WELFARE
2.0

How can the next generation of technology enable
better crew safety, health and wellbeing at sea?

Nick Chubb

COVID-19 has created an unprecedented crewing crisis, with no end in sight for the world's seafarers. But many factors that impact the ongoing welfare of seafarers existed long before the coronavirus crisis began and will continue long after. This report explores the major contributors to welfare at sea and the role that technology can play in each of them.

Thetius

CONTENTS

FOREWORD

When we first discussed putting together this report late last year with the author and some of the welfare organisations and charities we have worked very closely with over a number of years, none of us could have foreseen the impact that the COVID-19 pandemic would have on the world, shipping , seafarers and their families.

However, even then we were all of the impression that safety and crew welfare was being left behind in the technology stakes compared to other areas such as fleet and vessel management and more needed to be done to investigate how technology could help to enable better crew safety, health and well-being at sea. We were in agreement that the sector required a fresh vision of what could be possible for crew with the right use of technology. Welfare 2.0 was born.

Now, with shipping facing a humanitarian crisis on a scale it has never seen before with thousands of crew stranded and issues such as mental health and seafarer suffering making headlines in not just maritime media, but mainstream media across the world, the findings of this report and subsequent need for discussion and ultimately investment in technology to improve crew welfare and safety is even more important for a post-COVID-19 maritime world.

As this report concludes, how can we hear time and time again that the safety and welfare of seafarers is the industry's
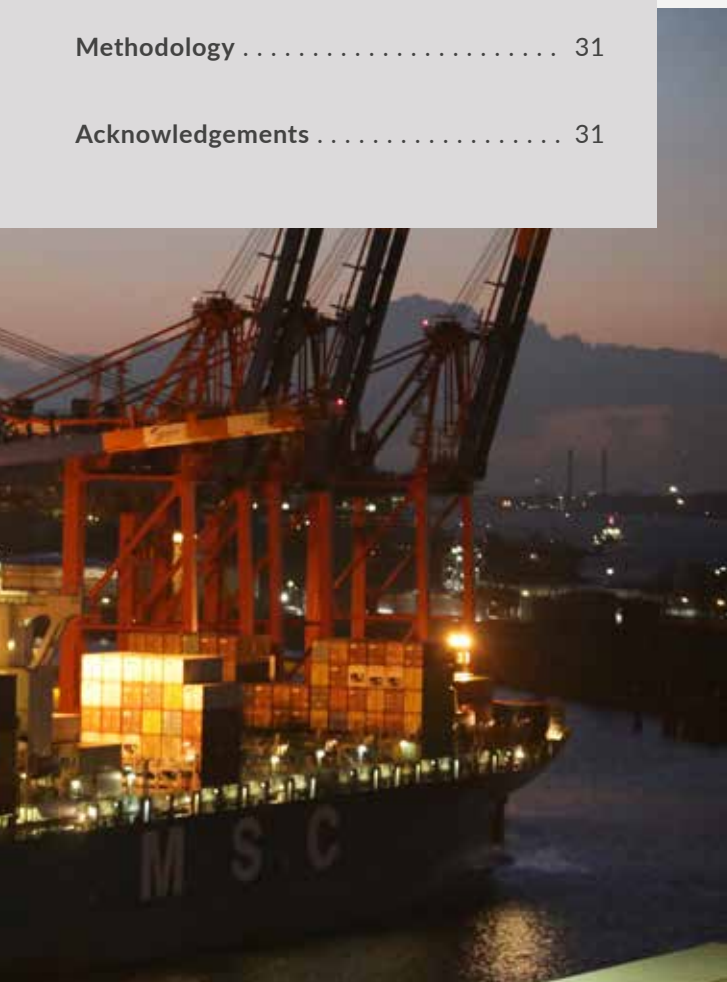
There is a genuine need for technology to bridge the gap and be used to better understand the link between mental health, physical health, stress, errors, safety on board and the preservation of assets

highest priority, when the situation we now currently face proves that this narrative is flawed and exacerbated by a woeful lack of investment in relevant technology.

It is hereby important to note that technology is not a panacea and should never be heralded as such, there will always be areas where technology cannot solve anything and even worse, if poorly adopted will actually cause more harm than good. These areas are probably better served with improved policy and practice.

However, there is a genuine need for technology to bridge the gap and be used to better understand the link between mental health, physical health, stress, errors, safety on board and the preservation of assets.

As safety is in our DNA, having been at the heart of our foundation over 40 years ago, we are always very keen to look at the relationship between welfare and crew safety and how new digital technology can reduce the risk of accidents particularly if we can use data and technology to provide proactive rather than reactive solutions that eliminate risk and again preserve value.

Similar to our previous Trade 2.0 reports written by the same author, this report looks at the underlying factors that impact the safety, welfare and learning

of crew and then profiles current technology and more importantly the companies and startups that are starting to address some of these underlying factors and address crew pain points.

From an Inmarsat perspective, now is a vital time to continue to develop a full crew welfare proposition using both existing technology, including our own connectivity and digital solutions but also work and collaborate with welfare organisations, charities, owners and managers as well as the all-important startup community, who are more agile and have the ability to test and modify solutions quicker than any more established company.

All stakeholders must now come together to create and work on common platforms to collect data, anonymise it, share it and use it to identify wider welfare trends, if the industry is going to start to eliminate the issues we are currently facing with crew wellbeing.

Ronald Spithout,
President, Inmarsat Maritime

EXECUTIVE SUMMARY

COVID-19 has created an unprecedented crewing crisis, with no end in sight for the world's seafarers. But many factors that impact the ongoing welfare of seafarers existed long before the coronavirus crisis began and will continue long after. This report explores the major contributors to welfare at sea and the role that technology can play in each of them.

Globally, the ship management software market is worth $3.8 billion a year, and startups and SMEs founded since 2010 have raised $280million in venture funding

When it comes to safety, most seafarers rely on their knowledge and experience to continually assess a situation. This model allows many seafarers to quickly make safety decisions that save many lives, but it has some flaws. The effective use of data and analytics systems to overcome these flaws is beginning to have a big impact on the safety of those that go to sea.

When exploring the overall wellbeing of seafarers, it is important to take a holistic approach that takes into account mental, social and physical health. There is a growing body of evidence that mental health is a serious issue for seafarers. Mental health problems in the seafaring population appear to trend slightly higher than in other professional populations, but we found no evidence that suicide is the leading cause of death at sea. There is evidence, however, that mental health problems actively contribute to the risk of accidents at sea. Across multiple mortality studies, cardiac events listed as the second highest cause of death, behind accidents but ahead of suicide. Physical and mental health are interdependent, depression and anxiety are positively correlated with cardiac diseases and sleep disorders in seafarers. The biggest roles that technology can play in improving physical and mental health are addressing the underlying causes, providing early intervention support, and enabling access to the right support in a time of crisis.

Though crew safety and welfare is often described as the industry's highest priority, this does not appear to be reflected by investments made, either in technology providers themselves or in procuring their solutions

The vast majority of seafarers certificates are issued in a paper format and need to be physically carried from ship to ship. As well as being challenging for individual seafarers, this creates problems for crew management teams who may need to manage certificates on behalf of thousands of people. A number of solutions have come onto the market recently that seek to eliminate paper certificates. One of the side effects of coronavirus is the acceleration of online and virtual training and a number of startups and suppliers are developing platforms to improve training management and delivery including booking platforms and the use of extended reality in simulations.

Globally, the ship management software market is worth $3.8 billion a year, and startups and SMEs founded since 2010 have raised $280million in venture funding. Though crew safety and welfare is often described as the industry's highest priority, this does not appear to be reflected by investments made, either in technology providers themselves or in procuring their solutions. Startups with a focus on human factors attract four times less funding and grow 25% slower on average than startups focused on machinery performance. That said, there are many stories emerging of startups and ship operators partnering to implement technology to improve life on board with great success.

One of the key barriers to understanding the link between health, safety and welfare is the lack of data. We recommend the development of a data model for seafarer health, welfare, and safety to make it easier for organisations to anonymously share and analyse data that can inform the development of policy to improve life on board. Further, we recommend the widespread adoption of tools that can help individual seafarers and fleet management teams to take steps to understand and improve overall welfare on board. Lastly, we recommend the development of a campaign to raise awareness of the dangers of heart disease at sea, the steps individuals can take to limit their risks, and the symptoms to watch out for.

