stage include:

> *"Captain, I am concerned we are going to ..."*
>
> *"Captain, have you considered this/that ..."*
>
> *"Chief, it appears your calculation is incorrect and ..."*
>
> *"Pilot, have you seen ..."*
>
> *"Captain, I believe we are running into danger, etc otherwise ... (statement of the outcome)"*

Here it is now obvious that you are directly criticising the other person and challenging what they are doing. At this stage, we are emphatically making the point that we are correct and the other person is wrong.

I am sure that many of us would quietly admit that this is the stage at which we normally begin our intervention with another person and this should now offer you an indication as to why so many of our interventions in the past have been unsuccessful. If we directly challenge someone without having preceded it with a few polite and simple questions, we immediately appear confrontational to the other person and we all know how we instinctively respond when someone challenges us! Our first response is invariably to hold firm to our original thoughts or opinions and build up our stubborn defences. With this FACE model, we have added two initial stages, which are courteous and non-confrontational and, therefore, they offer the best possible chances of never having to reach this stage.

Emergency

Unfortunately, and on extremely rare occasions (perhaps not more than once in your whole career), you may be presented with a very serious situation that requires direct and irrevocable intervention to prevent a disaster, which by this stage ought to be obvious to all involved.

In this final stage, you give a very firm indication that, if the other person does not take your advice, then you are going to take over control of the ship. At this point, you have committed yourself to what may be termed as a critical course of action and there is no way to backtrack. How you state your intentions here will run something like this:

> *"Captain, if you don't change ..., then I have to tell you that I will take over the conn/ the vessel/command/your position ..."*

Where possible, request the attendance of a senior officer to witness the situation, eg a junior officer calling the Chief Officer to the bridge, or the Chief Officer asking the Chief Engineer to be present on the bridge.

If there is no reaction at this increasingly late stage, then there are no alternatives open to you. You must do what you have said you will do and you will need to take action.

You may consider this last option extreme but, should a grounding, a collision or something equally urgent look increasingly likely, there comes a stage at which such direct intervention becomes necessary. The history of both the aviation and maritime industries is littered with accounts of officers who failed to intervene in time, even though they had recognised that something was wrong. The fact is we hesitate, due to a mixture of respect for authority, fear and general uncertainty that we are correct when a more senior and experienced colleague is wrong. Such hesitation can result in disastrous consequences.

An analysis of maritime disasters demonstrates that the sooner an intervention is commenced, the greater the likelihood of a successful outcome.

While it takes a considerable amount of courage for a junior officer to challenge a senior officer, senior officers should be sensitive when challenging juniors to ensure it is done in a manner that does not cause lasting damage to their confidence.

The FACE model offers you two valuable lower levels at which to commence an intervention and this process can easily take less than a minute when practised.

> Remember: it is not the number of questions you ask that will determine the outcome, but their structure. In most cases, you will not need to move beyond the 'Alert' stage.

You may wish to practise this at home or with your colleagues and see how successful you are. Start at the beginning and avoid certain words at the start of any sentence, particularly *'why'*. This word can instantly derail any subsequent intervention you need to make, however well intentioned, as the word *'why'*, or its equivalent in any language, may imply criticism. It implies from the start that you think the other person is wrong. Avoid generalising and ask questions that are as specific as possible to the situation.

Examples:

Scenario 1 – Fog
Own ship has dropped the pilot outbound from Rotterdam and is now building up to full sea speed. The visibility drops suddenly to less than 100 metres. The Master is completing his paperwork and before the OOW has the opportunity to inform him of the reduced visibility, the Master turns towards the bridge door and says *"I'm going down to my cabin, call me if you need me".*

The OOW realises that the Master has not noticed that the visibility has dropped. In this case, the OOW could use the FACE model as follows:

Find out
"Captain, do you still wish to proceed at full speed?"

If the Master responds in the affirmative to this, you will need to move to the next stage.

Alert
"Captain, it appears to me that the visibility is reducing."

At this point, the Master, if he hadn't already noticed the reduction in visibility, is able to reassess the situation, taking into account your concerns.

Scenario 2 – OOW challenging a Pilot
Own ship has just commenced a long river transit with a pilot on board and is still in the outer estuary. The OOW notices that, as the ship is approaching a 30° alteration of course, it is still in autopilot as the pilot has not asked for the helmsman to take the wheel. Your own experience tells you that the ship is not very responsive at such large alterations of course when in autopilot. In this case, the OOW could use the FACE model as follows:

Find out
"Pilot, is it your intention to complete the 30° turn on autopilot?"

If the pilot responds in the affirmative to this, you will need to move to the next stage.

Alert
"Pilot, in my experience this ship does not respond well to large alterations of course on autopilot and we would normally engage hand steering."

Scenario 3 – OOW challenging the Master
Own ship has reduced to manoeuvring speed and has to negotiate a 12' buoyed channel inbound, from the fairway buoy to the pilot station, and the Third Officer has handed over the conn to the Master.

The ship is currently on a course of 270°(T) and the next charted course is 258°(T), but the Master asks the helmsman to steer 285°(T). At this stage, the OOW could use the FACE model as follows:

Find out
"Captain, did you mean 258°?"

At this stage, the Master accepts the correction. However, soon after this, the Master makes an unclear order, neither directed at the OOW nor the helmsman. Again the OOW has to 'find out' as follows:

"Captain, can you repeat your order please?"

The Master answers incomprehensibly.

Alert
"Captain, is everything okay? I'm having trouble understanding you."

Again the Master answers incomprehensibly.

Challenge
"Captain, I think we have a problem here. I'm going to call the Chief Officer."

The Master issues an order to the helmsman that requires immediate intervention, at that stage ...

Emergency
"Captain, I am taking the conn and calling the Chief Officer" and at that stage you issue the correct order to the helmsman.

As an OOW, it is impressed upon you to understand when it is necessary to call the Master. If you are in any doubt as to whether you should call the Master, the expectation is that he should already be there. Scenario 3, demonstrates that, when the action of calling the Master is not available to you, there are still further resources available on board to assist.

While the situations presented are on the navigational bridge, the FACE model is equally appropriate in many other situations on board where you are in doubt or have concerns, such as in the cargo control room or at a lifeboat drill.

