Navigation Accidents and their Causes

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This book has been prepared to address the subject of navigation accidents and their causes. This should not, however, be taken to mean that this document deals comprehensively with all of the concerns that will need to be addressed or even, where a particular matter is addressed, that this document sets out the only definitive view for all situations. The opinions expressed are those of the contributors only and are not necessarily to be taken as the policies or views of any organisation with which they have any connection.

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This book tackles an important question – why do navigation accidents keep happening?

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This book builds on two books written by the late Captain Richard Cahill MBA FNI, *Collisions and their Causes* and *Strandings and their Causes*, which The Nautical Institute was pleased to publish. They proved very popular and ran to several editions.

While *Navigation Accidents and their Causes* describes the same failings that Cahill identified so clearly in his books, it also looks to the future to identify trends that may have an impact on navigational risk and suggests ways to mitigate these.

Contents

Foreword

By Koji Sekimizu
Secretary-General, International Maritime Organization

While the safety of maritime navigation continues to improve, thanks in no small part to the effective implementation of IMO measures and the effective education and training of ships' officers, accidents do, nevertheless, still frequently occur. When they do, human error is often found to be a significant causal factor. This timely publication from The Nautical Institute should provide a crucial guide for every mariner serving at sea and serve to assist in reducing collisions and groundings.

The chapters are written by an international group of authors with relevant knowledge and experience, having served as accident investigators, Master Mariners, navigation specialists and university lecturers. Key issues of concern have been addressed, including the use and misuse of the collision regulations, crew fatigue and over-reliance on electronic navigation aids.

The authors have used their experience and knowledge to look at these and other issues which have been a major cause of mistakes that have led to collisions and groundings. Previous casualties have been used to illustrate where failures have occurred and lessons which can be learned from these. The need for risk assessment in advance of a voyage is highlighted in many ways, including bridge resource management and passage planning. Situational awareness is highlighted throughout. Time has been taken to examine practical ways forward for those on the bridge to consider the risks, plan for them and then take action to avoid them. The authors have also taken a look into the future, to identify trends that may impact on navigational risk and suggest ways to mitigate them.

If we are to learn from accidents we have to consider where the best place to do so might be. Onboard training and mentoring may hold the key, and the navigation bridge is an ideal place for this to take place. At the same time, however, relevant training ashore is equally important and should be run in parallel.

The publication is written in maritime English for international mariners. Each chapter can be read individually, thus forming a valuable onboard resource. The overall message is that everyone can learn from the mistakes of others and everyone has a part to play in ensuring that training and experience are used effectively to keep vessels safe.

Case studies

There are multiple lessons to be learned from the case studies in this book and you will see several references to the same casualties in the text.

The case studies only give an outline of the casualty and we hope that you will be motivated to look at a more comprehensive account in the report produced by the relevant authorities.

Links to these can be found in the reference list below. Separately some authors have given references to their sources at the end of each chapter for further reading.

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Chapter 4, page 34; Chapter 9, page 85

***Ovit*, oil/chemical tanker, grounding Dover Strait, September 2013.**
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***Sea Diamond*, sinking off Santorini, Greece, April 2007.**
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***River Embley*, bulk carrier, grounding Torres Strait, May 1987.**
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***Ropax 1*, ro-pax ferry, grounding Algeciras Bay, Spain, December 2008.**
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***Pasha Bulker*, bulk carrier, grounding Newcastle, NSW, Australia, June 2007.**
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(image: London Offshore Consultants)

Introduction

David A Pockett, Technical Editor, *Navigation Accidents and their Causes*

Despite the advanced techniques in navigation, the Safety Management System and so many other guidelines and regulations, ships still get involved in collisions and run aground, or at worst, sink. Unfortunately, human error remains a prime cause of these types of accidents. The claims statistics of one of the largest P&I Clubs, the UK P&I Club, produced in 1997 found that deck officer and pilot error accounted for over 80% of the causes of collisions. The remainder were down to equipment, mechanical or structural failure and error by those ashore. A review and analysis carried out by the American Bureau of Shipping (ABS) in 2003 entitled *ABS Review and Analysis of Accident Databases* (Clifford C Baker & Denise B McCafferty) found similar statistics for human error. It seems that statistics have not shown any marked improvements over the passage of time and human error remains a primary cause of incidents such as collisions and groundings. On the contrary, human error still gives cause for concern.