INTRODUCTION

At the time of writing, the maritime industry is in the grips of an unprecedented crewing crisis. The novel coronavirus has wreaked havoc on our lives ashore, but it has also led to a seemingly endless state of uncertainty for the men and women that operate the world's ships and the families that depend on them.

This crisis is one of the most important and fast moving problems the global shipping community has faced in recent decades
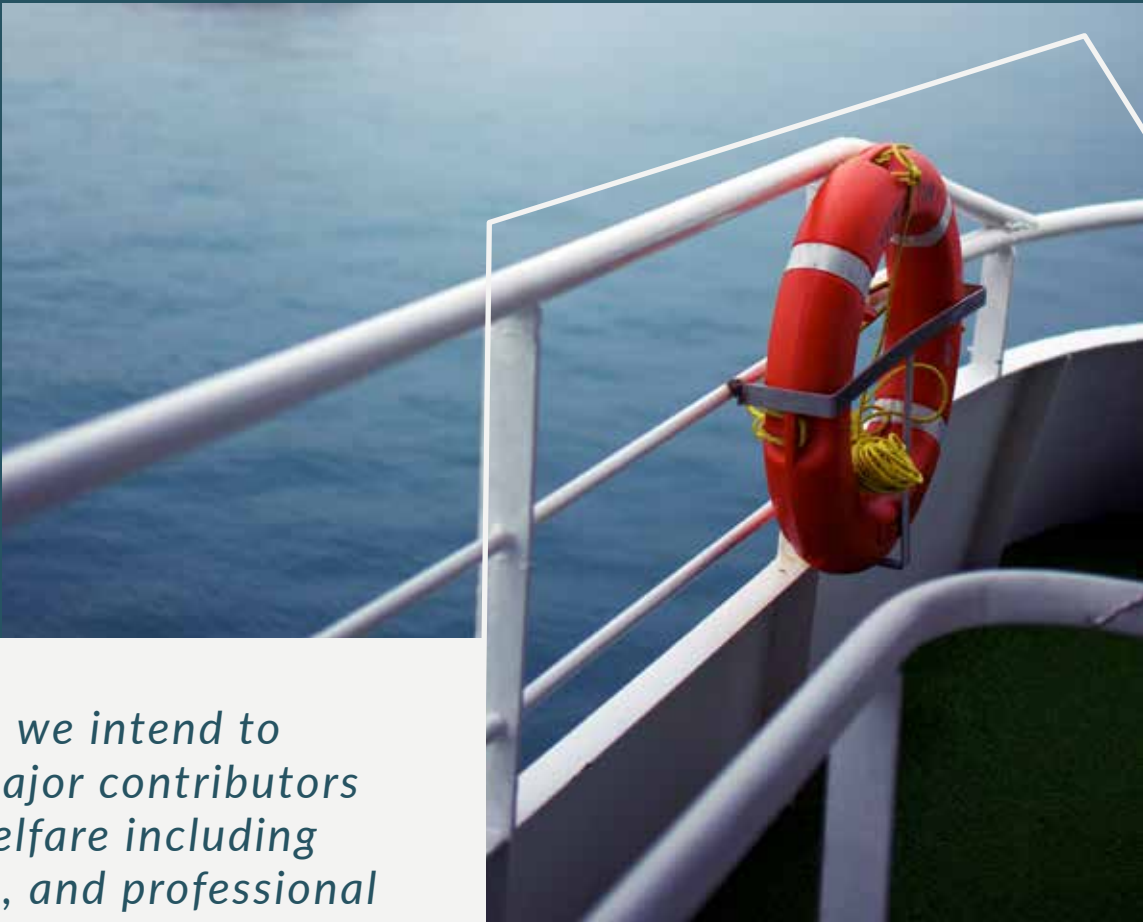
As many as 200,000 seafarers need urgent repatriation, having reached the end of their contracts months ago. For every seafarer trapped on board, there is another trapped at home, unable to join a ship and work to support their family.

This crisis is one of the most important and fast moving problems the global shipping community has faced in recent decades. Urgent action is required by governments around the world to lift restrictions and keep seafarers moving freely around the world. While there is no doubt as to the intensity of this crisis, it is important to remember that it is not the only issue seafarers face. The

COVID-19 crisis will pass in time, but some of the factors that impact the ongoing welfare of seafarers appear to remain steadfast and unmoving.

The sea is an incredibly hostile place to live and work. It has been tragically unforgiving over centuries of maritime trade and remains so today. A life at sea can mean months away from home each year, strained relationships with loved ones, and missing out on key milestones in life. It can mean giving up control of basic freedoms that the rest of society takes for granted, like choosing what to eat and when to sleep. Further, the daily difficulties of a life at sea are compounded by an ever present risk of incidents, accidents, or emergencies, and the fact that help can be days, if not weeks away. But a life at sea can also be incredibly rewarding. From the master and chief engineer all the way down through the ranks, seafaring is a highly skilled profession. It provides unrivalled opportunities to travel, earn a good wage, forge friendships that last a lifetime, and take great satisfaction from the important contribution made to wider society.

In this report, we intend to explore the major contributors to seafarer welfare including safety, health, and professional development and the role that technology can play in improving each of them

In this report, we intend to explore the major contributors to seafarer welfare including safety, health, and professional development and the role that technology can play in improving each of them. The combination of humans and technology is never simple; particularly when it is used in the workplace to tackle highly personal issues like mental health. We have found that while more technology is not always the answer, it has an incredibly important role to play in improving life on board. Further, we have found that overall wellbeing requires a holistic approach and that some pieces of this puzzle do not receive enough attention.

We don't yet know what the long term impact of COVID-19 will be on seafaring communities. In the short term at least, it has highlighted the importance of seafarers to the world. We hope that the 1.6 million men and women who keep us all supplied can soon move freely around the world once again, we also hope that this crisis can be a catalyst for wider change in the industry. We hope this report serves as a small contribution to that movement and helps to direct some of the positive action to come in the months and years ahead.

SAFETY AND EMERGENCY RESPONSE

Every seafarer remembers stepping on board a ship for the first time. Feelings of excitement, trepidation, and wonder are accompanied by a dawning realisation of how little one knows despite months of training and preparation. A ship is an alien environment to everyone without sufficient experience, and it takes many months, if not years to learn how to stay safe on board.

UNDERSTANDING RISK

For the most part, when it comes to safety we place our trust in knowledge and experience. Through years of learning, many seafarers develop an intuition for safety issues. This "sixth sense" is not unique to shipping, it has been cited across many safety critical industries including the military, clinical practice, emergency services, and aviation. This sense is developed over many years at sea, with more experienced officers and ratings often appearing to be able to spot emerging safety issues before they fully develop. But research shows that it is experienced seafarers who are most likely to fall victim of a serious accident on board a ship. The leading cause of death at sea is accidents, and the average age of those of accidental fatalities at sea is 40.[1]

For the most part, when it comes to safety we place our trust in knowledge and experience

In a complicated situation with many possible outcomes, our brains cannot process all of the information required to make decisions. Instead, we use mental shortcuts known as heuristics.[2] These are rules of thumb that we apply without thought to help us make decisions quickly and efficiently. For example, with enough experience you know how much milk to put in a cup of tea without ever having to measure it accurately. The same goes for an experienced pilot judging collision risk in a busy port

---

1   Fatal accidents and injuries among merchant seafarers worldwide, Occupational Medicine, Roberts et alia, 2014

2   Managing cognitive bias in safety decision making: Application of emotional intelligence competencies, Journal of Space Safety Engineering, Hersing, 2017

channel, or a deck rating judging the strain on a mooring line. Precise measurements do not need to be taken, our brains automatically and quickly make a judgement based on past experience and knowledge.

While this cognitive process allows us to quickly make decisions that can save lives, it has some flaws. We use a number of different heuristics in our decision making, and though they often allow us to make good judgements quickly, they also present unconscious biases. For example, authority heuristics are based on the opinions of people who we believe have superior knowledge or experience. If an experienced Chief Engineer tells an inexperienced rating that an activity is safe, they are likely to believe it regardless of the circumstances. We also use availability heuristics that are based on how easily certain scenarios come to mind. A deck officer who has recently been involved in a collision or close quarters situation will likely judge collision risk to be higher than one who has not.