1.2.5 Protecting Your Eyes

Eyesight and the ability to tolerate glare deteriorate with increasing age. Sensitivity to bright light increases and eye protection is needed. Eyes should always be protected from sunlight and also from the danger of objects, liquids or gases entering them.

Glare also causes visual fatigue and stress which, over time, may lead to headaches.

It is strongly recommended that good quality sunglasses that have ultraviolet (UV) filters are used because excessive exposure to UV is one of the many causes of premature cataracts. This is a clouding of the lens and will seriously affect acuity.

Good, general purpose sunglasses usually block between 60% to 90% of visible light and UVA rays and between 95% to 99% of UVB rays.

> Polarised sunglasses are some of the best for reducing glare and improving contrast. However, most ships will have heated, multi-layered windows on the bridge. If so, avoid polarised lenses as these will polarise the windows, severely restricting your vision!

Night Vision
A discussion on keeping a visual lookout at night can be found in Section 4.3 of *'Safe Nav Watch'*.

The two types of cell that sense light on the retina are called rods and cones. The cones are used for vision in good light conditions, whether this is natural or artificial. They are the colour sensitive cells and so are active during daylight hours or in brightly lit interiors. Cone vision is known as *photopic* vision.

The rods, of which there are over 125 million, generally surround the cones and come into action in marginally lit conditions or darkness. They are not sensitive to colour and they enable night vision, or *scotopic* vision, in shades of black, white and grey. This is why in the evening, as it becomes darker, colours will begin to become indistinct and fade, starting with red.

The rods contain a pigment called 'rhodopsin', which is broken down or bleached in the light and regenerated when the light dims or it becomes dark. When all the pigment is bleached in bright day or artificial light, the rods cease to function. The regeneration of the rhodopsin takes time once the light is removed and this accounts for the long time it takes to acquire full night vision. Rod cells are generally relatively weak and tire quickly.

The transition from day vision, or vision in well-lit surroundings, to full night vision takes between 30 to 40 minutes and it is important to be aware of this when commencing a watch. This is why it is essential to adjust the bridge instrumentation to the dimmest illumination possible and to avoid flashing a bright light in any person's eyes. Night vision will immediately go and the adaptation process will have to start all over again. Working in a darkened bridge facilitates an easier and quicker transition to vision outside the bridge windows.

Vision may also be negatively influenced by temporary physical or health factors. These can affect night vision and reduce the ability to see as clearly as possible in low light or darkness. Such factors include:

- **Fatigue:** Sleep deficit can affect the ability to view something clearly and accurately
- **Lack of oxygen:** Eyes are heavily dependent on a good supply of oxygen to function optimally
- **Long exposure to sunlight:** This can result in a disproportionate amount of time being required to acquire full night vision
- **Heavy smoking:** Smoking introduces carbon monoxide into the blood, reducing its ability to transport oxygen to the eyes and brain. This will degrade visual acuity and the ability to accommodate slightly brighter lighting thresholds. It will also slow reaction times to visual stimuli
- **Drugs:** Certain forms of medication, even those easily purchased over the counter, can degrade night vision
- **Headaches:** These can cause forms of dizziness and may make focussing difficult and painful, particularly simple or complex migraines
- **Consumption of alcohol within the preceding 48 hours:** This will also depend upon the individual's ability to process alcohol
- **Improper or poor diet:** This can lead to a potential deficiency in minerals and/or vitamins.

An object or distant light is often seen more clearly by looking slightly away from it. This technique is effective at night since it maximises the use of the rods and also because movement is more easily detected with peripheral vision.

Don't look directly at the object you are observing. You will see it much better by using the off-centre vision technique. Experiment and practise to find the best off-centre angle for you. For most people, it is about 6° to 10° away from the object, or about a fist's width at arm's length.

One thing we constantly do without thinking is focus on objects at different distances, from bridge to the horizon and back again. Remember that this focussing can become more difficult with age.

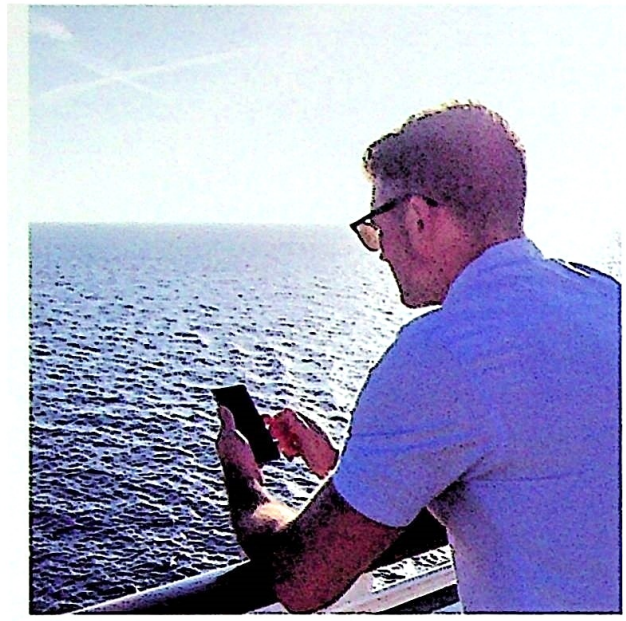
Use of Electronic Devices

According to the eye health care organisation Optegra, the frequent use of personal electronic devices (especially smartphones and tablets) has negative effects on eye health. From research conducted in 2018, they reported that, for people aged between 30 and 44:

- Over a quarter (26%) look at their smartphone between 10 and 20 times a day
- 15% admit to looking at their smartphone constantly and even taking it to sleep with them
- 35% suffer headaches or blurred vision after prolonged smartphone use
- only a quarter (26%) of this age group would get their eyes checked immediately if they suffered vision problems
- almost a quarter (23%) wish the text was bigger on their phone screen.

