SWEDISH MARITIME SAFETY INSPECTORATE

LUND UNIVERSITY
School of Aviation

Swedish Maritime Administration report series B 2008-6

Near-Misses and Accidents in Proactive Safety Work

Near-Misses and Accidents in Proactive Safety Work

A study of human and other factors in near-miss and accident databases

SWEDISH MARITIME SAFETY INSPECTORATE

LUND UNIVERSITY
School of Aviation

Near-Misses and Accidents in Proactive Safety Work

A study of human and other factors in near-miss and accident databases

The paper can found on our website:

www.sjofartsverket.se - Maritime Safety Inspectorate - Accidents and Near-Misses - Analysis

2008-05-15 Dnr 0804-07-1750 Jörgen Zachau +46 (0)11-19 12 73
jorgen.zachau@sjofartsverket.se

This paper is a thesis of master's degree in Human Element and System Safety at Lund University School of Aviation under the supervision by Prof. John Stoop.

Opinions, findings and suggestions are the author's and may differ from the official standpoint of the Swedish Maritime Safety Inspectorate.

List of Contents

1 Sammanfattning

Historiskt har utvecklingen av sjösäkerhet drivits framåt av olyckor, d.v.s. det har förekommit ett reaktivt sätt att hantera säkerheten. Då detta kan betraktas som otillfredsställande har det uppstått en strävan att använda sig inte bara av olyckor utan även nästan-olyckor eller tillbud och därmed övergå till ett proaktivt sätt.

Flera frågor uppstår, bl.a. vilken skillnad det eventuellt är mellan rapporter avseende nästan-olyckor respektive olyckor och om kan data användas i ett proaktivt betraktelsesätt. Huvudfrågan är definierad som *är det någon skillnad mellan rapporter i tillbudsdatabaser och olycksdatabaser, och, i så fall, hur kan det påverka ett proaktivt närmande till sjösäkerheten?*

För att kunna fullfölja detta arbete har vissa definitioner klarlagts. Vanligtvis används begreppet ”orsak” för att beskriva hur ett olycksförlopp uppstått. Begreppet betecknar normalt ett förhållande som påverkat händelseförloppet, d.v.s. det måste finnas ett samband mellan orsaken och dess verkan. Något annorlunda är begreppet ”faktor”. En faktor är ett förhållande som **kan** ha påverkat utgången, men inte nödvändigtvis måste ha gjort det, vilket innebär att man inte måste bevisa sambandet mellan faktorn och den verkan som uppstått. Det leder till att en utredare som använder begreppet faktor istället för orsak har en större frihet att utfärda rekommendationer, eftersom det är lättare att definiera faktorer framför orsaker.

Vidare är begreppet ”tillbud” eller ”nästan-olycka” definierat som en händelse utöver rutin men som inte lett till någon skada (till skillnad mot olyckan, där en mätbar skada uppstått).

Mänsklig faktor definieras som det som av den enskilde operatören är påverkbart i nära anslutning till händelsen. Det utesluter faktorer som underhåll, ledning och konstruktion/design.

Jämförelser har gjorts mellan Sjöfartsinspektionens officiella databas Sjöolyckssystemet (SOS) och branschens gemensamma databas Insjö. Skillnaderna mellan dessa databaser är bl.a. att SOS inte accepterar anonyma rapporter och inte heller garanterar att rapporten inte används mot rapportören medan Insjö i båda dessa avseenden är i motsats.

Rapporterna till båda databaserna kommer ursprungligen från fartygen och dess besättningar, SOS direkt medan Insjö-rapporten egentligen är riktad till rederiet, utgörande en del av ISM-systemet. Rederiet har sedan valmöjligheten att skicka rapporten vidare till databasen Insjö. För att kunna göra relevanta jämförelser har SOS-rapporterna anpassats till de kategorier som används i Insjö, d.v.s. **marine environment, human, technical, working environment** och **management.**

1.1 Jämförelser

Diagrammen visar jämförelser enligt nedan.

1. 922 olyckor + 78 nästan-olyckor från SOS jämförs med 581 olyckor + 419 nästan-olyckor/avvikelser från Insjö.
2. 922 olyckor från SOS jämförs med 902 nästan-olyckor/avvikelser från Insjö.
3. Insjörapporterna från diagram 1 och 2 jämförs.
4. Nästan-olyckor/avvikelser från Insjö jämförs med olyckor från Insjö.
5. Olyckor från SOS jämförs med nästan-olyckor från SOS.
6. Diagram 5 korrigeras (för irrelevanta tillbudsrapporter).
7. Olyckor från SOS: enbart mänsklig faktor (MF), MF + andra faktorer, enbart andra faktorer.
8. Rapporter från Insjö: enbart MF, MF + andra faktorer, enbart andra faktorer.
9. Bränder i SOS: olyckor respektive nästan-olyckor.
10. Bränder i Insjö: olyckor, nästan-olyckor respektive avvikelser.

1.2 Resultat

Det kan konstateras att det finns ett reellt behov av tillbudsrapporteringssystem. Det finns ett antal händelser som inte skulle ha rapporterats alls annars. Istället för ett förhållande mellan tillbud och olyckor om 1:20 som i SOS är förhållandet i Insjö snarare 50:50. Man kan också sluta sig till att det är en stor skillnad mellan rapporterna i de olika systemen – de tycks helt enkelt fylla olika behov där SOS-rapporten är mer formell och officiell medan Insjörapporten har karaktär av att dela med sig av en erfarenhet.

Andelen mänsklig faktor visade sig inte vara som förväntad i SOS, d.v.s. 80 % eller däromkring. Istället var enbart 64 % av olyckorna kategoriserade som helt eller delvis påverkade av mänsklig faktor. Som förväntat var andelen mänsklig faktor i Insjörapporterna betydligt mindre, omkring 38 %.

1.3 Diskussion

I ett längre perspektiv är det inte tillfredsställande att enbart lita till ett reaktivt sätt att förbättra sjösäkerheten. I stället bör man satsa på ett proaktivt sätt, d.v.s. att försöka förutse olyckan innan den inträffar. Problem kan då uppstå i försöken att ekonomiskt motivera t.ex. en föreskrift. Ett sätt att finna en sådan motivation är att använda data från nästan-olyckor. Det som skiljer en nästan-olycka från en olycka är egentligen endast att det inte uppstått någon skada vid nästan-olyckan. Det finns således all anledning att uppmuntra rapportering av nästan-olyckor och att tillhandahålla system så att erfarenheterna från dessa händelser kan tas tillvara. Det har också visat sig att tillbudsdatabasen Insjö innehåller händelser av ofta helt annan karaktär än händelserna i olycksdatabasen SOS.

För att ytterligare öka möjligheten att kontrollera risker kan det vara nödvändigt att innefatta även tillsyns- och inspektionsdata. Dessa kan visa var brister finns och var tillsynsresurser använts. Genom att jämföra dessa databaser kan man styra resurser för ökad optimering.

Mänsklig faktor som grund för en proaktiv säkerhetssyn är emellertid svårare att finna i tillbudsrapporteringen. Detta kan möjligen förklaras med att det är rapportören som själv avgör om ett tillbud ska rapporteras eller inte, till skillnad mot olyckan som ju oftast är känd av utomstående. Dessutom kan rapportören av ett tillbud styra innehållet i rapporten så att den mänskliga faktorn, som ju ofta berör rapportören själv, tonas ner helt eller delvis.