These mental shortcuts change our perception of risk over time, even when the actual risk we face from day to day does not. More importantly however, our perception of risk can stay the same, even when our circumstances and situation are evolving. Our ability to judge risk is further constrained by the fact that our decision making is limited only to our own knowledge and experiences of the world.

The effective use of data and analytics is key to overcoming the shortcomings of our own brains and ultimately improving our ability to prevent accidents

THE ROLE OF DATA

The effective use of data and analytics is key to overcoming the shortcomings of our own brains and ultimately improving our ability to prevent accidents. In the same way that our brains use knowledge and experience to make sense of complicated situations, it is possible to use data and experimentation to build models that can predict the risk of accidents. Algorithms that take into account many different factors can be used to calculate risk on a mathematical basis. This cuts out many of the unconscious biases and inconsistencies of our own minds. Further, with the right system in place, it is possible to capture data across whole fleets of ships, making it possible for thousands of people to benefit from the insight of a single crew member on a single ship.

One such company using algorithms to predict risk at sea is HiLo. Catastrophic disasters like explosions or major collisions are high impact low frequency events. They often cause multiple fatalities and can lead to untold damage to the marine environment. But because they are so infrequent they are very difficult to predict. With the right approach, it is possible to use data from near misses and minor incidents as leading

indicators of a major disaster. HiLo makes use of data from low impact incidents that occur more frequently to build a predictive risk profile for an individual ship or an entire fleet. Subscribers to HiLo contribute data from their own fleet which is pooled anonymously and fed into a mathematical risk model. The result is that HiLo can identify critical areas of action to avoid serious incidents and allow crew members and fleet management teams to act before minor issues become major accidents.[3]

While the information to improve safety on board ships will often come from near miss reports, maintenance logs and machinery data, for Danish startup Scoutbase, it all comes down to asking the right questions. Seafarers who are on board a ship day in day out have the clearest understanding of the problems and challenges they face. Recognising this, Scoutbase designed a system that allows crew members to anonymously share their experiences with a few simple taps on a smart device.

This system makes it possible for leaders to access real time data about crew productivity, safety and wellbeing across a fleet of ships. The Scoutbase team believes that even though it is attributed as a cause to most maritime accidents, human error is a symptom of underlying problems relating to interactions between humans, technology, and organisations. By continuously asking crew members questions about their honest experiences of life on board, the Scoutbase platform builds a picture of emerging safety issues that runs deeper than relying on occasional surveys and inspections. Ultimately, this makes it easier for decision makers to spot emerging
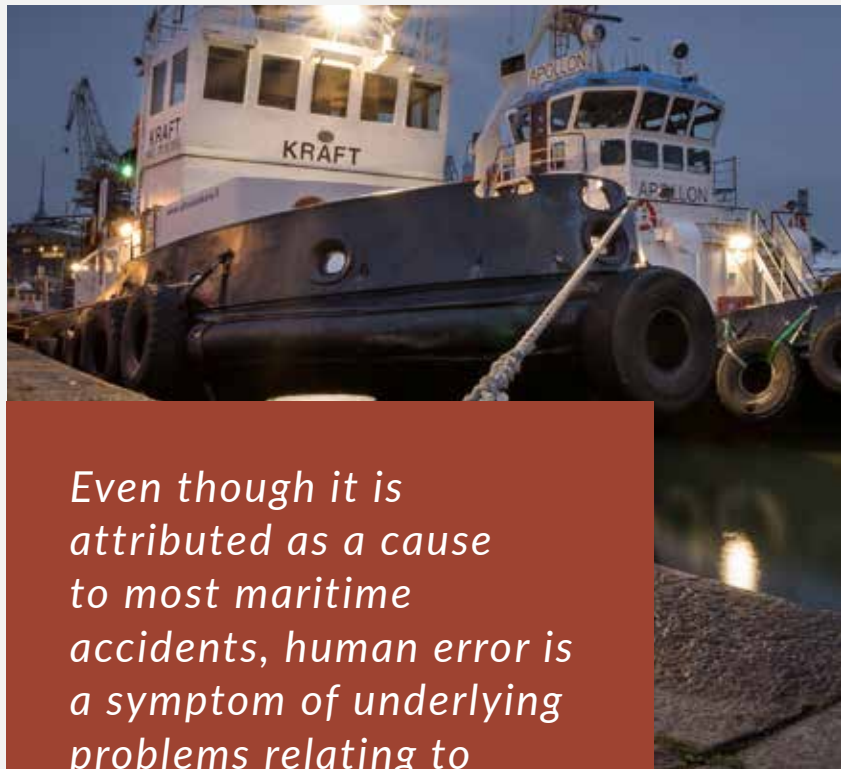
Even though it is attributed as a cause to most maritime accidents, human error is a symptom of underlying problems relating to interactions between humans, technology, and organisations

patterns and take action to improve safety, wellbeing and productivity.

Another company creating out of the box ways to solve safety problems is Big Yellow Fish. The Indian startup was founded on the principle that game based learning holds the key to improving safety and welfare at sea. Though most computer games exist for entertainment purposes, gaming has been used as a mechanism to teach serious concepts for centuries. Board games like Chess and Go have been used to teach people strategy for thousands of years. Big Yellow Fish uses simple games to first create a "net safety score" for a vessel based on human factors. Following on from this, games that

3   Don't let it turn to dust, Harbours Revier, Chander, 2019

inmarsat

are designed for regular, short engagements are used to reinforce desirable behaviours like resilience, teamwork, and communication. The platform is designed so that, over time, regular engagement can improve the safety score, ultimately reducing the risk of accidents. Additionally, Big Yellow Fish has a built in health-bot that can offer exercises to help crew members overcome stress and fatigue and has customisable content options to make it easier for crew to provide ongoing feedback about life on board to fleet management.[4]

EMERGENCY RESPONSE

Unfortunately, despite recent advances in safety technologies and best practices, incidents and accidents still happen. Some of the largest ships sailing the oceans today are longer than four football pitches. As well as this, they can have multiple decks, bilge and machinery spaces, cargo holds, cabins, and accommodation areas. Until recently there has been no systematic way of monitoring people as they go about their daily work and rest. Sadly, it is still common for crew members to fall overboard, suffer from trips and falls when working on deck, or become trapped during a fire. During any emergency, speed is crucial.

> *Being able to quickly locate all of the crew members on board during a fire, know instantly if someone has fallen overboard, or locate a crew member who has become trapped can mean the difference between life and death*

Being able to quickly locate all of the crew members on board during a fire, know instantly if someone has fallen overboard, or locate a crew member who has become trapped can mean the difference between life and death. Norwegian startup Dimeq has developed a lightweight wrist band that makes it possible to instantly locate crew members during an emergency. The wristband has a six month battery life and can be set up to instantly trigger an alarm on the bridge if a crew member falls overboard or fails to arrive at a muster station. Further, during emergency operations like firefighting, Dimeq's system can be used to monitor the location and progress of fire teams or locate casualties during a search and rescue operation. The next generation of Dimeq bands can even be used to make cashless payments on board, and as a key for controlling access to cabins, store rooms, and restricted areas.

---

4   Big Yellow Fish, accessed 2020

MENTAL, SOCIAL AND PHYSICAL WELLBEING

Ensuring the safety of seafarers extends well beyond incidents, accidents, and emergency response. A more holistic approach to the overall wellbeing of those at sea must include their mental, social, and physical wellbeing.