The implication is that frequent use of smartphones, tablets and other devices puts pressure on eyesight and causes strain. To protect eyesight, Optegra advises as follows:

- Increase the font size on your screen, so you are not straining your eyes more than necessary (this applies to small devices as well as computer screens)
- be aware that sunlight glare on a screen can cause headaches and difficulty with vision, so should be avoided if possible. On a ship, either the shades should be deployed on the bridge windows or the OOW should use suitable protective sunglasses (ensuring that tints are compatible with the bridge windows and control screens)
- when using a small screen (such as a tablet or laptop), consider instead using an additional larger monitor (for example a desktop computer)
- avoid using smartphones and other small devices for longer than 20 minutes without a break
- get your eyesight checked every two years and always wear reading glasses if you are struggling with small screens and/or font sizes.



Personal electronic devices should not be used on the nav bridge when the ship is at sea

1.2.6 Target Fascination and Reduced Processing

Target Fascination

Lack of sleep has serious effects on vision, levels of concentration and the ability to interpret what you are actually seeing. Be aware of this when on night watches in particular. It is easy to become focussed entirely on one parameter while ignoring all others, rather than thoroughly scanning all instrumentation and displays and what is outside the bridge windows. This is termed 'target fascination'.

Reduced Processing (due to fatigue)

Tiredness at any level will have a detrimental effect on the overall performance of our eyes (as will poor health) and our ability to process correctly what we are seeing. In such circumstances, we can occasionally 'see' what we expect to see, rather than what is actually there.

As we tire, or when approaching the end of a bridge watch or towards the end of a long contract, there can be a natural tendency to not work as accurately as might be expected and, due to lowered states of motivation, wakefulness and alertness, this may not be recognised.

1.2.7 Situational Awareness

A factor in all poor decisions, collisions and groundings is a loss of situational awareness.

Situational awareness must be built up prior to taking over the navigational watch and then maintained throughout the watch. This is a scanning discipline that involves three key steps:

1. **Perception:** Building up awareness requires a systematic review of all parameters, which starts with verification of the ship's position in relation to the ship's surroundings. The next step is, typically, scanning the horizon. From this initial appraisal, further information can be added from the ship's heading readout, speed log, echo sounder, Radar, ARPA, AIS, etc, creating a full mental picture of the surroundings.

2. **Comprehension:** Once a base perception of the situation has been acquired, it is easier to process new incoming information. This might be termed as having built a 'mental model'.

3. **Projection:** Taking the mental model you have created and thinking ahead to anticipate likely scenarios that you may encounter.

Maintaining Situational Awareness
This takes energy, routine and professional self-discipline.

It is too easy, especially with the reliability of machinery and computer-controlled systems, to become relaxed, distracted and potentially complacent.

The first way of guarding against lapses in concentration is to be acutely aware that they can happen at any time. The likelihood of these lapses occurring may increase according to the circumstances, such as during periods of tiredness or ill health, when preoccupied with worries about families at home or some other personal matter, or when the pressures of a heavy workload cause stress.

> Approximately 85% of human element related incident reports mention loss of situational awareness.

An officer who has lost situational awareness will generally be unaware of that fact. This is why it is important that the navigational bridge is manned appropriately for the conditions.

Projecting Situational Awareness
To ensure effective planning and analysis, you must project ahead of the ship's present position and continuously re-evaluate the situation.

A central part of the *projection* of situational awareness is imagining scenarios that are not part of the current status. Start by asking 'What if ... ?' questions, such as:

- What if I were to experience a steering failure in this narrow area? What will my first actions be? What options do I have?
- Where are the greatest hazards to my ship?
- Which are the most critical targets to monitor or to avoid?
- In the event of a gyro or radar failure, where do I have the most sea room?

Consider all the questions and the hundreds of others you can ask yourself as a key safety component and extension of your passage planning. The answers to these questions are nothing more than real-time updates to your passage plan.

1.2.8 Decision Making

Decision making is the process of reaching a judgement, coming to a conclusion or choosing an option (see Figure 3).

It is the amount of time available that determines which of the following decision models should be used.

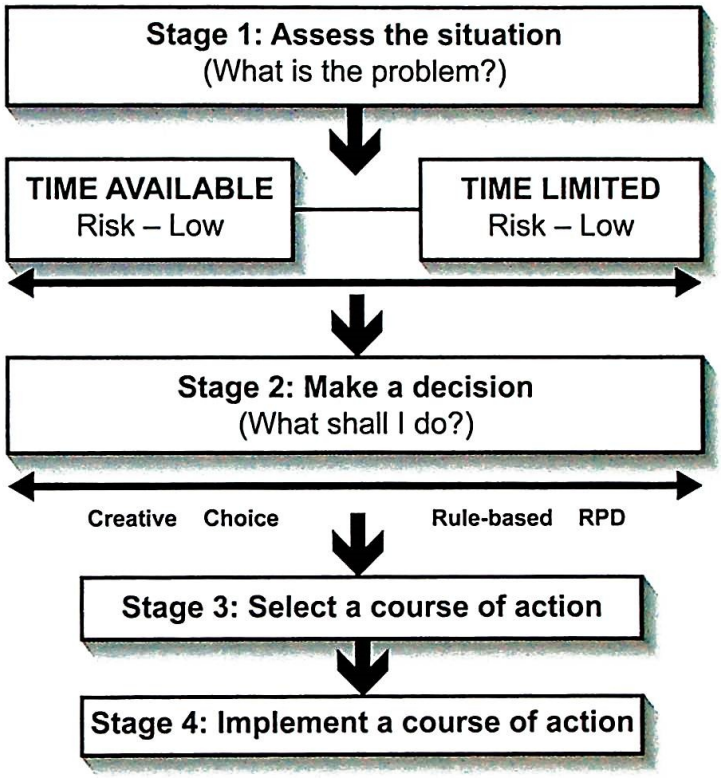


Figure 3: Simplified model of decision making. Adapted from *'Safety at the Sharp End'*, R. Flin et al, Ashgate

1. Recognition-Primed Decision Making

This is the decision making style of the experienced professional who has been involved in many similar situations in the past. The response is instant but is well considered by referring back to a response used on a previous occasion. These responses come from mental models or pictures that have been stored and maybe modified, depending upon the level of success achieved.

We are great pattern matchers and this is where we can utilise this talent to its best. Our response to a situation is almost instinctive as a result of our previous experience.