Further analysis has shown that human error in groundings and collisions has resulted from some basic failings, including a misunderstanding of the Colregs (Convention on the International Regulations for Preventing Collisions at Sea, 1972) and their application, poor bridge resource management and, in an alarming number of cases, crew fatigue.

It can be argued that it is hardly surprising there are collisions arising from human error in congested waters. Nevertheless, the counter argument has to point to collision avoidance measures which are clearly provided for in the Colregs and well supported by the navigation aids and resources on board ships today.

Collisions do result because Colregs are not followed. Rule 5 (keeping a lookout), Rule 6 (safe speed), Rule 7 (risk of collision) and Rule 8 (positive action to avoid collision), remain the key rules which seem to feature in so many collisions, and indeed groundings. Why is it that these fundamental principles of navigation and seamanship are ignored? Is it a lack of training, experience, mentoring, misunderstanding of the navigation tools provided or just plain ignorance?

Steamship Mutual P&I Club's excellent DVDs on collisions, *Collision Course* (2008), and groundings, *Groundings – Shallow Water, Deep Trouble* (2013), provide stark reminders of the consequences of human error and the best actions to avoid accidents.

Chapter 5 of this publication devotes particular attention to Colregs, which navigators would do well to heed.

An alarming number of groundings originate from ships dragging while at anchor. Again, failure to observe fundamental principles is so often the cause: an appreciation of the location and what shelter it may provide and the prevailing environmental conditions (wind, wave and current), an adequate swinging circle, an adequate scope of chain, a vigilant anchor watch to check the position at regular intervals and keep a

watchful eye on the weather. All these factors and others are drummed into us at college and ought to be practised at sea. And yet ships still anchor on a lee shore, the signs of adverse weather are still ignored and a dragging anchor goes un-noticed until it is too late to do anything about it. Anchoring is addressed in Chapter 8, which focuses on many of the shortcomings in procedures which lead to incidents.

Pilot error cannot be ignored as a possible cause of accidents and statistics bear testament to this. Inadequate knowledge of the ship's characteristics, failure to discuss the un-berthing or berthing plan properly, or at all, (although the Master is implicated here too), and other factors have led to pilot-related accidents. Statistics provided by the Swedish Club in 2011 found that there was a pilot on board their insured vessels 53% of the time during a collision in congested waters. On the other hand, pilots have local knowledge and experience which should be an invaluable asset to the bridge team. Invariably they will have superior knowledge of shiphandling and manoeuvring into and out of a berth and ports, but at the same time will need full bridge resources in support of this. Chapter 6 addresses pilotage in enlightening detail.

Modern navigation techniques, with the wide array of electronic aids, are there to improve the safety of navigation. Over reliance on, or misuse of these, can lead to incidents and Chapter 9 gives examples and advice on this.

Are lessons learned from accidents? One might have thought so, but there is still a trend of the same causes repeating themselves. Chapter 11 serves as a useful reminder of how we can learn from accidents and near misses with due reference to some typical causes. And the most appropriate forum for learning? On board training and mentoring must surely be the answer and the navigation bridge the ideal venue. At the same time, relevant shore training is equally important and should be run in parallel.

Trends in the industry

The paper chart has been largely superseded by the electronic chart – ECDIS – and by 2018 all vessels over 500gt will have to use ECDIS. In other words, one might say that the paperless office has extended from ashore to ships! But can ECDIS be wholly relied upon?

Certainly not! ECDIS is also prone to human error and must be integrated in the bridge resources as a key factor for navigation. Fixing the ship's position on charts will always be a critical feature of navigation and techniques including parallel indexing, plotting the swinging circle at anchor as well as continuous monitoring will always be the primary tools for safe navigation. Chapter 4 addresses plotting. With the wide array of electronic navigational aids, there is even more emphasis on situation awareness and the need for a proper understanding of bridge resources and management.