There is a growing body of evidence that mental health is a serious issue for the seafaring population. Isolation, loneliness, lack of shore leave, fear of criminalisation, fear of job loss and separation from family all predispose seafarers to mental ill-health. There is evidence of an increase in recent-onset anxiety and depression among serving seafarers, and in some roles, seafarers may be particularly prone to emotional exhaustion and burnout.[5] 28% of seafarers screened in a study by ITF and Yale University showed signs of depression, anxiety, or both and more than a quarter (26%) showed signs of moderate to severe depression.[6]

MENTAL HEALTH AT SEA

Mental health problems in the seafaring population appear to trend slightly higher than in other professional populations.[7] Contrary to popular belief, there is no evidence that suicide is the leading cause of death at sea. Across multiple studies of fatalities in seafaring populations, injuries and accidents consistently rank as the

28% *of seafarers screened in a study by ITF and Yale University showed signs of depression, anxiety, or both and more than a quarter (26%) showed signs of moderate to severe depression*

leading cause of death. That said, there is evidence that mental health problems actively contribute to the risk of accidents at sea. Seafarers who are depressed or suffering from anxiety are twice as likely to get injured or suffer from another illness while on board when compared with those who are not.[8] Left unchecked, poor mental health in the seafaring population is as much a safety problem as it is a welfare problem.

5   Seafarers' mental health and wellbeing, Seafarers International Research Centre, Cardiff University, Sampson, Ellis, 2019

6   Seafarer Mental Health Study, ITF Seafarers Trust and Yale University, Lefkowitz, Slade, 2019

7   Ibid

8   Ibid. 6

Mental health problems in the seafaring population appear to trend slightly higher than in other professional populations

THE SILENT KILLER AT SEA

Though injuries sustained from accidents are the leading cause of deaths at sea, across multiple mortality studies cardiac events are the second highest cause, ahead of suicide.[12] In one mortality study focused on a population of Polish seafarers, circulatory diseases accounted for over 80% of non-accidental deaths. In one third of those cases, cardiac problems had already been diagnosed before the voyage.[13] Cardiovascular disease is particularly prevalent in men over the age of 40, but it is often largely preventable. High blood pressure, high cholesterol, smoking, obesity, and a lack of exercise all contribute to the development of cardiovascular disease.[14] Unfortunately for many seafarers, the three key tools to limiting the risk of cardiovascular disease, diet, sleep and exercise, are largely outside of their control.

When looking at welfare holistically, mental, social and physical health are interdependent and linked. For example, depression and anxiety are positively correlated with cardiac diseases and sleep disorders in seafarers.[15] Similarly, the likelihood of injuries and illness is also correlated to depression, anxiety, and suicidal thoughts. Ultimately, a direct link can be drawn between the wellbeing of a ship's crew and the safety of those on board. While technology has a great role to

One of the key triggers for poor mental health is social isolation.[9] In recent decades, the social makeup of many ships has changed dramatically. Crew sizes have steadily decreased and crews are often transient in nature and made up of many different nationalities. Further, for better or worse, connectivity has completely transformed how seafarers spend their down time on board. In a study of over 1,500 seafarers, spending time using personal devices alone in their cabins was ranked one of the factors having the highest impact on social interaction on board, ahead of hours worked, the availability of leisure facilities, and only slightly behind the use of a common language on board.[10] Despite this, there is no doubt that connectivity is here to stay. In another study, seafarers identified the provision of free internet access as the most significant contribution that could be made by employers to the improvement of mental health and wellbeing at sea. Over and above better terms of employment, accommodation, relationships on board, and access to exercise equipment.[11]

---

9   Mental health and social relationships, Economic and Social Research Council, 2013

10   An investigation into connectivity at sea, Nautilus International, 2017

11   Ibid, 5

12   Analysis by Thetius, see bibliography for full list of sources

13   Death at Sea: Certain Factors Responsible for Occupational Hazard in Polish Seamen and Deep-Sea Fishermen

14   Cardiovascular disease, NHS, accessed 2020

15   Ibid. 6

play in intervention, ensuring that people get access to the right support during times of crisis, we must also look at how technology can be used to improve the underlying problems that cause wellbeing to decline.

UNDERLYING ISSUES

One of those underlying issues is working hours and uncertainty of contract lengths. One of the key contributing factors affecting seafarers' mental health is the movement of dates for the end of a contract.[16] A contract extension for a seafarer reaching the end of their planned voyage has been shown to cause a 40% drop in their mood. This pattern is consistent regardless of whether a crew member is experiencing other mental health problems.[17] The impact of uncertain leave is particularly prevalent for crew members who have family commitments at home, and the lack of commitment to a contract end date can have a significant impact on an individual seafarer's attitude and performance while on board.[18] Though it will be some time before we truly understand the impact COVID-19 related contract extensions are having on the health and wellbeing of seafarers, we know from overwhelming anecdotal evidence that it has placed an enormous strain on the entire seafaring community and their loved ones at home.

Unfortunately, even during normal times, a combination of the operational requirements for the ship, commercial priorities, and the complexities of managing the mandatory competencies and experiences on board the vessel make a commitment to contract start and end dates difficult to achieve. However, research has shown that operating a stable crewing pattern, where senior crew members serve together on the same

While technology has a great role to play in intervention, ensuring that people get access to the right support during times of crisis, we must also look at how technology can be used to improve the underlying problems that cause wellbeing to decline

rotation, has benefits not just for vessel performance, but also reducing social isolation on board, encouraging a sense of belonging, and improving overall mental health of crew members.[19] Unfortunately, this is more of an issue of policy than technology. But streamlining the work of crewing management teams may help to free up more time for individual shipping companies to explore these issues fully.

---

16   An examination of the key benefits of assigning stable or fluid crews within the Merchant Shipping Industry, Southampton Solent University, Pike et alia, 2019

17   Seafarer Mental Health Study, ITF Seafarers Trust and Yale University, Lefkowitz, Slade, 2019

18   An examination of the key benefits of assigning stable or fluid crews within the Merchant Shipping Industry, Southampton Solent University, Pike et alia, 2019

19   An examination of the key benefits of assigning stable or fluid crews within the Merchant Shipping Industry, Southampton Solent University, Pike et alia, 2019

inmarsat

Mental health problems in the seafaring population appear to trend slightly higher than in other professional populations

UK startup Workrest has developed a SaaS application to help crews and crew managers to better manage leave and rest hours. The platform, which is becoming increasingly popular in the superyacht sector, allows users to download an app to their phone to log their hours. The app works offline, and syncs to a cloud platform whenever there is a connection. Once data is synced, it is automatically checked for compliance to regulations and passed to senior officers who can digitally sign them off. The chief mate on board and fleet management ashore are notified automatically of non-compliance, and the entire crew's timesheets can be printed in case of an inspection. Building on the success of their rest hours module, the Workrest team recently released a leave management app. The app allows fleet management teams to set leave allowances by rank, role, or individual contract. Accrued leave is automatically calculated, and individual seafarers have access to their own personal contract calendar in the app. The whole module is tied together with a scheduling tool that makes it possible for crewing teams to see who is due to pay off or join the ship at any given time, making it easier to spot and fill gaps in the manning requirements.

Another of those underlying problems can be worries about money and pay. Many seafarers around the world are paid in dollars rather than their home currency. Though most seafarers will have a portion of their pay sent directly to loved ones at home by their employer, it can be incredibly difficult to send extra money home in times of need. Many seafarers have to rely on other crew members to deliver cash to family members when they pay off or use money transfer agencies, some of which charge as much as 8% in fees to seafarers sending money home. UK fintech startup Remitly has created a dedicated service for crew members on board cruise ships to send money home.[20] Crew members can register with a smartphone app, and once verified can send money to family at home for free. The transfer takes 3-5 days, with an instant transfer available for a small fee.

ENABLING INTERVENTION

Early intervention for mental health issues is key. It is far better to manage an evolving issue than wait until it becomes a crisis. But despite the great work of many mental health organisations, the stigma surrounding mental health problems, particularly at sea, means seafarers don't feel able to speak out. Operating out of the UK, the Big White Wall is a digital platform that anonymously connects people to trained therapists, an online support network, and a library of tools and resources for managing mental health. Thanks to the support of the Seafarers' Hospital Society, seafarers, fishers, and their families can access the Big White Wall platform for free. By providing anonymity to users, Big White Wall is able to help people overcome the fear of speaking about their problems. 46% of Big White Wall users have used it to share an issue they have never spoken about before, and 70% of members report feeling better.[21]

It is far better to proactively monitor and improve health and wellbeing on board than it is to quickly respond to emergencies. But often when emergencies do strike, the victim themselves and other crew members are not able to quickly diagnose and assess the symptoms. It is of vital importance to be able to access medical information, advice, and support when crew members are injured or become ill.