This is often referred to as a 'gut feeling' and is the result of retrieving stored images and mental models from long-term memories. We feel we have seen this situation or something very similar to it before or, alternatively, we have been trained and intensively drilled to recognise and handle similar situations, so some relevant information is stored in our memory and we can call upon it for guidance in our decision making. It will appear to be an automatic reaction to circumstances without much conscious thought.

The steps that take place are:

1. Reading the situation (including a comparison of what is evident against knowledge and experience).
2. A response based on (recalled images from) training and experience.
3. A decision taken that will bring a rapid solution to the present situation. It may not be the perfect long-term solution, but it should be practical.

These are, for example, the mental processes that go through a Master's mind when he is called to the bridge and confronted with a challenging situation. The reason that he may find the solution to the present predicament more quickly than his more junior OOW is that he has many more years of stored images to refer to. This is his experience.

However, response does not always necessarily refer to an action. The response can sometimes be to do nothing, to sit back and to wait. Instantaneous action without a thorough situation assessment has led to many unnecessary incidents. Taking the smallest amount of time to do nothing but think is often a wise move, although it is usually only the response of the experienced professional as the lesser experienced often feel pressured to act.

2. Rule-Based Decision Making (the use of established processes, procedures, checklists and training)

Well-constructed procedures and checklists are available for many anticipated difficulties, ranging from simple technical failures and abnormal situations to urgent and emergency scenarios. These are the work of qualified people, often the designers of the equipment, producing logical multi-step procedures that can help in the operation of equipment and to manage it when something goes wrong. They also provide assistance in troubleshooting and fault analysis. While there can be some resistance to the use of formal checklists, their use can be very comforting when confronted by challenging situations as they can help overcome a number of natural human reactions, such as surprise, shock and fear.

Checklists and procedures are common tools in all high-risk and complex industries. The systems' complexity and their integration normally go far beyond the knowledge required to operate them. When unfamiliar with any task or item of equipment, procedures and checklists offer invaluable support. However, it is essential that procedures are kept up to date and are reviewed every time new equipment is installed or updated.

The important point is to select the correct procedure or checklist to manage the problem or malfunction successfully by carrying out a short analysis of the problem.

3. Choice Decisions

With available time, it is possible to consult reference documents and technical manuals, which are likely to be the same procedures and checklists as above but in more analytical detail. It may be possible to discuss the situation with other members of the team or others in the crew and it may even be possible to consult others via satellite links.

With more expertise available from the team and others, it may be possible to not only solve the immediate problem, but to take the process further and devise the optimum solution.

The potential for error lies in the possibility that not all options available are considered or that, having studied all the options, the analysis is inaccurate and therefore the wrong choice is made.

This method of decision making is only available when there is sufficient time.

An example of this is any type of bridge team meeting, whether before entering an area that is navigationally challenging, such as the Straits of Malacca and Singapore or the English Channel and Dover Strait, or before a particularly challenging berthing or unberthing operation (including ship to ship transfer), whether due to the location of the berth or the weather conditions prevailing at the time.

4. Creative Decision Making

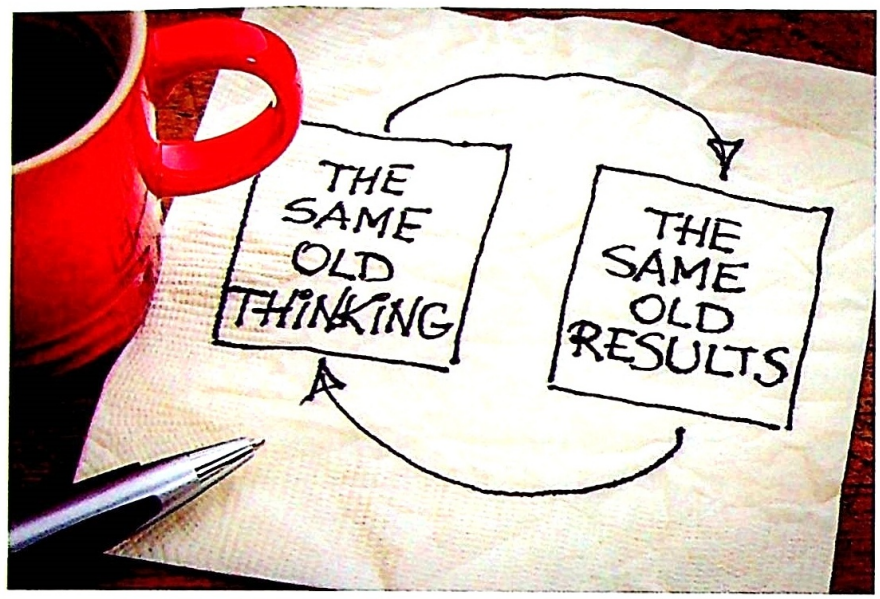
Any regulatory or technological change on board existing ships, or a completely new ship type or class, often involves new skill sets or onboard equipment with greater complexity than has been encountered previously.

Such a circumstance will often surpass established areas of expertise and will require creative decision making and solutions that go beyond established practice.

What Affects our Decision Making?

Fatigue and stress can lead to fixations and target fascination, causing a focus of attention on one specific factor while ignoring all others. When starting to feel overloaded by a situation, it is tempting to seek a decision path for no other reason than it is easy.

Training, competence and proficiency in a skill, in addition to procedures, manuals and checklists, can help protect against the effects of stress and fatigue.



Factors that can lead to a rushed decision include:

- Following your initial impression without analysing all the available factors
- concentration or focus is elsewhere when you are suddenly presented with a new situation that you have limited time to assess
- allowing yourself to be overly influenced by others you consider to be more experienced
- arriving at a premature conclusion through comparison of the present situation to a similar scenario seen before
- when the level of urgency appears greater than it actually is, leading to underestimation of the time available to make a decision
- failure to consult established procedures.

Decision-Making Process

The first act when confronted with any unexpected situation should be to ask the question: 'How much time is there?' The answer to this initial question will immediately determine the decision making model and it will also serve as a prompt to start the decision making process. Without making the question of time the initial consideration, it is unlikely that the situation will be managed successfully.

Never make a decision in a complex, dynamic operating environment without having first answered the question of how much time is available?