Arbetet visar att problemen med tekniska faktorer är betydligt större än förväntat. I och med att andelen mänskliga faktorer inte är så stora, ökar ju andelen övriga faktorer, varav tekniska faktorer enligt rapporterna i databaserna utgör en stor del. En anledning till att de tekniska faktorerna inte minskar kan vara att fartyg är mer tekniskt komplexa idag med mycket utrustning som ska interagera. En annan anledning kan vara att många tekniska processer styrs av mjukvara, som ju kan ”flippa ut” ibland. En tredje kan vara att ny utrustning och teknik sätts i fartygen och förväntas kunna fungera ihop med äldre, medan det istället är en källa till problem. Det verkliga problemet med fallerande teknik är att det oftast inte är möjligt att förutse haverier. Givetvis är ordentliga installationer nödvändiga. Realistiska och fullständiga fullskaletester på konstruktions- och/eller monteringsstadiet torde vara ett viktigt sätt att förhindra skador.

Avseende mänskliga faktorer kan två enskilda definieras som utmärkande, dels bristande utkik och dels trötthet.

Med bristande utkik menas att man bryter mot grundregeln att man alltid ska vara två personer på bryggan, en navigatör och en särskild utkik. I allt för många olyckor har det visat sig att styrman eller befälhavaren varit ensam på bryggan, vilket lett till att avsaknaden av utkik kommit att bli en faktor med betydelse för händelseförloppet. Det bör noteras att enbart närvaron av utkik inte är hela svaret – denne ska vara aktiv och motiverad för sin uppgift.

Trötthet betraktas även internationellt som ett stort problem för sjösäkerheten, även om denna faktor i en olycksutredning ibland kan vara svårt att definiera eftersom det finns en tendens bland de inblandade att inte vilja medge denna som en faktor. Problemet är störst på fartyg med enbart två navigatörer, men det problemet kan inte lösas med mindre än att man internationellt enas om att öka bemanningsnivån på dessa fartyg.

Det finns dock möjliga sätt att lösa problemen. Det enklaste är att minska belastningen på två-navigatörsfartyg genom att sköta avlösningarna klockan 03, 09, 15 och 21 (istället för traditionella 00, 06, 12 och 18). Ett annat är att utveckla BRM-konceptet till att omfatta även utkiken. Men för att långsiktigt reducera problemet behövs mer radikala åtgärder. Ett sätt vore att uppgradera utkiken till att ha någon form av navigationsutbildning. Denne och den ordinarie navigatören skulle då kunna dela på ansvaret för vakten, kanske i 1-timmarspass, medan den andre finns tillgänglig i närheten, möjligen sysselsatt med administrativa uppgifter eller rent av en kaffepaus. Pressen att ansvara för en vakt skulle därmed minska och risken för trötthet reduceras.

Ytterligare en fråga som har stor betydelse i sammanhanget är frågan om enskilda personers lämplighet. Det vore rimligt att branschen kunde erbjuda någon form av lämplighetstest, inte bara för branschens egen skull utan även för den potentielle sjöfararens.

1.4 För framtiden

Konklusionerna av detta arbete blir att:

- arbetet med att verka för ökad tillbudsrapportering och utvecklandet av tillbudsrapporteringssystem bör fortsätta
- ansträngningar bör göras för att minska olyckorna med teknisk och annan faktor så väl som de med mänsklig faktor inblandad
- fullskaletest bör göras så ofta och så fullständigt som möjligt
- undersökning eller studie om ett alternativt sätt att bemanna bryggor bör genomföras
- lämplighetstest för framtida sjöfarare bör övervägas.

Slutligen ska det inte glömmas bort, att det dagligen i verkliga livet händer att operatörer tar över tekniska system och griper in i skeendet och därmed förebygger olyckor som annars skulle ha inträffat.

Det är också *mänsklig faktor*.

2 Summary

During recent years, the need of making not only accidents but also near-misses or near-accidents commonly known and part of what shipping safety is based upon has led to a number of near-miss databases in use. This leads to a number of questions. A major issue is if there is a difference between reports in accidents compared to near-miss databases, and, if so, how that can affect a proactive approach to safety work.

One identified difference is the distinction between the circumstances that embrace a reporter. In most cases an accident becomes known to others, a near-miss may be known only to a few. This means that the reporter may not have the choice of not reporting the accident, but may still have the possibility to decide whether or not to report the near-miss. To keep the number of reports on a high level, anonymity is often guaranteed in near-miss reporting systems.

By comparing factors in two selected databases (the accident database SOS and the voluntary database Insjö) it is evident that neither of these contain the expected relation human factor/other factors 80/20. Instead the SOS database has a relation 64/36 and the near-miss database Insjö the relation 38/62. This means that the possibility not to report near-misses is influencing the reporter. It also shows that there is still a need to take other factors than the human one into account when dealing with accident prevention.

There are also other indications revealing a need for near-miss databases. The ratio of near-misses is about 50:50 in the voluntary system, which is far more than in the SOS system.

The near-miss database Insjö contains far more reports concerning technical failures than expected. This shows that it is possible to act proactively, taking these reports, otherwise unknown, into account. One way to do so is to increase the number of full-scale tests before taking technical systems into operation.

Regarding the human factor, the way of how to act proactively is not that obvious when taking only near-miss databases into account. Instead, experience and already familiar knowledge have to be considered as well. Two major problems are identified, fatigue and poor lookout. Future discussions should take into account a different way to develop manning conditions, especially concerning bridge teams, as well as aptitude test for future ship’s officers.

Finally, it must not be forgotten, that in real life a number of accidents are prevented every day by human intervention. People do break in into a technical system, take over the operation and thus prevent accidents.

3 Introduction

Historically, maritime safety has been developed by factual accidents as the accidents have revealed deficiencies in legislation, organisation as well as construction. Major occurrences have trigged new ways of approaching the safety concept, sometimes with major changes of philosophy. This means that safety has developed step by step in a reactive way.[1] Sacrifices have been made, sacrifices counting human lives. Eventually, this has lead to improved safety at sea.

However, it is of course not very satisfying if it is necessary to wait for another accident to happen before safety work can develop further. Instead the idea has come up to use not only accidents but also occurrences that might have resulted in accidents but for some reason did not (i.e. near-misses).[2]

But what is really the difference between an accident and a near-miss? The outcome, of course, but the circumstances ending up in either an accident or a near-miss are most likely similar in many ways. If so, this would mean that also near-misses could deliver experiences valuable to the future safety strategy. This would also mean that it might be possible to reach a proactive way to handle future maritime safety.

Therefore, during recent years not only accident databases are in use, but also some near-miss databases have been put into operation. It comes natural to study and discuss the similarities and/or differences of the two kinds of data system.

4 Topic

Maritime activities regarding shipping are often divided into different areas or segments. Main areas are often defined as merchant shipping, military activity and leisure activity. In Sweden, the Maritime Safety Inspectorate functions as an authority towards merchant shipping. In this work, the

[1] E.g. the accidents concerning Titanic, Herald of Free Enterprise, Piper Alpha, Estonia.

[2] Malmberg (2000). SOU (1996). Grimvall et al. (1998).

Inspectorate has a specific task to improve safety within that segment and different databases are run as tools to handle reports and descriptions from casualties and near-misses.

A number of questions rise: What near-miss databases are there? Are there any differences when it comes to comparing accident reports to near-miss reports? Can the data be useful in a proactive way of working? Is there any need at all of near-miss databases, if it did not end up as an accident?

The questions are many and all of them cannot be listed here. The main research question is identified as:

Is there a difference between reports in casualty and near-miss databases, and, if so, how can that affect a proactive approach to safety work?

5 Expected Result and Analysis

The work will show that there is a difference between the contents in accident (compulsory) reports and near-miss (in practice voluntary) reports. The difference will show a difference in amount of data, but also in the character of data. The former will consist of much technical information and the latter will be more like descriptions of what happened or could have happened, due to the differences of reporting format (which in the near-miss database is simplified in order to improve the reporting willingness).