20   About Remitly, Remitly, accessed 2020

21   Having a tough time? Big White Wall can help you get support, take control and feel better, Big White Wall, accessed 2020

Telemedicine services, where shore based doctors are available on call to diagnose, support, and coordinate a response to medical emergencies have been growing in popularity in recent years. Maritime health services provider Vikand provides medical services via video calls, which greatly improves the support that medical personnel on shore can offer to the crew on board. However, these services, and video calls in particular, have previously been constrained by limited connectivity, and usually interrupt the primary bandwidth of the vessel. A recent partnership between Inmarsat, Vikand and artificial intelligence startup FrontM has now overcome these bandwidth limitations by providing a dedicated service, Fleet Connect. It enables Vikand and FrontM to completely separate their applications from other connected services, making it possible to run video consultations without interrupting crew or operational connectivity. FrontM's platform is designed to enable messaging, phone, and even video calls in Internet constrained environments. By leveraging their technology, Inmarsat and Vikand have been able to offer seafarers free video consultations with medical professionals ashore during the COVID-19 crisis. As well as responding to emergencies and health crises, Vikand has developed a holistic health monitoring service. Vikand Healthnet combines emergency response with ongoing access to wellness programmes, mental health and stress management, chronic disease support, and occupational health and safety education.

Similar to mental health, it is far better to proactively monitor heart health and reduce the risk of an emergency than it is to attempt to deal with a cardiac emergency while on board

Vikand Healthnet ensures that, not only are there adequate resources available in an emergency, but that the likelihood of those emergencies is reduced over time.

Similar to mental health, it is far better to proactively monitor heart health and reduce the risk of an emergency than it is to attempt to deal with a cardiac emergency while on board. Dutch technology startup Medassist Online has developed a solution to this problem. Their Care4Crew platform is designed to increase compliance, reduce costs and improve care on board. The Care4Crew platform includes a heart app that can take a 12 lead, hospital quality ECG to measure how effectively a crew member's heart is beating. The results can be sent ashore instantly for interpretation by a doctor. As well as performing diagnostics, the system includes a step by step guide for 18 vital medical procedures that may need to be conducted on board. If a crew member performing a medical procedure needs extra support, the platform can facilitate an augmented reality connection to a doctor ashore. The doctor ashore can see what that the medical team on board sees, and can provide specific instructions and advice in real time.
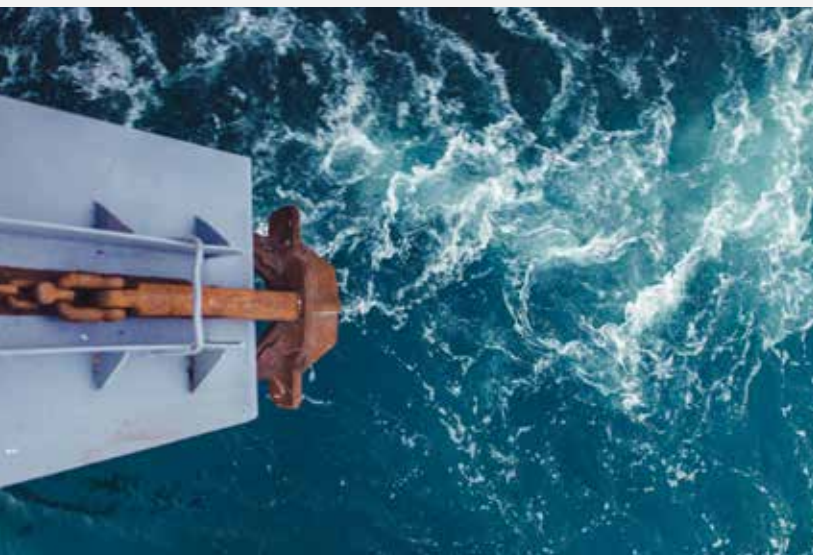
TRAINING AND PROFESSIONAL DEVELOPMENT

The seafaring profession takes years to learn and a lifetime to master. As technologies and best practice evolve, mariners of all ranks and from all departments of a ship need to work to maintain their knowledge and improve their skills.

MANAGING THE PAPER TRAIL

Throughout their career, every professional seafarer will acquire stacks of certificates and qualifications. The majority of these certificates must be physically carried on board the ships they serve on and maintained and updated throughout their career.

For a trainee deck officer to be eligible to take their final exams to qualify as an Officer of the Watch, they will need to have obtained no less than 11 different certificates, covering everything from basic medical fitness to safety and watchkeeping skills.[22] Upon qualification, they will still need to carry original copies of all of those basic certificates with them as well as their new certificate of competency. This is just the basics. It excludes any specialist qualifications for the ship type they are sailing or any company requirements for specialist training or certification.

Maintaining an ever growing portfolio of certificates and qualifications is not just challenging for individual seafarers, but also for the companies that employ them

Maintaining an ever growing portfolio of certificates and qualifications is not just challenging for individual seafarers, but also for the companies that employ them. Some of the industry's largest ship management firms employ tens of thousands of seafarers, each with their own portfolio of paper certificates. These companies must ensure that every ship they are responsible for is adequately manned, with competent seafarers who have the right experience for the role they are doing.

REMOTE LEARNING

One of the major disruptions of the COVID-19 crisis has been the closure of the majority of maritime education and training institutions. Every certificate issued to a seafarer represents knowledge and competencies gained, and closing training establishments, even temporarily, has impacted the ability of current and future seafarers to learn, and institutions to assess their competence. Before the coronavirus crisis, the majority of maritime education and training was conducted at training centres and schools that require students to be physically present.

Though remote learning has been embraced by many industries, the maritime sector has been slow to adopt the technologies for various reasons. Although rapidly improving, ships have historically had lower levels of internet access we take for granted when ashore, meaning the majority of the tools that make remote learning possible do not work effectively or are limited. Driven by a desire to improve education and training across the industry, but accelerated by lockdown measures, several companies are exploring how technology can be used to train and educate seafarers.

Operating out of Odessa, OMS-VR has developed a series of virtual reality based simulations covering activities that are difficult or dangerous to train in the real world. Their training library includes titles covering proficiency in survival craft and fast rescue boats, tanker cargo operations, steering gear maintenance, launching distress flares, and ballast tank inspections. The Ukrainian startup is certified by Bureau Veritas and is already working with fleet management companies including Wallem, Anglo-Eastern, and Star Bulk.[23]

Where virtual reality comes into its own is in making it possible for people to learn how to react to emergencies in a safe environment. For most emergency response drills, it is not possible to replicate the environment

OMS-VR has developed a series of virtual reality based simulations covering activities that are difficult or dangerous to train in the real world

of a real emergency. Though there are some dedicated training grounds for activities like firefighting they are expensive to run. This means the majority of seafarers only get to use them once every five years when they renew their certificates. Recognising this challenge, the Port of Rotterdam's Industrial Firefighting Team partnered with immersive training startup Parable to build a chemical firefighting course. The course lets firefighting barge crews repeatedly practice the procedures for extinguishing chemical fires including manoeuvring and docking, hose connections, and pump start procedures.

One of the key barriers to the adoption of virtual reality for training is that the cost of headsets and equipment can make it prohibitive for organisations to use the technology at scale. The founding team of UK based Seabot XR is working to make virtual and augmented reality accessible to every company and individual seafarer. Their virtual reality simulations are designed to work on a smartphone. With the addition of a simple cardboard headset, available for less than $10, most modern smartphones can support VR applications. Seabot XR offers training and familiarisation simulations, making it possible for seafarers to complete basic shipboard familiarisation and ship specific training at home in the days before they join a new vessel. They are also making the maritime industry accessible to the next generation by offering VR experiences of life at sea to schoolchildren around the UK.

---

23   OMS-VR, accessed 2020

TACKLING PHYSICAL TRAINING

Though simulation can replicate many real world experiences at sea, it is still important that seafarers get their hands on real equipment and have their competency assessed in a physical environment. With thousands of training centres around the world, but no single view of availability or pricing, booking training at physical centres is currently inefficient. Operating out of the Isle of Man, Tapiit is building a global marketplace of maritime training providers. Tapiit currently lists hundreds of courses available around the world, making it possible to quickly book maritime training with transparent pricing and availability. As well as making it easier to book courses, Tapiit is rolling out live streaming for virtual courses and a smartphone app to help seafarers manage their certificates and book renewal training.