In emergency situations, the environment changes from 'normal operations' to what can be, quite literally, a frightening situation involving questions of life and death. It is important to know that this will cause a loss of sense of time.

Most companies require crews to maintain a time log in emergency situations, but a plan that looks forward may be invaluable. For example, it is important to note the estimated times of arrival of any responding assistance as it will need to be coordinated to prevent chaos developing.

It will be difficult to retain complete information in your head under these circumstances and you will need the data to assist you with strategic planning and your decision making.

In the field of aviation crew resource management, a number of acronyms have been produced to assist officers in their decision making, assuming that the operating crew have time. One of the most used is the FORDEC model:

F – Facts: What is the problem? Define it clearly.

O – Options: What are the options, and how many do we have?

R – Risks (and Benefits): What are the pros and cons of each option? How do they balance out? Which option carries the fewest risks with most benefit?

D – Decide: Which option should we follow? If time allows, the decision may be discussed with other team members.

E – Execute: Carry out the selected option and delegate tasks to appropriate team members.

C – Check: Is everything working out as planned and does anything need to be changed or adjusted? This is, in practice, a continuous process to ensure a safe and successful outcome.

These six points could be written on a small card that you can carry with you in your notebook on the bridge. How closely you follow these points will depend on the time you have available, but they should help to provide focus on the essential considerations, reducing the risk of overlooking something important while under pressure.

1.3 Bridge Resource Management (BRM)

The aim of bridge resource management (BRM) is to improve the attitudes of the bridge team and encourage more efficient and effective teamwork. It not only covers management of the various personnel contributing their individual skills to achieve agreed objectives safely, but also involves the use of all tools, machinery and equipment at their disposal. The key factor for success is that each individual's contribution is considered and acknowledged.

An effective bridge team will:

- Maintain full situational awareness (360°) around the ship underway
- assimilate information from all sources available
- monitor the progress of the ship against the passage plan (monitoring position, course and UKC), adjusting correctly to maintain a safe passage
- anticipate and react to potentially dangerous situations before they can develop
- be able to work with visiting members of the bridge team (pilots, ice navigators, etc)
- know their respective roles and, where relevant, delegate authority and individual tasks (as the manning level increases, the bridge team should know what to expect from each other)
- ensure the whole bridge team is fully aware of visual aids and indicators and the team is not solely focussed on radar or ECDIS
- prevent each other from being preoccupied with irrelevant issues or minor technical problems that can wait until it is safe to resolve them
- recognise individually when an error may be happening and point this out to the rest of the bridge team, to take appropriate action and stop an unsafe act.

As the situation changes on the bridge, a good and effective bridge team should respond using all available resources. Importantly, the bridge team must maintain situational awareness. To do this, effective communication is essential.

The members of the bridge team should exchange information and not feel afraid to point out relevant observations. The Master must allow the OOWs and other ranks to have the confidence to do this. The OOW should respectfully challenge the pilot or Master where he thinks information is missing or an error is occurring. Other considerations include closed-loop communication (repeat orders, assess the order and then verify it is done) and confirmation of who has the conn.

Bridge manning levels are also important and there must always be enough people to effectively manage the navigational situation. The OOW should not hesitate to call for additional support from the Master and other officers. Equally, the Master and the company must ensure adequate manning for busy voyages, especially when transiting areas of high traffic density. When needed, the use of deep-sea pilots or extra manning should never be disregarded on financial grounds.

Knowledge sharing is essential during the voyage. Senior officers and the Master should use suitable opportunities to impart their experience to junior officers and cadets. For example, whenever an OOW calls the Master to assist with collision avoidance, this presents an opportunity for knowledge sharing. Once the situation has been resolved, the Master can talk through what has happened, explaining to the OOW why they dealt with the situation in the way that they did. If the Master simply alters course then leaves the bridge, without explaining the reasons for the actions, this will not be constructive for training of the OOW, who may repeat the same error next time.

Training and feedback briefings before and after manoeuvring, operations or a voyage can help consolidate the understanding of the bridge team. The Master should ensure that frequent bridge team meetings take place and that these ensure good discussion between all ranks.

The OOW should ensure a good relationship with the crew on their watch. This should involve setting out what the OOW expects from the watch team and, importantly, what information should be relayed between each other. The lookout is often one of the most under-utilised members of the bridge team and should be encouraged to pass on navigationally relevant information to the OOW, Master and pilot.

The Master/pilot exchange should always be followed and respected by both parties. The Master should inform the pilot of the state of the ship and the composition of the bridge team and discuss how communications between the pilot and the bridge team will be handled.

The Master should go on to discuss the voyage plan with the pilot and inform bridge team members of the pilot's intentions and special concerns.

The Master or OOW should immediately advise the pilot when (for example):

- The manoeuvrability of the ship has been adversely affected
- alarms occur on the bridge and what the consequences of these are for the pilotage

- the pilot seems unaware of another vessel that is causing concern
- there is uncertainty regarding any of the pilot's intentions or orders.

Crucially, all members of the bridge team should remember that good teamwork is essential for safe navigation.

1.4 Working with a Pilot On Board

What Changes when the Pilot Comes On Board?
It is important not to relax simply because the pilot is on board. Apart from the presence of another person, a number of subtle and not so subtle changes will take place as the pilot comes onto the bridge. It is important to ensure an understanding of changes in the bridge team dynamic. As this happens, consider the following questions:

- Are there new risks that accompany this change within our bridge team?
- What can I do additionally to protect my ship against these new risks?
- What safety precautions can I assist with?

When a pilot joins the bridge team, there is an additional source of commands and orders on the bridge. It is important to know what to expect from the pilot and to clarify any uncertainty.

In most cases, the Master will also be present on the bridge, so there must be absolute certainty about who has the conn. With both the Master and pilot present, the command structure becomes more complex, so there is an even greater need for clarity and priority in communications.

An increase in the size of the bridge team has the potential to upset the balance of a team that has already been working together for days, weeks or even months. The new member joining the team will be unaware of what has happened prior to joining, and will also be unaware of everyone's strengths, weaknesses and levels of experience. All officers are likely to be treated in a similar way by the pilot.