The navigator today is seen at the control centre in the bridge surrounded by screens with displays. While the bridge window and bridge wings are far less featured, they are just as important tools for navigation as they have always been. During my many accident investigations, I have often witnessed rusted-up bridge wing gyro repeater covers

indicating that they played no part in a ship's navigation. Also, collision assessments revealed that the bridge window and wings were not used to enhance a good lookout. There is certainly a strong argument for 'back to the future' and the need to rejuvenate the lost traditional skills with navigators also using their eyes beyond the wheelhouse and the comfortable chair in front of rows of control panels, displays and neon lights.

And so, with all the equipment on board ships today, there has to be the requisite training, mentoring, knowledge, skills, attentiveness and management to ensure this is used to the maximum benefit. Teamwork on board has never been more important and nor has situation awareness and the critical need to fully understand the resources at the navigator's disposal.

Add to this the increasing regulation provided from shore in the form of vessel traffic services and sea traffic management, coupled with yet more restricted areas for navigation, it is easy to see how spatial concerns will come to the fore more often in the future.

The human element

The human element plays a key role in safe voyage prosecution as it does, unfortunately, in errors that can result in collisions or groundings, minor or catastrophic. Ships' crews today are, more often than not, a mix of nationalities, languages and cultures. The need for clear understanding and fluent channels of communication has never been more important. Training and mentoring (Chapter 12) are critical ingredients in the development of efficient bridge teams, with the key objective of continuous improvement.

The plethora of electronic navigation aids poses new challenges and requires new attitudes from ships' crews. We have the human-machine interface with the navigator requiring an understanding of how systems are programmed, whether something is wrong and how to fix it. There is a complete organisational shift and different pressures on navigators today. They play more of a monitoring than controlling role insofar as navigation is concerned. New levels of competence are required to cover the technical and organisational aspects.

Monitoring the vessel's position during a voyage and having the skills required to ensure safe passage through areas of potential risk, are crucial for the navigator. Here, human intervention is critical. Old fashioned navigation techniques and principles are as important today as they were yesterday and can be used with electronic aids just as effectively, if not more so. Plotting a ship's safe course and progress is afforded particular attention in Chapter 4.

And then we have Human Element Leadership and Management (HELM). Now a requirement under Regulations II (navigating officer in charge of a watch) and III (engineer officer in charge of a watch) on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), it provides the watch-keeping navigator and engineer with the knowledge and awareness of the key human factors which can influence effective resource management. The objectives of HELM are to improve

safety at sea. In so doing, the emphasis is on risk assessment, situation awareness, good communications, on board training, cultural issues with the international make-up of crews today, the need for teamwork, recognition and understanding of workload and how this might be best managed to avoid problems of fatigue. Above all, management skills to address these issues to obtain the best results are afforded particular attention.

Actions and decisions taken shoreside affect those seafarers whose errors have been shown to be the cause of such a high percentage of navigation accidents. Owners, management and authorities play a role in so many ways. Investment in training, the provision of good working conditions including leave, shore/ship communications, efficient and meaningful superintendence are all key considerations. Crew manning scales set by flag states dictate watchkeeping arrangements, which in turn can have an impact on the risk of fatigue. Safe manning scales should have that mind. Do they? How can profit margin be weighed against safety and efficiency? A serious question to consider, although the answer should be obvious.

Managing risks

What better way to manage risks than to identify them, then discuss and plan to avoid them occurring. Bridge resource management (Chapter 3) is the ideal forum for this and can take the members of the bridge team, including the pilot (a temporary member of the team) and chief engineer, through the various stages of a voyage.

Before departure, a passage plan should be prepared which sets the courses, identifies the risks en route, the 'no go' areas, and directs the navigating officers to the relevant publications to be consulted or downloaded for the particular voyage. Chapter 2 addresses passage planning and the crucial part it plays in safe navigation.

The Master/pilot exchange provides the perfect opportunity for sharing of knowledge before a ship leaves the berth. The pilot can be tuned in to the ship's characteristics and the Master will have an understanding of the pilot's un-berthing plan, use of tugs or otherwise and navigation from the port. The same applies to port arrival and berthing. Chapter 6 touches upon the Master/pilot exchange and also the pilot's position within the bridge team.