ELIMINATING PAPER

Despite all of the developments in the way we access and undertake training, the industry is still entirely reliant on paper certificates for validating training. As well as forcing individual seafarers to carry reams of certificates everywhere they go, this practice is susceptible to fraud, and highly inefficient

for employers and training providers alike. One company working to solve this issue is Seattle based Pingle. Their CredentialMate platform, which is currently in Beta, allows mariners around the world to upload their paper certificates to digitally store and share them with potential employers. Users also receive notifications when they have expiring certificates and can book refresher courses directly through the app.

But paper certificates can still be lost, stolen or damaged, and in many circumstances a digital copy of a paper certificate is not accepted as valid proof of training. Recognising this, Navozyme, a Singapore-based blockchain startup has developed a certificate platform that makes it possible for training providers to issue digital certificates to seafarers that can be instantly shared with employers, port and flag state authorities, and other education institutions. The Navozyme platform makes it possible for employers and authorities to instantly verify a certificate with a training institution, removing the need for providers to keep costly paper archives and issue replacement paper certificates when the originals are damaged.

Taking this concept one step further is C-Log. Originally founded in Norway, the document management startup moved to Singapore to join the Eastern Pacific startup accelerator run in partnership with Techstars. C-Log has developed a decentralized platform to handle digital crew ID, documentation, and certificates, removing the need to create any paper certificates. The C-Log platform works by creating a universal crew ID that is completely free to use and can be shared between permissioned stakeholders. The Crew ID creates a unique identifier for each seafarer that protects their privacy and gives them access to a digital document wallet that can be shared with employers. Because the certificates are completely digital, they can also be integrated with existing ship management systems and be used to automate compliance checks for specific vessel requirements against international regulations.

THE EVOLVING WELFARE TECHNOLOGY MARKET

Globally, the workplace wellness market was worth $48 billion in 2018, with 321 million employees enrolled in workplace wellness or wellbeing programmes.[24] The massive scale of the wellness economy has created a huge opportunity for wellness related technology startups. At the time of writing, $13.1billion has been invested in more than 1,400 startups building technology to improve wellness and wellbeing.[25]

Despite all of this, there are only a handful of technology providers focused exclusively on building technologies to support crew welfare and wellbeing, and there is evidence that those that do struggle to take off. Globally, the ship management technology market is worth $2.2 billion a year, and startups and SMEs founded since 2010 have raised $280million in venture funding.[26]

AN UNDERINVESTED MARKET

Partly because of its small size and partly because multiple services are often combined into a single solution, it is very difficult to split crew welfare and wellbeing technologies out of the broader market for ship management technologies. But despite the obvious importance of crew input in overall vessel performance, startups that focus on human-centred technologies attract less funding and grow more slowly than those that focus just on the performance of the vessel's machinery and physical characteristics.

Though crew safety and welfare is often described as the industry's highest priority, this does not appear to be reflected by investments made, either in technology providers themselves or in procuring their solutions. Since 2010, startups with a focus on human factors, crew management, wellbeing, welfare, and seafarer safety have on average attracted a total investment of $2.25 million. This is around four times less than the average total investment in startups focusing on vessel machinery performance technologies such as engine efficiency, hull monitoring, and hydrodynamic performance in the same period ($9.6 million). Further, in the first five years in business, the revenue of startups focused on human safety and performance grows on average 25% slower than startups focused on vessel machinery performance.[27]

---

24   2018 Global Wellness Economy Monitor, Global Wellness Institute, 2019

25   Data from Crunchbase Pro, accessed 2020

26   Ship Management Technology Market Map, Thetius, 2020

27   Analysis by Thetius, data from Thetius platform, accessed 2020

> *The simple truth is that technology alone cannot improve welfare and safety. After gathering insight into life on board, the next step is to use that data to put in place policies, procedures, and solutions that best serve seafarers*

One of the likely reasons that investments in human-centred technologies is lower than investments in machinery-centred technologies is that the science of behavioural psychology is relatively new and not yet widely adopted in the workplace. It is far easier to predict the behaviour of an engine or the friction of a ship's hull than it is to predict the behaviour of a human or the complex nature of relationships on board. This of course makes it more difficult to invest in those technologies but there is no doubt that, as our collective understanding of what makes humans safe, productive, and happy grows, so too will opportunities to use that knowledge to improve life at sea.

DATA IS KEY TO UNDERSTANDING WELFARE

For fleet management teams that want to invest in improving the welfare and safety of their crews, gaining a proper understanding of day to day life on board is crucial. Technology can play a key role in collecting the data required to build this understanding. This is reflected in the range of startups and technology services working in this space, many are about collecting data to help management teams improve their day to day understanding of life on board the ships in their fleet.

A key barrier to the adoption of these technologies and a key consideration to make when investing in them is data privacy. There is a fine line between a helpful and well-meaning employer and a draconian "big brother" employer. That fine line is often dictated by the level of trust between a ship's crew and their employers. In maritime, trust is impacted by the physical distance between ship and shore staff, different cultural factors, and employment practices.[28] Many health technology initiatives fail because of a lack of trust between employers and employees and concerns over data ownership. Anonymous reporting can overcome a lot of these barriers, but building trust between ship and shore is crucial to successful implementation of any of these initiatives.

The simple truth is that technology alone cannot improve welfare and safety. After gathering insight into life on board, the next step is to use that data to put in place policies, procedures, and solutions that best serve seafarers. One of the keys to using data to measure life on board, is that it makes it possible to test what works and what doesn't and track changes over time. These changes may be driven by technology, like wearables devices and blockchain enabled certificates. But just as

---

28   Trust and safety onboard, WMU Journal of Maritime Affairs, Gausdal, Makarova, 2017

often they may be low-tech, like investing more dollars per head in food, or changing the watch patterns. There are no silver bullets here, helping to improve people's working lives is complex at the best of times, but that complexity is compounded by the environment seafarers must operate in. Though there is no doubt that technology has an important and growing role to play in improving life at sea, it must be built upon a foundation of mutual trust and respect between ship and shore.

EARLY SIGNS OF PROGRESS

Where that foundation of trust exists, technology is making a real difference to the lives of those on board. Many of the technology providers mentioned in this report are seeing growing adoption rates of their technologies. For example, HiLo, the risk management not for profit, is now in use on a fleet of 3,500 ships including tankers, bulk and container carriers. HiLo is working too, the model has generated a range of successful risk reductions across their portfolio of ships. Across a fleet of 1,000 ships in their portfolio, insight from HiLo reduced the risks of lifeboat accidents by 72%.[29] In one instance, the risk of a fatal engine room fire was unusually high for one ship owner. The company investigated the weak risk signal, small leaks of fuel, and discovered that they were related to inadequate bolt tightening and incorrect bolts being used in fuel lines. This discovery enabled the owner to take a simple corrective action across their fleet that significantly reduced the risk of a fatal engine room fire.[30]

There are other signs too of ship operators taking the opportunity to use technology to improve the lives of their crew members. DFDS and Shell have been working with Danish startup Scoutbase to pilot their anonymous feedback tools. In the trials, the Scoutbase team has been able to

> *Where that foundation of trust exists, technology is making a real difference to the lives of those on board*

achieve a steady 80% response rate from crew members using their app, giving fleet safety managers ashore 100x more data to inform their decision making.

Another area where digital technology is being shown to have a big impact is in rapidly developing solutions in times of a crisis. Motion Ventures, a Guernsey based technology startup built and launched a secure ID and compliance monitoring tool for the financial services industry in 2019. As the COVID-19 crisis began to unfold, the Motion Ventures team set about repurposing the technology to support secure symptom tracking and healthcare monitoring for ships' crews. The new product, IDCrew was launched in March and allows crew members to securely track and declare their health status while at home, on board, or during transit to or from a vessel. The platform has been further developed using the IMO's 12 step plan for enabling crew changes allowing fleet management teams to track crew members through the transit process including any travel and quarantine time. IDCrew is now being used by one of the world's largest offshore support vessel operators to monitor crew health, and proactively manage repatriations. This type of rapid intervention is only possible through digital technology and demonstrates that it is possible to quickly find, build and distribute solutions to difficult problems the industry faces.