In many cases, a significant challenge to the bridge team is that of an entirely new voice, with a very different pronunciation of the English language that will be influenced by the pilot's own native language. Language skills may not be what you are expecting and phrases may be used that are not immediately understood, with accent and manner potentially making some phrases or words initially difficult to comprehend.

Within the shortest period of time, due to his professional role, it is expected that you will place your trust in the pilot and there will be high expectations of their professional skills. However, you will have little or no knowledge of the pilot's skills or experience and you will be unaware of the pilot's style of working.

Working with the Pilot

From the moment the pilot enters the bridge, there is one very important human factor that the Master and the whole bridge team must keep in mind. The pilot is a new addition to an existing team, so it is important that they are welcomed and the team makes every effort to support the pilot's requirements.

Be welcoming, as it is your team that has the duty to accommodate the pilot. Meaningful gestures like offering refreshments and food on longer passages is respectful hospitality.

All documentation should be ready for the pilot (and possibly sent ahead) before they board and the ship must be ready for the pilotage. The Master will lead the Master/pilot exchange and can overrule the pilot at any time as he maintains full and final authority over the ship except in some very specific locations, such as the Panama Canal.

There is a responsibility on Masters/pilots to ensure the OOW remains engaged. However, a frequently reported issue by OOWs is the feeling of being undervalued or even excluded from the whole team. The pilot and the Master should take steps to rectify this situation. Failing that, it is essential that the OOW takes the initiative to become involved should anything be causing concern.

1.5 Keeping Fit for Duty

Officers who are not in the best of health and not well rested are prone to error and serious mistakes – errors of action and judgement that will result in poor decision making and elevated risk.

1. Inadequate Rest

Tired people lack energy and coordination and every task requires extra effort. Concentration and levels of alertness are seriously diminished and things are forgotten more easily. Perceptions are slower and sounds may not register. Vision is also impaired.

How do you know if you are tired (fatigued) and not getting enough sleep? A couple of useful indicators of sleep deprivation are that you could fall back to sleep within an hour or two of getting up or cannot function without caffeine.

On the bridge, such levels of tiredness or fatigue can have disastrous consequences.

2. Disturbed/Displaced Biological Rhythms

Disturbed and/or displaced biological rhythms can occur when joining a ship, after a change of shift pattern or workload while in port, or due to operational requirements at sea, such as tank or hold cleaning.

When joining a ship, there is often little time, if any, to recover before assuming duties. It is natural to be fatigued after a long flight, which is not just the result of a lack of sleep in a cramped seat. The body's natural rhythms will have been disturbed, the degree of disruption depending upon how many time zones have been crossed and the direction travelled.

Take the example of flying from NW Europe to the West Coast of the USA, or flying from the Philippines to NW Europe to join a ship, crossing multiple time zones.

In both examples, if you arrive in the early morning, your body clock will be telling you that it is late afternoon/early evening. By the time you have left the airport and arrived at the ship, you would normally be going to sleep (in your home time zone).

There is still worse to come. By the time you complete your handover, and you settle in to your cabin, your body clock will be at the stage where you would normally be waking up at home.

You may find yourself lying in your bunk unable to sleep. This is known as jet lag, where you feel tired and sleepy in your new time zone but your body clock still thinks it's on its previous time zone, that of your home.

This disturbance can lead to a degradation in performance that will affect everything, from psychomotor coordination to cognitive or mental work. Concentration may be poor, basic errors may be made in calculations and memory may be weakened. There is an increased risk of injury when operating systems and equipment.

Other symptoms of disturbance of body rhythms include difficulty in falling asleep, difficulty in staying asleep, not sleeping deeply enough to help recovery, and headaches or migraine.

3. Stress

Stress can be serious and, if not addressed, can lead to multiple health problems. The Oxford Concise Medical Dictionary defines stress as:

"*Any factor that threatens the health of the body or has an adverse effect on its functioning such as injury, disease or worry. The existence of one form of stress tends to diminish resistance to other forms. Constant stress brings about changes in the balance of hormones in the body.*"

Work at sea presents a unique and complex array of potential factors (stressors) that exceeds the occupational and lifestyle issues found in other industries onshore.

Some of the main causes of stress on the ship are:

- Lack of long periods of good quality sleep
- separation from loved ones, including family and friends
- personal worries and anxieties, from finances to health
- loneliness and a lack of socialisation on the ship
- poor quality food
- frequent port calls, extra duties or overtime hours
- language problems/cultural differences
- bullying/poor support from a senior officer/other seafarers losing their tempers
- heavy seas, especially those lasting for several days
- poorly designed/maintained ships, where bunks are not comfortable and/or the ship always rolls (stiff ship)
- uncomfortable temperatures
- inspections and other official visits.

The Australian Maritime Safety Authority (AMSA) observes that *"exposure to ongoing elevated stress levels has a negative impact on physical and mental health as well as work performance"*. To mitigate the worst effects of stress, the following is suggested:

- Controlled breathing: this involves inhaling slowly through the nose, taking as deep and long a breath as possible. Try sitting in the cabin in the dark for a while, perhaps with stretches
- regular exercise: regular periods of moderate intensity exercise is essential because exercise stimulates oxygen flow, clears thoughts and allows a better state of mind
- sufficient rest: while difficult with watch constraints, minimum periods of rest are essential. Enough time should be taken to sleep during off hours. While some media entertainment is good to unwind, avoid lengthy periods in the cabin watching TV/films, especially when it reduces time asleep
- socialise: spend time with others on the ship. This is important as it not only offers a distraction but also encourages bonding as a team
- positive thinking: this involves trying to concentrate on good things. Playing music, reading and exercise are all good aids to positive thinking.

When feeling stressed, it is important to try to identify what is causing the stress. Writing a list of stressful things on board can relieve some of the pressure mentally. Equally beneficial is talking it over with another trusted seafarer. It can sometimes help to voice problems, provided this is done in a professional manner. While a lot of factors causing stress may be part of being a seafarer, others can be improved by taking

action. For example, try going to the gym a few times a week or try some walks in the fresh air where possible. If food is causing an issue, consider speaking to the cook/ Master.