On the other hand, there will probably not be a large difference how to characterise the reports, regarding factors or, what it is sometimes called, causes. The main principles on how to categorise these things are supposed to be similar since it is about the same kind of events, concerning the same kind of equipment, personnel and activity.

An expected difference is the relation technical/human factors. In a casualty database, the normal relation will, according to what is already known, be 20/80 %. An internal database (reports within an organization, e.g. Insjö) is expected to have another relation, maybe even 80/20 %, as signals show. It would be interesting to look into the reasons for this difference.

Regarding the proactive approach, most probably, the thesis will lead to a need to discuss the factors in the databases and compare these factors with other relevant databases. Such a database could be anyone containing data about performance of inspections and/or surveys.

6 Method

The first part of this work consists of definitions and short descriptions of known and available databases.

The second part deals with some comparisons between an accident database and a near-miss reporting system. In the first part of the comparisons the numbers of causes or factors are counted. Since it is possible that one occurrence contains more than one factor, the amount of factors may be higher than the number of occurrences compared. The latter part deals with the relation between factors, i.e. the maximum is 100 %. Some of the reports from the databases are in one case excluded as in-data. (During the construction of the Sound-bridge (Öresundsbron), a large amount of near-misses (233) were reported concerning the high-speed ferry between Malmö and Copenhagen. These reports are all alike regarding causes, and they were made routinely during a restricted period of time for a special reason (most likely mainly to have a reference if claims should be made).[3] Since the result thereby changes quite a lot, it was decided **not** to use these 233 reports to base any findings.) Hence, diagram 5 is replaced by diagram 6.

This is followed by results based on the comparison.

Finally, a discussion follows with some suggestions or theories on how to continue a fruitful way in the progress of safety development.

7 Causes and Factors

Terminology is very important when it comes to dealing with an occurrence. Normally, an investigation of an occurrence is including defining the cause or causes of what happened. Furthermore, the causes could also be defined as direct, indirect, or even root causes.

[3] SMA, SOS database.

At this stage it is needed to clarify what is meant by the expression ‘cause’. Normally, cause could be defined as ‘a condition that has had influence on the outcome of what happened’. This normally means that if a condition is to be defined as a cause, there has to be a connection between the condition and the outcome.[4]

Somewhat different is the situation regarding the expression ‘factor’. A factor is an occurrence that **may** have influenced the outcome, but not necessarily.[5] This means that it is not necessary to prove a connection between the condition and the outcome. The result is that the investigator using factors instead of causes will have more space to act upon when issuing recommendations, since it is easier to define a ‘factor’ compared to a ‘cause’. This will also allow the investigator to use recommendations more freely, thus giving the investigation the chance of having more impact in the industry.

As an example grounding with a ship can be used. The accident happens when the officer is alone on the bridge, though there should also have been a lookout. Is the fact that the lookout was somewhere else a cause? If so, the investigation has to show that the absence of the lookout influenced the outcome. If such an influence cannot be shown, it is difficult to defend the absence of the lookout as a cause, and subsequently it may be difficult to issue any recommendation regarding that condition.

However, nobody can really deny that the absence of the lookout is a factor. Therefore, it is natural to issue a recommendation regarding that particular circumstance.

8 Different Kinds of Occurrences

Normally there is no reason to argue about what is an accident and what is not. It is, however, of interest to know what is meant by near-miss or near-accident.

---

[4] Nationalencyklopedin (1994).

[5] The difference could be discussed, but the connection of factor/influence is somewhat vaguer than cause/influence. Nationalencyklopedin (1991). Australian Transport Safety Bureau, www.atsb.gov.au.

Definitions differ from place to place and from situation to situation. The Swedish Work Environment Authority, as an example, uses the expression ‘incident’ about an explosion in an empty room as long as nobody is injured, regardless of the material damage.[6] It turns into an ‘accident’ when somebody is injured. Some companies or organisations use special tables to grade an occurrence.[7]

In this paper the expression ‘incident’ is consequently avoided. Instead, **near-miss** or **near-accident** is used to describe a situation **above** routine level but with no damage, prevented by action by person or protection by system, i.e. when a reaction more than a routine activity is necessary. An occurrence with any damage is an **accident**, even if the damage is small. **Non-conformity** is used about an occurrence when normal procedure is by-passed, leading to a risk.[8]

9 Reporting Systems

It is a standard procedure and compulsory for anyone after experiencing an accident to report it, normally to an authority. The reason why the authority wants the report could be to find out whether or not legal actions should be taken, but also to give the responsible authority the opportunity to take action from a safety point of view, trying to prevent another accident. To facilitate handling and future analyses, the report is often stored in a computerised database. This is not controversial, instead commonly accepted in professional industries.

As the work making the world safer progresses, it is understood that there are many occurrences similar to accidents, but without causing any damage. Theories claiming that there are hundreds of near-misses or near-accidents happening suggest that there is more information to catch.[9] Thus, it has become a demand to report also near-misses or near-accidents. This

---

[6] Swedish Work Environment Authority.

[7] E.g. Göteborgs Spårvägar, IAEA and SKI (Swedish Nuclear Power Inspectorate).

[8] www.insjo.org

[9] Renborg et al. (2007), Grimvall et al. (1995).

obligation has often been formalised in rules and legislations, making also this reporting compulsory for people in the Swedish shipping industry.[10]

However, an important difference between sending reports into an accident reporting system or a near-miss reporting system is the fact that an accident actually happened, and a near-miss did not. This means that the people involved actually are in quite different situations, where the one involved in an accident in practise does not have a choice since there obviously is damage – the report has to be made. In the case of a near-accident it is more rare that any outsiders are involved, which opens the possibility not to report at all, or to choose what to report and what not to report. It also opens the possibility of judging that since the problem was solved, it was not a near-miss as nothing happened. It seems to be an integral part of our western way of thinking, the cause-effect. No effect, hence no cause.[11]

9.1 CHIRP

In UK there has been a Confidential Hazardous Incident Reporting Programme, CHIRP, concerning aviation since 1982. The Department of Transport funded the CHIRP programme for the maritime industry in 2003.[12]

The system is not expected to be anonymous since the administrator of the programme needs to have the opportunity to contact the reporter for complementary information. Also, the reporter will receive an acknowledgement of the report as it has arrived in the system. Instead, anonymous reports are not accepted as they cannot be adequately validated.

Anyone can report to CHIRP. That includes passengers and employees as well as a mere observer. The reporter is guaranteed confidentiality by the return of the personal data and details to the reporter.

---

[10] The Accident Investigation Act (SFS 1990:712).

[11] van deer Schaaf et al. (2004).

[12] www.chirp.co.uk

The report is validated as it comes in and possible actions how to take care of the problems are discussed and agreed upon with the reporter. These actions are then performed by the administrators.

Output from the system is available through the site www.chirp.co.uk and through regular, de-identified, feedbacks from the administrator.

The system taxonomy used is based on the SHEL-concept[13] which gives the opportunity to search accordingly. In the midyear of 2007 there are more than 400 reports in the system, some 150 of which were reported in the last 12-months period.[14]

9.2 MARS

The Nautical Institute is an international organisation with its headquarter in London, UK. It is an "educational charity" open for qualified seafarers and others "with an interest in nautical matters". There are over 7,000 members all over the world.

Among other safety promoting tasks, the Nautical Institute provides a reporting system, called MARS, Marine Accident Reporting Scheme, established in 1992.[15] The reporter, who most often is a member of the Nautical Institute, though it is open for anyone to report, is asked to leave personal details to make further contact possible, but is also guaranteed anonymity for himself as well as for the ship. The report is then published on the NI web site as well as in Seaways, the monthly journal of the Nautical Institute.