29   Our services, HiLo, Accessed 2020

30   HiLo, how does it work?, HiLo, accessed 2020

CONCLUSION AND RECOMMENDATIONS

There is a common narrative across the maritime sector that the safety and welfare of seafarers is the industry's highest priority. Unfortunately, the narrative is betrayed by the apparent lack of investment in relevant technology. That said, no matter how good a piece of technology is, it cannot replace the need for sensible policies and working practices that promote safety and wellbeing on board.

Though it is obvious to many in the industry, the vital importance of seafarers has been highlighted to the wider world by the ongoing coronavirus crisis. The plight of thousands of crew members stuck at sea has further underpinned the need to properly invest in crew welfare and wellbeing services.

It is important to recognise that a lot of great progress has been made in this regard, much of it mentioned in this report. We are beginning to see the positive impact of technology investments, but there is still a great more to do. Broadly speaking it is possible to rank welfare problems and solutions in two ways; by the need for technological intervention, and the availability of solutions. There are some problem areas that are well provisioned for; where a high demand for technological solutions is matched by a growing level of interest from innovators and investment from ship operators. There are also some areas that will not be solved by technology alone; where instead seafarers will likely benefit more from changes in policy and practice than they would from the procurement of the latest digital platform. Lastly, there are some problem areas that desperately need an injection of ideas, energy and capital.

> *The plight of the many thousands of crew members stuck at sea has further underpinned the need to properly invest in crew welfare and wellbeing services*

SAFETY AND EMERGENCY RESPONSE

Safety and emergency response is an area with a high need for technology support. Incidents and accidents are still a leading cause of death at sea. Technologies including telemedicine services and emergency IoT tracking can save vital minutes during the course of an emergency. Just as important, if not more, are technologies that can help predict risk ahead of time and make it possible for officers and crew to intervene early to prevent a major incident. Thankfully, this is an area with both a growing body of research, and a growing number of technology providers, many of whom are specialists in maritime and transport safety. There is real progress being made here too, with technologists

A seafarer is twice as likely to die at sea due to a cardiac related illness than by suicide, but in the last five years mental health issues and suicide among seafarers have received ten times more press coverage than stories relating to cardiac health and heart attacks at sea

and ship owners working together to create tangible outcomes that improve life on board and ultimately save lives.

PROFESSIONAL DEVELOPMENT

There are a number of problems related to the professional development of seafarers including getting access to high quality training and the ongoing secure management of certificates and qualifications. But similar to safety and emergency response, we found a growing supply of solution providers and novel uses of technologies including blockchain and virtual reality fuelling transformation in this space. It is impossible to overestimate the ultimate impact of the right training for those on board. Those innovations that make training more accessible whilst simultaneously reducing the heavy admin burden placed on seafarers, crew managers, and training centres are beginning to gain real traction.

MENTAL HEALTH

Though we found no evidence that suicide is the leading cause of death at sea, mental health is an incredibly important problem and too many seafarers still take their own lives while on board. Further, we still don't have a clear idea of the impact of the COVID-19 crisis on the mental health of the seafaring population, though anecdotal evidence suggests it is severe. There are a lot of generic resources available for mental health management, many of which can be downloaded by individual seafarers while ashore. What is lacking however, is widespread access to common tools that an individual seafarer can use while at sea. This can be resources to make it easier to manage mental health or the ability to quickly access the right support in the time of a crisis. This does not have to be technological, but it is important to recognise the fact that some seafarers will not seek help for depression or anxiety from others on board their ship, and provision should be made for seafarers to be able to privately seek help from services ashore when they need it.

SOCIAL WELLBEING

Social wellbeing appears to be a growing problem at sea, with isolation and loneliness on board commonly cited as a contributing factor of depression in seafarers. While access to communication services on board ships has improved for the majority of seafarers in recent years, the rise of the use of personal devices has had a major impact on the social environment on board merchant ships.[31] But it is clear that removing or reducing connectivity will not solve this problem for the long term. The youngest generation of seafarers today grew up being constantly connected, and the ability to communicate with loved ones at home has become an expected minimum requirement for the vast majority of seafarers. This is one area where more technology is not necessarily the answer. Ensuring that crews have access to adequate social and leisure facilities, enough rest hours, adequate shore leave, and ways of dealing with harassment and bullying on board, whether technologically driven or not, is crucial to improving social cohesion on board.

there is also a need for fleet management teams to be able to take proactive steps to reduce the risks their crew members face. To make this possible, there is an urgent need for tools that can improve access to data on cardiovascular health across crew populations in a way that does not compromise the privacy of any one individual seafarer.

HOLISTIC RESEARCH REQUIRED

It is also important to better understand the link between mental health, physical health, and safety on board. There is a correlation between anxiety, depression, sleep disorders, cardiac diseases, other illnesses, and injury risk at sea. More research is required to establish where causation lies between all of those factors, but a clear link can be made between the welfare of the crew on board a ship and the overall safety of the ship. While there are a great many solutions on offer across the charity, medical and commercial sectors that help with these risk factors in isolation, there is a need for solutions that can help crews and fleet management teams to manage welfare holistically.

Much of the research cited in this report was published before 2015, and many of the mortality studies analysed were published before 2010. Though it is useful to be able to look into the past, it is far more useful to be able to understand the present, or have an indication of future problems. As an industry we have no way to measure the evolving relationship between seafarer welfare, health, safety, and mortality. This is despite the fact that welfare workers, crew managers, and P&I clubs are all on the front line providing support and gathering data on these issues. There is a need for solutions that can provide a systematic way of monitoring leading indicators of safety, mental, social, and physical wellbeing to spot emerging trends in these areas.

There is an urgent need for tools that can improve access to data on cardiovascular health across crew populations in a way that does not compromise the privacy of any individual seafarer

AN URGENT PROBLEM

One of the most surprising insights to emerge from this research project is the disparity between the frequency of cardiovascular related deaths at sea, and the availability of information, support, and tools to minimise the risk of developing circulatory diseases and dealing with heart-related emergencies. This is demonstrated by the fact that a seafarer is twice as likely to die at sea due to a cardiac related illness than by suicide, but in the last five years mental health issues and suicide among seafarers have received ten times more press coverage than stories relating to cardiac health and heart attacks at sea.[32]

There is an urgent need for better access to tools that can help seafarers assess and take steps to improve their own cardiovascular health. Recognising the fact that many of the lifestyle factors that affect heart health are outside of an individual seafarer's control,

---

32   Analysis by Thetius. Data sources, Google News, accessed 2020, Causes of Death at Sea 2008 - 2013, Liberian Flag, 2019

RECOMMENDATIONS

There is a need for solutions that can provide a systematic way of monitoring leading indicators of safety, mental, social, and physical wellbeing to spot emerging trends in these areas

1. THE DEVELOPMENT AND ADOPTION OF A DATA MODEL FOR SEAFARER HEALTH, WELFARE, AND SAFETY.

Multiple stakeholders across the industry are working to measure and improve seafarer safety, welfare and health. This includes ship managers, P&I Clubs, welfare organisations, flag states, and individual seafarers themselves. Every group records data on welfare, medical problems, accidents, and outcomes differently. This means that the impact of individual stakeholder groups is limited by an inability to share insight into safety and welfare problems in a way that can be easily analysed.

We recommend the engagement of key stakeholders to develop a data model for capturing, storing and analysing factors that contribute to seafarer health, welfare, and safety issues. The model should be anonymous, meaning that no data can be captured that makes it possible to identify an individual. The model should be open source, meaning it is free to use by anyone and anyone can contribute to its development.

The adoption of this model should make it possible for individual organisations to build a better understanding of the factors that contribute to the health, safety, and welfare of crew members they are responsible for. At the same time, it should make it easier to share data across multiple organisations to build an industry wide picture of evolving trends.

inmarsat

2. THE WIDESPREAD ADOPTION OF TOOLS TO HELP INDIVIDUAL SEAFARERS AND FLEET MANAGEMENT TEAMS TO TAKE STEPS TO UNDERSTAND AND IMPROVE OVERALL WELFARE ON BOARD.