Getting a good period of sleep is usually possible and while watches/arrivals/departures may intervene, sleep can still be made effective by other actions such as:

- Set an alarm for the same period before each watch. This allows the body clock to adjust to the same waking up time each day. Try to avoid rushing to the watch at the last minute. Ensure you have enough time to wake up properly, get a hot drink, have a wash or shower, etc
- start the day with a warm shower, as this can be an effective way of waking up. Equally, having a shower after a watch can have a good restorative effect
- avoid heavy carbohydrate and/or spicy foods before going to sleep and do not drink milk/consume cheese if it has an unsettling effect
- avoid using a personal electronic device right before sleep. The use of tablets and smartphones is a key contributor to poor periods of sleep
- avoid the consumption of alcohol (even if permitted). Drinking alcohol can mean several days of poor sleep afterwards, with reduced concentration and reduced effectiveness during cargo operations/on departure/on the navigational bridge
- use the main bed (bunk) to sleep as much as possible. Although on many ships there may be a day bed (sofa) provided, it is always better to go to the main bed for sleep, even if just a nap. This is because the brain will associate it as being the main place to sleep properly (rolling in heavy weather conditions excepted!)

1.6 Fatigue

When fatigue is not managed properly, there is a risk that ship's personnel may fall asleep uncontrollably at inconvenient and/or dangerous times. Rules, regulations and threats of disciplinary action are ineffective in preventing the negative effects of fatigue from affecting a ship's operations.

Lapses in cognitive work and breakdowns in psychomotor skills may follow. Involuntary microsleeping or even deep sleep cannot be prevented in cases of extreme fatigue. The only potential defences are to plan in advance and be aware of the onset of fatigue by monitoring the symptoms.

Fatigue management programmes exist in some companies and should be encouraged where they do not exist. The core element of any programme is assuring awareness, among all crew members, of the dangers associated with fatigue and the possible onset of involuntary sleep. One of the greatest dangers is that a tired person is often the last to recognise the symptoms. In some ways, this is similar to a person who has consumed alcohol, but is unaware of the deterioration in their performance.

The effect of fatigue on performance is similar to that of alcohol. Consider a Third Officer getting up at 07:00 hrs for the morning 8–12 watch, working on deck during the afternoon and then completing the evening 8–12 watch. If they then had to participate in berthing operations at the next port, or an emergency, they would typically have the same cognitive level by 02:00 hrs as being drunk.

Microsleeps
Microsleeps are unintended, and normally brief, episodes of sleep that can last from a fraction of a second to a few minutes. Often the person is not even aware of the shorter sleep periods. They are most prevalent when someone is involved in periods of low-stimulation activity or periods of boredom. They are further induced by monotonous surroundings and are a frequent cause of road traffic accidents. They have also been prevalent in aviation incidents and accidents, where all crew members have fallen asleep at the same time.

Microsleeps are also more prevalent at times of a body's 'low' in the circadian rhythm cycle (body clock) and in people suffering from a sleep deficit. They can even occur when a person has their eyes open. They are unpredictable and a potentially tragic outcome for someone who is in denial regarding their state of fatigue.

Napping (Short Shallow Sleep)
Research shows that napping can increase alertness, reduce stress and improve cognitive functioning. Napping has been proven to have beneficial effects and in some countries, most notably around the Mediterranean, it forms a way of life as a siesta.

A nap is little more than a recuperative break that allows us to slip into light sleep. Naps are best taken before the onset of fatigue and, even if they are very short (5–20 minutes), they can be very regenerative. Afternoon naps are best for redressing a sleep deficit as we generally feel slightly drowsy during the afternoon (14:00–16:00 hrs), which is approximately 8 hours after sunrise. However, if a nap exceeds 40 minutes, a longer period will be required for recovery.

Closing the eyes and relaxing can have a rapid regenerative effect on vision, perception, concentration and judgement. It is also a stress reducer. Should a nap be long, say more than an hour, it will be natural that sleep will be shorter during the following night or the next sleep period.

Project Horizon – (web search for 'Project Horizon' + 'Warsash Academy')

To advance the understanding of seafarer fatigue, *Project Horizon* was established to investigate the impact of watchkeeping patterns on the cognitive performance of seafarers. This was a multi-partner research study comprising 11 academic institutions and shipping industry organisations, employing highly recognised and respected data acquisition methods and infrastructure. Its findings were published in 2012 and they demonstrate conclusively the links between performance degradation and certain patterns of work.

90 experienced volunteer deck and engineer officers took part in the study, representing the majority of seafaring nationalities. In the introduction to the report, the researchers cited the correlation between the effects of fatigue on human performance and alertness and the similar effects of alcohol. It states: "*Studies have shown that around 22 hours of wakefulness will have a similar effect upon the impairment of an individual's performance as a blood–alcohol concentration of 0.10% – double the legal driving limit in most European Union states.*"

The importance of this correlation should be noted, considering how many shipping companies feel it necessary to ban alcohol on board their ships.

The perceived necessity for such a study resulted from a number of well known shipping casualties, which, upon investigation, had inadequate rest and fatigue as major contributory causes. Some are listed in the report. Studies were also published on the high incidence of watchkeepers falling asleep on watch; one stated an incidence of one in four while another cited 70% of watchkeepers falling asleep at some time during their careers.

A study by the UK's Marine Accident Investigation Board (MAIB) in 2004 stated that, *"fatigue was considered to be a contributory factor to 82% of the groundings in the study which occurred between 0000 and 0600 and was also a major causal factor in the majority of collisions."*

A number of aspects were considered in the *Project Horizon* study, such as physical activity, vigilance, sleepiness and stress. These were measured over a period of a week in research carried out in England and in Sweden, using full mission simulators to recreate accurately two return trips from Southampton to Rotterdam. The participants' performances were monitored through highly sophisticated measuring equipment and through video and audio recording. The participants each kept a diary to record their own personal perceptions of their stress, alertness, fatigue and sleep.

One of the major focusses of the study was the difference in crew members' performance and alertness when working two different work patterns: 6-on/6-off and 4-on/8-off. During the week's work, one rest period was deliberately disturbed.