In total there are more than 800 reports in the system, amongst them some 100 official reports from accident investigation authorities. It is possible for anyone visiting the site to search by word, phrase or report number.

[13] SHEL stands for software, hardware, environment and live-ware respectively. The concept high-lights the interaction between these components with live-ware (human factor) in the centre. IMO (2000).

[14] www.chirp.co.uk

[15] www.nautinst.org

9.3 SOS

The Swedish Maritime Safety Inspectorate has since 1985 the accident and near-miss database “SjöOlycksSystemet”, SOS (System for accidents at sea), in operation for the Swedish merchant fleet. Today there are almost 6,000 reports. The reports are sent in by ship captains or companies, following the legislation.[16] The system is based on these official reports. Most of the reports, about 75 %, concern Swedish ships, and consequently the rest represents foreign flags. Annually some 200 reports are sent in.[17]

The database consists mainly of accident reports, only some 7–8 % are named near-misses. Each report is labelled by the investigator with a primary cause and up to three contributory causes or factors (see table 1). The database is based on a coding system, where a specific code is representing a value, which in turn represents a condition or a fact (e.g. wind force, manning on bridge, number of injured people, etc.). There is also a free text, describing the occurrence. This labelling enables relatively easy searches to base statistics and analyses on.

Information in the database does not contain names of persons, but other information (like ship’s name, position, date and time) makes it easy to draw conclusions and gives opportunity to identify who did what. The reports and the files upon which they are based are public. However, as they are kept within the premises of the Inspectorate and the fact that the database is operated by Inspectorate personnel only, output can only be made within the Inspectorate, consequently on demand only.

Table 1: Causes/factors in the SOS database

Main categories
Unknown
External factors
Ship's construction
Technical fault on equipment
Operation/Design of equipment
Cargo/Securing
Communication/Organisation/Routine
Human factors

Subcategories are in Swedish only – see appendix.

16 SJÖFS 1991:5.

17 Swedish Maritime Administration (2006).

9.4 Insjö

As a result of the Swedish Maritime Safety Inspectorate not receiving the assumed number of near-miss reports, referring to the expected relation accidents/near-misses[18], as well as the interest of other involved parties, i.e. ship owners and employees, the industry has agreed upon a mutual, voluntary database, administrated by an independent company. Since some five years, the database is reached via the internet, making it easier to report for most companies as they normally use the internet for transferring information, compared to paper forms.[19] The report itself is simplified and consists of four questions only, i.e. what happened, what were the consequences, what caused the accident, what measures were taken.[20]

The system is made for the Swedish merchant fleet, though there is now a Danish similar database on trial. Today Insjö consists of about 1,800 reports, a little more than half of which are accidents and the rest near-misses and non-conformities. When reporting, a search for corresponding reports is routinely made and returned by the administrator of the system to the reporter. About 300 reports are sent in annually.

All reports are labelled according to predetermined choices (see table 2), established by the system constructor. Output can be made directly on the web-site by anyone with access, or, when more detailed searches are wanted by a company or part being registered as users, on demand by the administrator. All reports are totally de-identified and the database is not public.

[18] Renborg et al. (2007), Grimvall et al. (1995).

[19] E.g. Stena Line, Broström.

[20] http://www.insjo.org/Erfarenhetsbanken/ErfarenhetsbankenRapporteratillerfarenhetsbanken.asp

Table 2: Causes/factors in the Insjö-database

Human
Not reported
Crew composition
Criminal action
Culture/Language
Education/Training
Familiarization
Individual diminished ability
Individual motivation
Individual mental action
Qualification/Competence
Mental stress
Other

Technical
Not reported
Inspection/Test/Approval
Installation
Maintenance
Passenger
Quality of materials
Reliability/Lack of equipment
Repair
Ship/Equipment design
Stewing/Packing/Lashing
Technical documentation
Other

Marine environment
Not reported
Ice conditions
Navigational conditions
Pilot assistance
Yard, port and tug assistance
SAR operations
Traffic/Navigational information
Traffic situation and other ships
Visibility
Water/Sea state
Warfare/Piracy
Wind force
Other

Management
Not reported
Bridge and control room procedures
Communication and information
Contingency planning
Emergency response
Familiarization
Leadership and teamwork
Reporting and corrective actions
Responsibility/Supervision
ISM instructions and manuals
Training
Work organisation
Work planning
Other

Working environment
Not reported
Living conditions
Occupational health and safety standard
Personal protective equipment
Protection device/Safe guards
Professional leadership and teamwork
Safety training standard
Workplace design/Ergonomics
Working conditions
Other

10 Comparisons Human and Other Factors

10.1 Prerequisites

The comparisons in this report are made by comparing reports from the Swedish authority's official database SOS and the Swedish industry's jointly operated accident and near-miss database Insjö. The differences are evident. While the official SOS cannot accept anonymous reports, and cannot guarantee that no legal actions will be taken against the reporter, the Insjö system is the opposite: the reports are de-identified and thereby eliminates the risk of liability, thus supporting a blame-free situation. Such a blame-free situation is useful when investigating an occurrence as the people involved may feel more open when telling about what really happened. Some investigating bodies, like the MAIB[21] in the UK, even have legislation allowing them to keep such information confidential also in judicial matters, and it is generally recommended.[22]

Both SOS and Insjö systems are addressed to the Swedish merchant fleet, (excluding leisure craft, for which there is a special database[23]). Reports from either system are emanated from crew members, though the reports within the Insjö-system have a less official character since it is not primarily directed to the authority. Still, the reports are part of the official company ISM-system (International Safety Management) and would be expected to be as serious as the reports in the SOS-system. The main reason to introduce Insjö is the lack of near-misses in SOS. These near-misses are expected to be as important for future safety strategy proactively as accidents are in a reactive system.

Since these two databases do not have the same categories of causes or factors, it is necessary to adjust them to correspond for the present comparison. The five main categories of the Insjö-system were chosen, and all factors in SOS were sorted under one of these categories. The categories are **marine environment**, **human**, **technical**, **working environment** and **management**.

---

[21] Marine Accident Investigation Branch

[22] IMO (2001) MSC/Circ 1015.

[23] http://sjosag.test.interlan.se/rapportering/index.asp

10.1.1 What is a human factor?

The wording human factor or human element may require some discussion. As the expression really suggests, it would include everything with a human involvement. Since the maritime industry is highly influenced by human involvement, in practise all activities eventually leading to an accident could actually be regarded as “human factor”.

For example bad design of a ship particulars or bad design of an instrument is originally the result of a human being, at least on the construction stage. This could mean that an occurrence affected by the factor “ship/equipment design” is actually a human factor-influenced accident.

Another example is a collision between two ships. If the officer on one of the ships is in one way or another not doing what is expected, e.g. turns to port instead of starboard, the accident can be regarded as human factor. But for the officer on the other ship, who could be doing whatever possible to avoid the accident but without success, it would be more appropriate to consider it being marine environment causing the accident. So occurrences can be differently tagged or labelled depending on from what perspective it is seen.

The result of this discussion leads to the fact that almost every occurrence is actually influenced by human factor in one way or another. The only exemptions are when a tsunami, an unpredicted storm or the like is the major factor leading to an accident. This would leave us with a human factor ratio close to 100 %.

Furthermore, it would also mean that the category human factor is more or less useless. Why bother with that category if all, or almost all, of the occurrences involve human factors?