There are plenty of digital tools that exist to help an individual to manage their mental and physical health, including some that are specialised to the maritime industry. One of the key problems with this approach is that many of the lifestyle choices an individual can make to improve their wellbeing are outside of an individual seafarer's control. Exercising, eating healthily, and getting enough sleep are critical to improving physical and mental health, and reducing the risk of accidents, injuries, and mental and physical illnesses.

Though there are tools available to help fleet management teams build a proper understanding of the health and wellbeing of their crew members, they are not yet widely adopted. Without proper tools in place, it is impossible to measure the impact of changes in food, manning levels, shift patterns, contract lengths and other factors that may affect overall wellbeing and safety on board.

This is difficult for a number of reasons, privacy and engagement chief among them. As with safety reporting, It is vitally important to protect individual seafarers and ensure that no one can be singled out or penalized after contributing data. This is possible however, through fully anonymous data collection and aggregate reporting tools. Further, collecting data in a way that ensures crew members remain fully engaged in the programme is crucial. In the short term much of this can be achieved through good user experience design, but ensuring that the insights gained lead to genuine changes on board is the only way to maintain sustained engagement from crew.

3. THE DEVELOPMENT OF A CAMPAIGN TO RAISE AWARENESS OF THE DANGERS OF HEART DISEASE AT SEA, THE STEPS INDIVIDUALS CAN TAKE TO LIMIT THEIR RISK, AND THE SYMPTOMS OF CARDIAC PROBLEMS.

One of the most simple but effective solutions to many of the issues raised in this report, would be to run an information and awareness campaign across the industry on the dangers of heart disease. There is almost no information on heart disease at sea outside of medical journals and mortality studies. Without making the right information freely available, there is no way that seafarers, welfare groups, ship management teams, and families at home can ever be fully aware of the risk factors, symptoms to watch out for, or what to do in an emergency.

Further, more research is required to fully understand the impact of different treatment options for cardiac problems at sea. For example, automatic external defibrillator technology has advanced considerably in recent years and the cost of the technology has fallen significantly. But the most recent guidance from the UK government's Maritime and Coastguard Agency on the carriage of defibrillators at sea was issued 15 years ago.[33]

Technology can play an important role in raising awareness. But the means are less important than the end. Without equipping seafarers and those that support seafarers with the knowledge and awareness that this problem exists and what they can do about it, we are unnecessarily risking lives at sea. Ultimately this reduces the effectiveness of fantastic work in other areas such as safety, mental health, and suicide prevention.

---

33   MGN 297 (M), The Carriage Of Defibrillators On Ships, Maritime and Coastguard Agency, 2005

BIBLIOGRAPHY

Fatal accidents and injuries among merchant seafarers worldwide, Occupational Medicine, Roberts et alia, 2014

Managing cognitive bias in safety decision making: Application of emotional intelligence competencies, Journal of Space Safety Engineering, Hersing, 2017

Don't let it turn to dust, Harbours Revier, Chander, 2019

Big Yellow Fish, accessed 2020

Seafarers' mental health and wellbeing, Seafarers International Research Centre, Cardiff University, Sampson, Ellis, 2019

Seafarer Mental Health Study, ITF Seafarers Trust and Yale University, Lefkowitz, Slade, 2019

Mental health and social relationships, Economic and Social Research Council, 2013

An investigation into connectivity at sea, Nautilus International, 2017

Death at Sea: Certain Factors Responsible for Occupational Hazard in Polish Seamen and Deep-Sea Fishermen

Cardiovascular disease, NHS, accessed 2020

About Remitly, Remitly, accessed 2020

An examination of the key benefits of assigning stable or fluid crews within the Merchant Shipping Industry, Southampton Solent University, Pike et alia, 2019

Having a tough time? Big White Wall can help you get support, take control and feel better, Big White Wall, accessed 2020

OOW Unlimited, qualification requirements, Western Maritime Training, accessed 2020

OMS-VR, accessed 2020

2018 Global Wellness Economy Monitor, Global Wellness Institute, 2019

Data from Crunchbase Pro, accessed 2020

Ship Management Technology Market Map, Thetius, 2020

Data from Thetius platform, accessed 2020

Trust and safety onboard, WMU Journal of Maritime Affairs, Gausdal, Makarova, 2017

Our services, HiLo, Accessed 2020

HiLo, how does it work?, HiLo, accessed 2020

Analysis by Thetius. Data sources, Google News, accessed 2020, Causes of Death at Sea 2008 - 2013, Liberian Flag, 2019

MGN 297 (M), The Carriage Of Defibrillators On Ships, Maritime and Coastguard Agency, 2005

MORTALITY STUDIES USED FOR ANALYSIS

M. Oldenburg, J. Herzog, V. Harth, Seafarer deaths at sea: a German mortality study, Occupational Medicine, Volume 66, Issue 2, March 2016, Pages 135–137

Roberts SE, Nielsen D, Kotłowski A, Jaremin B. Fatal accidents and injuries among merchant seafarers worldwide. Occup Med (Lond). 2014;64(4):259-266.

Jaremin B, Kotulak E, Starnawska M, Mroziński W, Wojciechowski E. Death at sea: certain factors responsible for occupational hazard in Polish seamen and deep-sea fishermen. Int J Occup Med Environ Health. 1997;10(4):405-416.

Roberts SE, Jaremin B, Chalasani P, Rodgers SE. Suicides among seafarers in UK merchant shipping, 1919-2005. Occup Med (Lond). 2010;60(1):54-61.

Iversen RT. The mental health of seafarers. Int Marit Health. 2012;63(2):78-89.

Roberts SE, Jaremin B, Chalasani P, Rodgers SE. Suicides among seafarers in UK merchant shipping, 1919-2005. Occup Med (Lond). 2010;60(1):54-61.

Grappasonni I, Petrelli F, Amenta F. Deaths on board ships assisted by the Centro Internazionale Radio Medico in the last 25 years. Travel Med Infect Dis. 2012;10(4):186-191.

Borch DF, Hansen HL, Burr H, Jepsen JR. Surveillance of maritime deaths on board Danish merchant ships, 1986-2009. Int Marit Health. 2012;63(1):7-16.

Alves PM, Leigh R, Bartos G, Mody R, Gholson L, Nerwich N. Cardiovascular events on board commercial maritime vessels: a two-year review. Int Marit Health. 2010;62(3):137-142.

METHODOLOGY

The principal methodologies for our research are interviews with functional experts and industry leaders, and high-quality secondary sources including academic research, commercial whitepapers, and reputable news sources.

Additionally, we maintain the largest and most current data set on innovation in the maritime sector. The Thetius Innovation Intelligence platform tracks over 600 companies and pulls in around 30,000 data points per month including patent registrations, M&A activity, news mentions, partnerships, financial information, and investment announcements.

Thetius market size estimates are based on a bottom-up assessment of the revenue of companies and clusters of companies. Where revenue data for a company is not available, other factors including employee count, company age, and investment data is used as a conduit to revenue. Market forecasts are calculated by combining the current total market size with external GDP growth estimates and a multiple based on the maturity of the technology.

ACKNOWLEDGEMENTS

The author would like to thank the many people from the shipping industry who continuously give up their time and expertise to help shape Thetius research. This report is the result of the collective ideas, experience, and input from countless people at all levels of our industry.

To all of the team at Inmarsat for continuing to support innovation across the industry, particularly Clara Wahnich for contributing time, ideas, and a critical eye to this important piece work, and to Mark Warner for continuously championing the role that technology can play in supporting seafarers. We are proud and grateful to Inmarsat for their support in sponsoring this report, and for showing a consistent commitment to championing innovation in the maritime sector.

Most importantly however, the author would like to give heartfelt thanks to the hundreds of thousands of seafarers who work day and night, often at great personal risk, to keep world trade moving. We are all dependent on the sacrifices made by seafarers, society cannot function without them. In recent months, the level of sacrifice required has been unusually high, and the burden that brings has been carried with great professionalism and dignity. Thank you to all those who sail the sea and all those who support them from ashore.

Thetius

inmarsat

inmarsat | Research Programme