A brief overview of the findings indicated:

- Generally, sleepiness levels were higher on the 6-on/6-off system than in the 4-on/8-off system
- sleepiness levels did not significantly differ between deck and engine room
- sleepiness was found to increase with time on watch
- disturbance during rest time instantly increased sleepiness
- the percentage of participants showing sleep while working on the bridge was unexpectedly high
- more participants fell asleep during the night/morning watches than day–early evening watches
- a disturbed off-watch period was found to result in more sleep during the subsequent watch
- watchkeepers were found to be most tired at night and in the afternoon
- sleepiness levels were found to peak towards the end of night watches
- slowest reaction times were found at the end of night watches.

This short overview of this extensive study is provided for information only. Such studies in all industries are of great value and, while the individual crew member is not in a position to change their working environment, such studies advance knowledge greatly and help to enhance awareness of the risks and dangers. The full report is available on the Project Horizon website.

Fatigue Management

Some officers and crew will report that they never have an uninterrupted night or, due to their watches, can only sleep during the day. While this illustrates that each one of us is different, we all change with age. There is no fixed amount of sleep for everyone and, therefore, it is up to the individual to try to manage their life so that the body's requirements for rest and sleep are satisfied.

Fatigue is cumulative and all periods of no sleep or disturbed sleep must be compensated for at some stage and the sooner the better. However, sleep deficit can never be fully retrieved.

Managing with Minimal Sleep

This is a myth!

"The number of people who can survive on 5 hours of sleep or less without any impairment, expressed as a percentage of the population, and rounded to a whole number, is zero."

Dr Thomas Roth, Henry Ford Hospital, Detroit.

Pulling an All Nighter

You may have had to 'pull an all nighter' during cargo and mooring operations. In Matthew Walker's book, *'Why We Sleep'*, he describes a scenario where some of his students were pulling 'all nighters' to cram for exams. To determine whether they were right or wrong to do so, he conducted an experiment with an MRI machine comparing the difference between learning something and then having a full night's sleep versus cramming and last minute study.

His findings showed that there was a 40% deficit in the ability of the sleep deprived group when compared with the group that had a full night's sleep. To put that in context, that is the difference between acing an exam and failing it miserably!

It is important to ensure:

- Effective work/rest arrangements: while it is difficult to measure 'workload' so that it is equally distributed, it should be borne in mind when establishing work schedules, checks, inspections and drills. Be aware of fatigue within crew members. Some will always be more tired than others, particularly younger crew members such as cadets, who require more sleep
- potentially hazardous tasks are scheduled for daylight hours
- an open, fair culture for reporting and dealing with fatigue is created. When a crew member senses extreme fatigue, for whatever reason, they should feel free and unthreatened to speak up and mention it. Ignoring this state is potentially negligent. Do not forget that personal anxieties are powerful stressors that affect senior officers, including Masters
- when a fatigued crew member is recognised, positive action is taken
- accurate records of rest/work periods are kept. Despite commercial pressures, these should never be falsified
- minimisation of noise and disturbance in rest areas. All efforts should be made so that all crew members are assured of effective rest and uninterrupted sleep during their rest periods. This should be considered when coordinating maintenance work that can generate noise, but should also include ensuring disciplined and considerate behaviour by all crew members on duty

- healthy lifestyle and diet for crews: senior officers are responsible for the state of the crew and among their responsibilities is seeing that crew always have access to healthy food and drink and, when fitness facilities exist on board, they are allowed access to them.

All of the ship's company should ensure:

- They recognise the onset of fatigue: everyone should know their limitations and be aware of when they are feeling at their best and when they are not. They should realise that, when tired, they will not be performing at their best, and measures must be taken to compensate for this, such as taking everything more slowly, double-checking critical actions or summoning the help of a colleague
- they recognise that the greatest levels of sleep deprivation usually occur at the end of a voyage or contract, when the greatest amount of sleep deprivation has been accrued
- professional responsibility for their own rest regime: all crew members, including the Master, are responsible for achieving and maintaining their own hours of rest and sleep
- they take strategic naps and develop a 'pre-sleep' regime: rest periods are there for rest and should be used effectively. It is everyone's duty to be fully rested when returning for watch
- there are no disruptions during extended periods of sleep: it is understandable that, when crew members are away from home for extended periods, there is a desire to make as much contact with friends and family when the opportunity arises. However, it is essential to balance these desires with the need for rest, which may mean switching phones off or onto silent mode when near to land or in port
- they do not consume alcohol or caffeine before sleep. There are some people who feel that alcohol, if available on the ship, helps sleep. This is not the case and, while it may help initial relaxation, it can have a considerably disruptive effect on the quality of sleep. Caffeine should be avoided within a couple of hours of sleep, as it is a stimulant and will prolong the time it takes to find recuperative deep sleep

- they consume a regular and healthy diet: heavy meals and certain foods should be avoided before going to bed for a good sleep
- they maintain physical fitness: overall levels of physical fitness will have a strong influence on sleep quality. This will not only be a result of healthy eating habits but also of exercise and the amount of physical activity undertaken at sea. Exercise is a stress reducer and can help relaxation
- that fatigue is not concealed: colleagues have a right to expect all of the ship's company to be fit and performing at their best.

To be sleep deprived for 18–20 hours straight is the cognitive equivalent of being drunk.

Research shows that the recycle rate of the human brain is around 16 hours. After being awake for 16 hours, the performance of the human brain starts to deteriorate. People need a minimum of 7 hours of sleep per 24-hour period to maintain cognitive performance.

Adequate rest and good sleep are essential to our cognitive and psychomotor performance. Recognising that this is not always easy to obtain within our working environments, it is crucial that we manage our performance ability and fatigue levels as best we can. It is important to recognise that we are not the best judges of our own degree of tiredness and we often tend to overestimate our abilities.

- Understand what fatigues you and manage your workload within your limits. Do not hesitate to summon help when needed and inform others of any deterioration in ability due to fatigue (or any other factor)
- take early action to correct a growing sleep deficit – being proactive could prevent the next mistake or possible injury
- if not at your best, inform the Master or your colleagues
- you cannot fight fatigue; it is a natural human state
- fatigue is cumulative – rest is not.

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