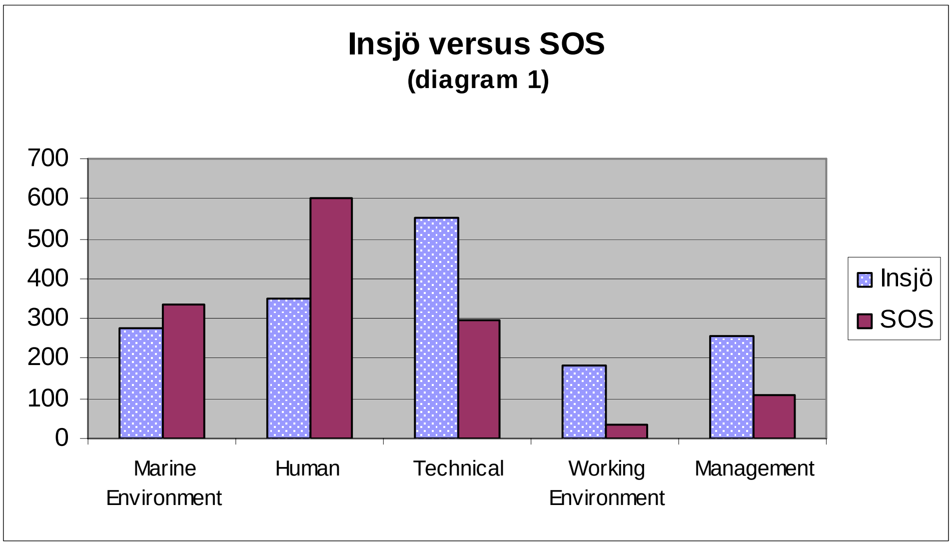
But, when talking about the human factor, it is normally the single operator at the site of the occurrence, being at the sharp end, that is the subject of the concern. Yet, in some of the cases, the human factors cannot be influenced or prevented at all by the single operator at the time for, or close to, the occurrence. This means that it is unfair to label an occurrence by human factor regarding e.g. bad design if it is not fully clear that the operator is not the one being the human factor.

Therefore, in this work, by human factor is meant the occurrences where the single operator has a realistic possibility to influence the situation close to or during the occurrence. This excludes e.g. maintenance, management and design from human factor.

10.2 Counting factors in reports

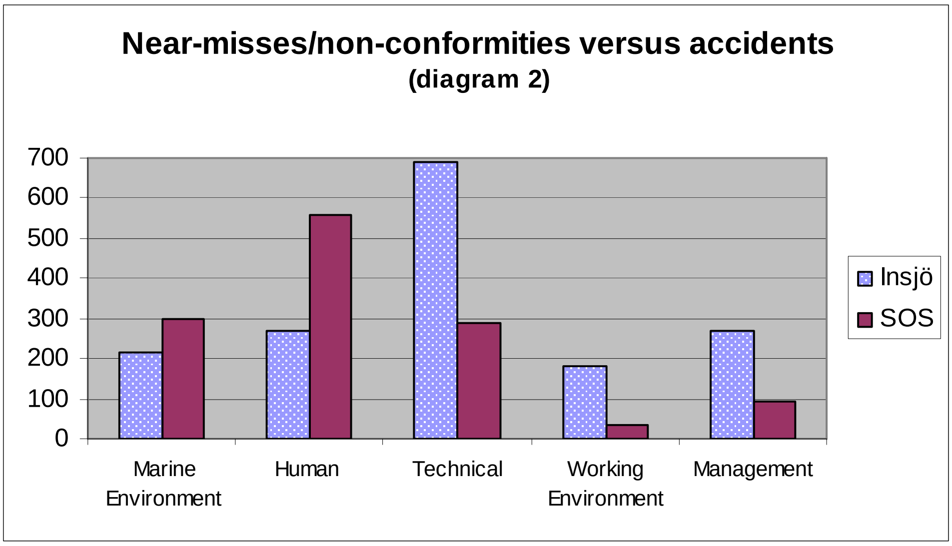
10.2.1 Insjö versus SOS

The first comparison is made by comparing the latest 1,000 reports from SOS, containing primarily accidents (922 accidents and 78 near-misses) with the latest 1,000 reports from Insjö, divided into 581 accidents and 419 near-misses/non-conformities (diagram 1).



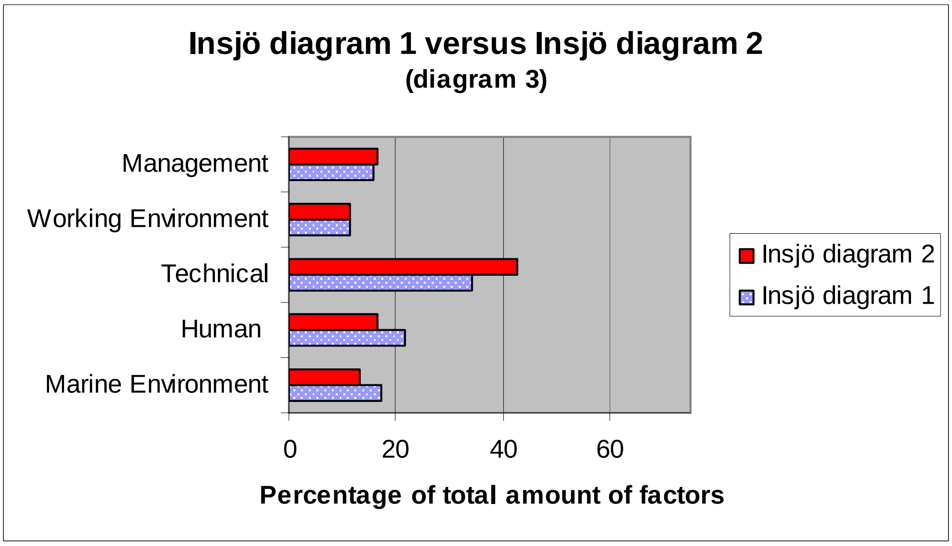
10.2.2 Near-misses/non-conformities (Insjö) versus accidents (SOS)

After removing the near-misses from the output in the SOS database, thus presenting the remaining 922 accidents, comparing them with **all** of the near-misses and non-conformities in the Insjö database (490 and 412 respectively, i.e. 902 altogether), the result can be seen in diagram 2.



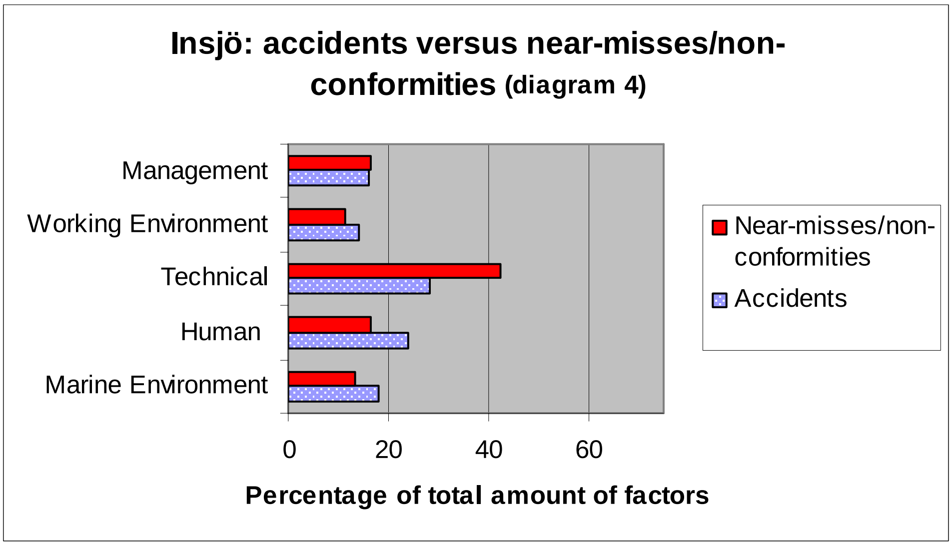
Three obvious observations can be noted regarding Insjö: the categories Marine Environment and Human have decreased while Technical has increased. There is also a decrease in SOS Human. The decreases can not be explained by the lower number of reports (78 fewer from SOS and 98 fewer from Insjö) as seen in diagram 3, where a relative comparison is made. Also the increase of Insjö Technical has to be explained by a real change: a technical factor is **more** represented in the near-misses/non-conformities than in the accidents as well as Human and Marine Environment is **less** represented.