Fatigue is an ever increasing problem with reduced manning scales, fast port turnarounds, long hours and constant commercial pressure to keep on schedule. Fatigue has been cited on many occasions as a cause of incidents. Consider the effect on one's mental alertness and ability to make timely decisions with a clear mind; at worst, a watchkeeper asleep on the bridge in the chair so kindly provided as a bridge comfort today whereas in yesteryear it was reserved for the pilot! Chapter 1 addresses crew manning and fatigue and gives an insight into the associated problems and measures that can be taken to avoid overwork and provide conditions that enable watchkeepers to keep alert and able to make well-informed decisions.

Safe draught is another feature which must be foremost in a Master's mind before and during the prosecution of a voyage. So often ships have run aground during river transits, while berthing and un-berthing, when dragging anchor or even on passage steering a course into shallow water believing there to be adequate under-keel clearance. Chapter 7 provides an ideal background into this and how to manage the risks.

Vessel traffic services (VTS) are an important aid which, if used properly, enhances the safety of navigation into and out of ports and harbours, estuaries and in coastal areas with heavy traffic density such as the Dover Strait. Clear and concise channels of communication between ship and shore, with alert, competent navigators and the appropriate aids to navigate a ship safely, are crucial ingredients to manage and reduce risk. Chapter 10 provides an excellent guide to VTS and the services offered.

Predicting the future

The pace of progress has been such over the last two decades that if it is maintained, the unthinkable could well come to fruition: driverless ships, remotely controlled from a shore base; specialist sea-going personnel with not only navigation knowledge but able to program, maintain and repair electronic aids during a voyage; berthing and un-berthing by dynamic positioning control; robots able to do the tasks of crew? Reality or fantasy?

And then we have the ever improving VTS. It is suggested that the instructions from the VTS station will ease the burden of the navigator. Might it take away the responsibility of the Master as well in due course? Will it be said that Masters may not be in sole charge of the safety of their ships?

What about the bridge window, the need for human intervention and, most important, the experience which can never be surpassed? Will electronic navigation aids be fail-safe? Will there be no need for situation awareness? Can this be sensed from a shore station or base? In other words, will the salt leave the sea? Definitely not!

Ships' crews can never be a thing of the past. On board human intervention is, and will always be, a must. Electronic navigation aids can never be fail-safe and will always require an operator. Machinery requires maintenance and care, as does steelwork and ships' fabric. Moorings have to be manhandled and the presence of crew demands hotel services.

Where there will be changes is how and when the burden of responsibility might shift between a Master, navigator and shore control. It is possible to foresee a voyage being prosecuted from berth to berth with crew intervention only for seamanship and maintenance and repair duties. Navigation might well be performed without human intervention other than to ensure that the instruments have the correct input data and to provide corrective or repair measures. At the same time, however, it is hard to consider a situation whereby the Master is not in overall command and responsible for the safety of the ship.

Automated systems exist today which enable navigation from berth to berth. However, they too can go wrong in much the same way as a jumbo jet's automatic landing

system. The plane's pilot is there to take control in the event of failure as too will be the Master and crew on board a ship for the same reason.

Driverless ships and run from ashore? Is it really possible? Can the con be transferred entirely? Will we say good-bye to the bridge window? Conceivable perhaps but a daunting prospect. Take away human intervention on the spot and one loses the core experience and expertise which is built up over many years in the maritime environment. Situation awareness too can best be provided from the source and not remotely.

Navigation aids are only as good as the user and will be in constant need of an alert observer who understands the input and output, can assess the data provided and identify faults. The navigator will still play an important role but the job specification will be wider and more sophisticated than before.

Spacial issues too will become ever more of a challenge. The continued exploration for hydrocarbons offshore and implementation of renewable energy systems do not come without an impact on navigation, particularly in coastal areas. New exclusive economic zones, reduced sea room, greater regulatory measures and the need for yet tighter control all suggest a leaning to a 'Big Brother' approach in the future.

The navigator navigating or being navigated, or perhaps active to passive navigation? An interesting concept. The many issues featured in this publication will hopefully give much food for thought.

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