No obvious differences regarding the reports in the SOS database can be noted.



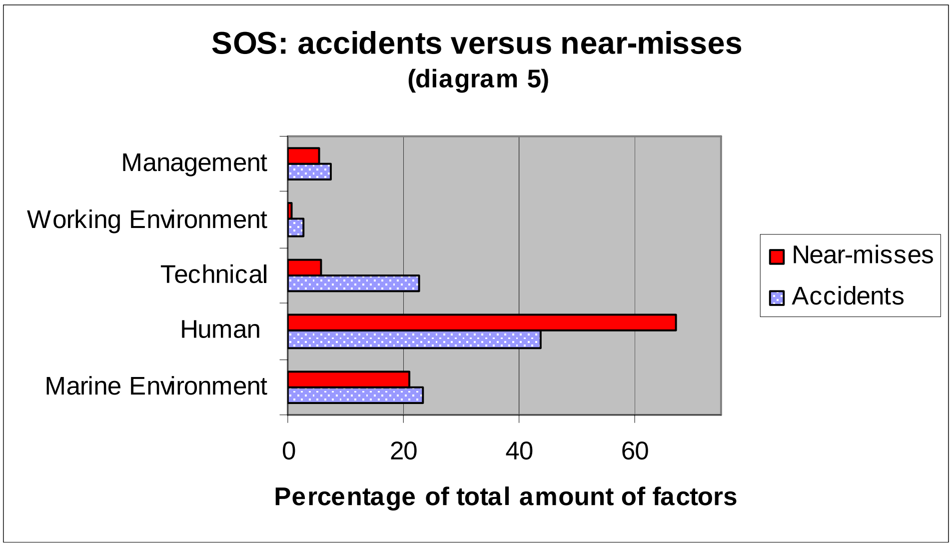
10.2.3 Near-misses/non-conformities (Insjö) versus accidents (Insjö)

So far there is an indication that there seems to be a difference as near-misses/non-conformities are getting more separated from accidents. Hence, a comparison between near-misses/non-conformities and accidents from Insjö only would be interesting. This is shown in diagram 4. The number of near-misses/non-conformities is 902 and accidents 950. The result is that the earlier indications are confirmed. The difference is not increasing very much, but there is still an increase in the difference between Human and, especially, Technical, confirming what is said above.



10.2.4 Diagram 5

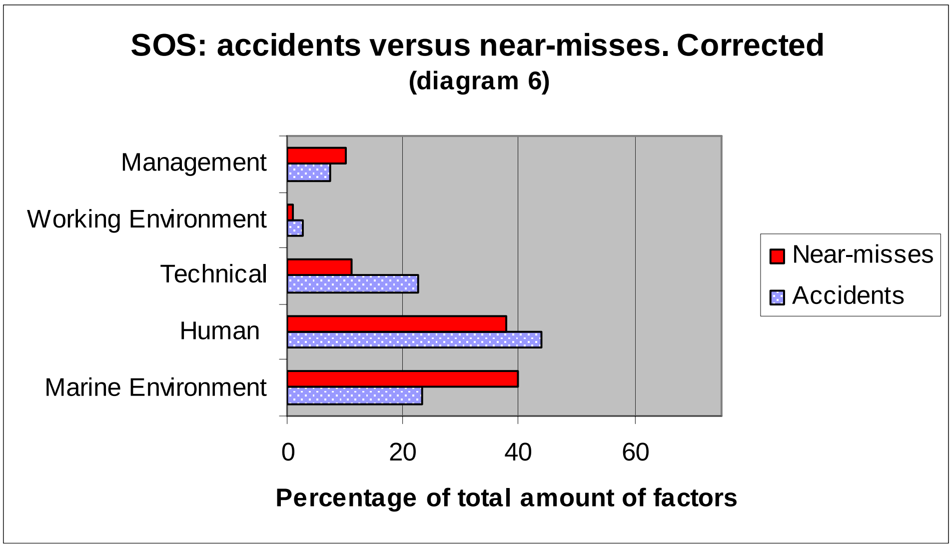
To find out whether the indications are confirmed in the SOS database, a similar comparison is made. The 922 accidents used above and all near-misses in the database are used (414 occurrences, 493 causes).



10.2.5 Diagram 6

Diagram 5 is replaced by diagram 6. Since 233 reports with cause "Other circumstances influenced by the human factor" are removed[24], all other causes are increased, especially Marine Environment. Thus, the remaining numbers of near-misses are 181 occurrences and 260 causes. The result is not the same as when comparing the result from diagram 4 (Insjö database). Instead there is a much smaller part Technical and Working Environment and larger Human and Marine Environment. However, regarding Human, one can see the same difference as in diagram 4, comparing with accidents.

[24] See Method.

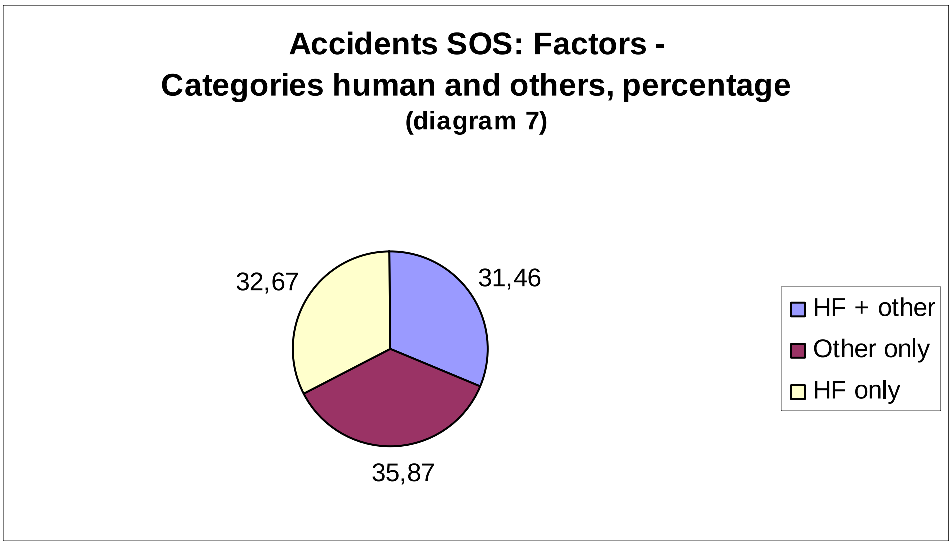


10.3 Relation Human versus others

1,000 of the latest accidents from the SOS-database and 1,000 reports from the Insjö-system respectively were examined and divided into three main categories: reports with **only** Human as cause or factor, reports with Human **and** other cause or factor, and reports **without** Human. The reason was to find out what relation really exists between Human and others.

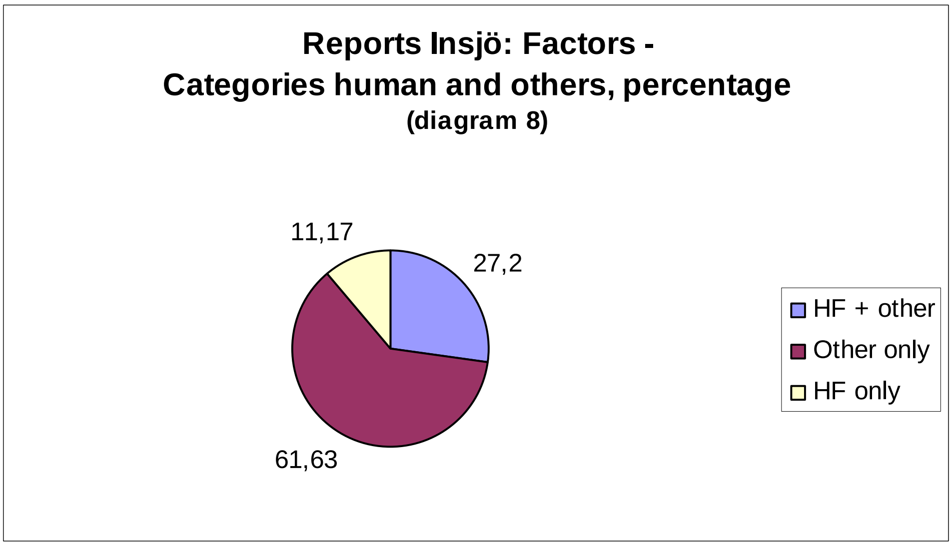
10.3.1 SOS-database

Out of the 1,000 accidents, 2 were removed from the comparison due to incomplete data. Out of the remaining 998, accidents with **only** Human were 326 (392 causes/factors); accidents with Human **and** other cause/factor were 314 (of these 270 causes/factors Human; 271 causes/factors other); and accidents **without** Human 358 (408 causes/factors). This result is presented in diagram 7.



10.3.2 Insjö-system

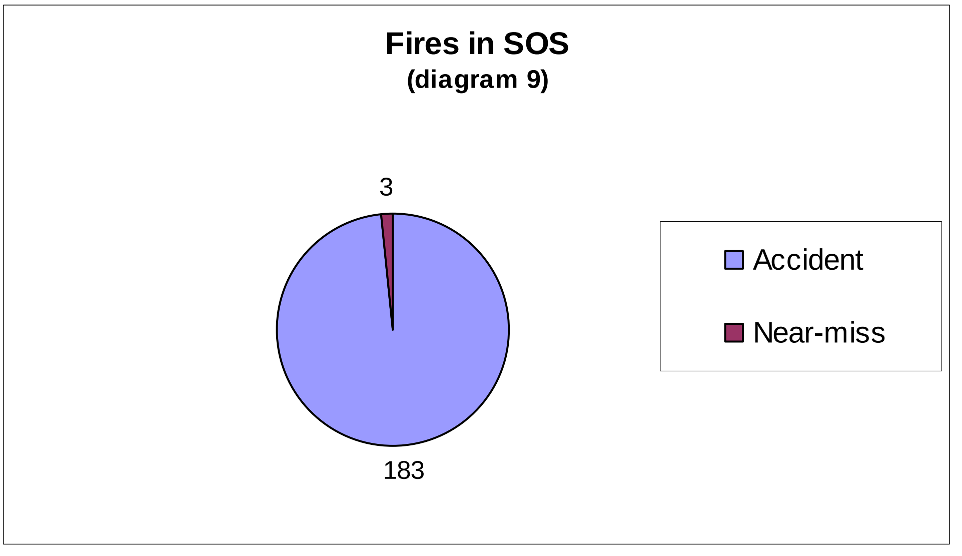
The selected reports from Insjö consist of the 1,000 latest recorded near-misses, non-conformities and accidents at the time. 33 of these were considered not relevant for some reason (e.g. no cause or factor defined since the report describes a suggestion instead of an occurrence). Out of the remaining reports 108 were with Human **only** (120 causes/factors); 263 with Human **and** other (284 causes/factors Human; 350 other); 596 **without** Human (804 causes/factors). This is shown in diagram 8.

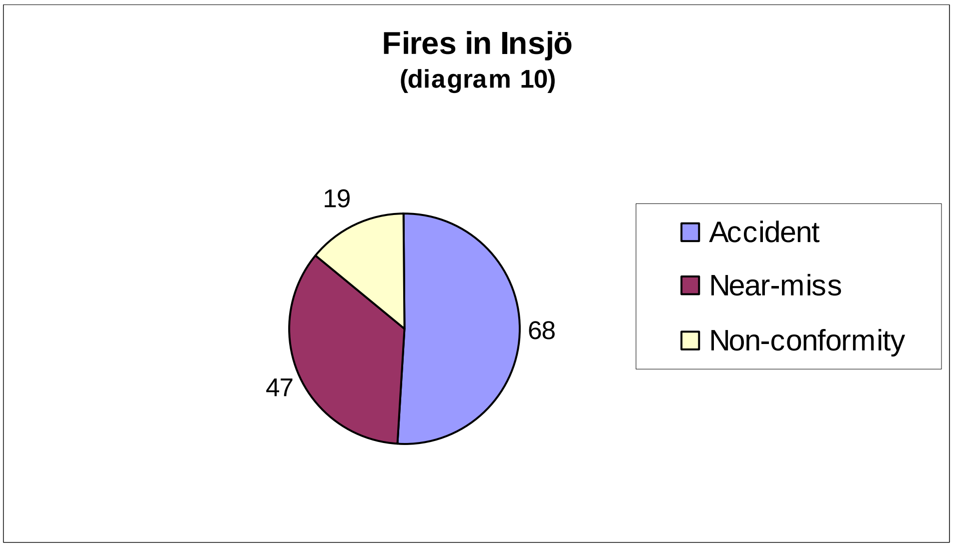


10.3.3 Comparison of a specific type of occurrence

To compare a specific type of reports from the two databases, the type of occurrence “fire/explosion” has been chosen. As seen in diagram 9, the number of fire/explosion in the SOS database is almost only actual accidents, i.e. there has been some damage. Only a few occurrences are referred to as near-misses.

In the Insjö system, however, the near-misses are almost half of the amount of the occurrences (diagrams 9 and 10).





11 Result

11.1.1 Counting factors in reports

First of all it can be determined that there is really a need for a near-miss reporting system. If the amount of reports that are sent to the Insjö-system had been sent to the authority (as regulated), the authority would have had the number of reports doubled or even tripled. Instead of these reports not being made at all or, at the best, being sent to the company only, they are now available for all joining organisations, including the authority. There is a long way to reach the expected 1:100 or even 1:10 relation accidents/near-misses, but it seems that the first step is taken in the right direction since the near-miss database Insjö contains a 50:50 relation.

It can also be clearly said, that regarding near-misses the SOS database is not supposed to be as representative as the Insjö database, due to the lower number of near-misses in SOS but also due to the purpose, history and attitudes regarding the reports. Considering the comparisons it can be noted that there is an obvious difference between accidents and near-misses/non-conformities. Human factor is obviously not as much represented in reported near-misses as in accidents, as shown. This is confirmed by the SOS database, even if the relation between the main categories largely differs, comparing the two databases. Regarding near-misses, SOS is not considered to be fully relevant, due to a historically based difference in attitudes why to hand in such reports. Economical and judicial reasons may have had too large an influence, which was indicated as near-misses in practice were only reported to SOS in the specific situation when the Sound Bridge was built.

The categorisation of occurrences from the two different kinds of databases was not a problem. Occurrences from either database were possible to sort under the five main categories chosen.

11.1.2 Relation human factors versus others

The relation human factors and others is as previously discussed depending on what definition of human factor is used. It could differ from the single operator at the sharp end to human influence at drawing and construction stage (which would in the ultimate case - including also the factors Organisation and Management - give us a relation close to 100/0).

Normally, however, it is common with expected relations as 80/20, or maybe 70/30.[25] Sometimes even the relation 95/5 is mentioned.[26]

This comparison shows, however, that about 64 % of the accidents reported to the SOS-database in one way or another involves the human factor. This is far less than expected, referring to the figures above, especially when taking into account that it actually concerns accidents.

Regarding the reports in the Insjö-system, the human factor-influenced reports are even less. Only some 38 % are categorised that way, making 62 % not at all being influenced by human factor.

11.1.3 Specific type of occurrences

When looking at a specific type of occurrence, it is shown that the near-miss reporting systems contain a large number of reports that will not be reported into compulsory accident databases. In this example, the relation near-misses/accidents in Insjö is close to 50:50 compared to the relation 1:60 in SOS. This confirms what is said earlier about relations between near-misses/accidents in these databases.

12 Discussion

As mentioned above, maritime safety has for many years been developed by accidents triggering regulators to improve legislation on an ad hoc-basis. In reality, it means that some sacrifices have been made prior to better safety.

This is, of course, in a long term perspective not a satisfactory way to handle. Instead, one should try to turn from this reactive way to a proactive, which may be somewhat difficult since facts then may turn out to be guesses. It could be explained by the pedagogic trouble to motivate expenses (safety almost always implies some costs) for something that has not yet happened. Proof or evidence has to be sought to defend such action.

---

[25] SOU (1996). Grimvall et al. (1998).

[26] IMO (2000).

It could be discussed if the comparisons between Insjö and SOS should be made at all. The origin, purpose and conditions for the two databases are very much different: SOS has existed since many years and the attitude towards the human factor has changed a lot during these years. The in-data of SOS have been evaluated by many different people, representing different values of persons and time. The reasons to report to SOS have also changed during the years. Instead of sharing lessons to learn, judicial and economical reasons may have influenced the attitude.

Insjö, however, has as its only purpose the sharing of experiences and it is influenced by one person only regarding how to evaluate the reports. It is not that long ago that Insjö was put into operation, thus a modern way to deal with human factor has been in use during all that time.

In the matter of reaching a proactive way to handle safety, near-misses have a large and important role to play. Near-misses are, as mentioned before, accidents that did not happen, which means that by using near-misses we approach the way of thinking proactively. This is confirmed by the reports in the Insjö-database many of which show that there are lacks in the reliability of technology on board.[27]

The relation near-misses/accidents in the near-miss system Insjö confirms that the reports are possible to use in a proactive way. Any type of occurrence will expose a number of reports that are not within an accident reporting system. When analysing the near-miss system, it will be possible to identify any type of occurrences, showing a relatively high amount of reports compared to the accident reporting system, where the number of reports are fewer. Hence, if only the accident reports are used, there is an obvious risk of the potential danger in that particular type of occurrence not being identified, unless, of course, there is a severe accident happening. In other words, if you just rely upon accident reporting schemes, you may loose information from other schemes that may give you an opportunity to act proactively.

To have a full hand of possibilities to control the different types of occurrences and their risks, it would be necessary to include also survey or inspection databases. These will tell you where deficiencies are found and

[27] Bråfelt (2006). www.insjo.org.

efforts made during inspections. Comparing the different databases, it will be possible to steer resources in such a way that the result will be more optimized. This would lead to that unnecessary efforts are minimized and instead efforts are made where they are more useful.

Finding basis for proactive safety work is more difficult regarding human factor, at least when looking for support in near-miss databases. The reports are not containing very much of human factor, which may give rise to a reflection. In a near-miss database, it is the reporter who decides whether or not there is going to be a report at all, which is the contrary condition as regards accidents (when there has been an accident, this is almost always known by someone else, hence there must be a report). This means that the reporter has the choice to sort out uncomfortable reports. When a report is written, the reporter also has the chance of expressing himself in a way that turns the occurrence to something else but a human factor case. This is likely to be a good reason why the human factor is not represented very much in Insjö. Instead knowledge about other contributing factors is gained this way.

Thus, dealing with the human factor proactively, the ordinary accident databases have to be used together with common knowledge and experiences from investigations. In this part of the thesis some suggestions to reach pro-activity are discussed, both regarding technical as well as human factors.

One interesting reflection about relations measured in percentage is that if one category is decreasing, another will be showing an increasing percentage regardless of if the actual number is still the same. If, for example in a period of 10 years, 100 accidents occur annually, the first year related 33 % technical factors (i.e. 33 accidents), 33 % human factors and 34 % other, and in that period the annual **number** of technically related accidents decreased to 20, the **percentage** of human factor-related accidents would rise to almost 39 %. This phenomenon has to be taken into account when dealing with this kind of statistics[28]. A high percentage of one factor does not necessarily mean that the actual amount is high, or vice versa. This has to be taken into account when relations are referred to.

---

[28] Grimvall et al. (1995).

12.1 Technical

The findings so far show that there are certainly reasons to take into account technical causes or factors for accidents. The influence from these is greater than expected, as a consequence of the influence of human factors being less than expected. The result is however only in general terms and no detailed solutions can be made. But, by looking through some of these reports, it is obvious that complex inter-action between technical equipment is one of the major problems (see examples below).

12.1.1 Example from the Insjö-database

Report 1413 from database Insjö			
Event	**Cause**	**Consequence**	**Measure**
Radar Failure			ID: 1413
0510 Departure Gothenburg for destination Stockholm. 0520 Radars S-Band and X-Band failed in operation, both radars have a " frozen" picture and the touch screens/buttons was unmanoeuvreable. 0522 Radars were switched off, one by one and restarted, both radars was functional without any errors. 0530 Radars failed in operation and found inoperational. 0535 Radars switched off one by one and restarted, both radars were found functional without any errors. I therefore decided to drop anchor off Trubaduren and wait for service engineers consultation. 0650 Anchored off Trubaduren anchorage "Bravo" and waiting further instructions. 0940 After consultation with service engineer vessel departed anchorage "Bravo" for destination Stockholm.	Probable immediate cause at the time was upgrading and installation of new software in DGPS system due to jumping waypoints.	Delayed departure	DGPS disconnected from radar system after phone conversation with CA Clase Gothenburg.

12.1.2 Example from the SOS-database

The container/ro-ro ship approached the harbour. The chief engineer decided to make a routine test with an alternative, parallel system for the fuel. However, it was revealed that the pump was under-dimensioned for more than one auxiliary engine, leading to auxiliary engine stop and consequently blackout.

During the attempts to recover, a series of technical failures occurred, impossible to predict, which lead to yet another blackout and finally grounding.

(SOS-database 6157)

12.1.3 Why technical problems?

It seems that technical problems are far more common than assumed. If the relation 80:20, or even 95:5, is accepted, it is natural that focus is on the human factor which, according to that relation, is dominating. Even if the relation 64:36, as shown in SOS database, is accepted, there is still reason to high-light the human factor. But realizing the opposite relation from near-miss databases, such as Insjö's 38:62, it must be understood that there is no reason at all to disregard technical factors. It becomes reasonable to ask why the technical factors are not decreasing as the technical development continues.

A natural answer would be that ships in operation today are more complex and contain more interacting technical equipment than they used to. Another reason would be that equipment used today actually is not only hardware, but also software controlling the equipment and their processes. And software, as we all know, may have a tendency to "flip out" from time to time.[29] A third answer is that as more and more instruments are put into a ship and connected to older equipment (sometimes years after the original apparatuses were installed), more and more problems are created.[30]

The real problem with this is that the malfunction of the technique often does not show until it is too late, and that it in reality is impossible to foresee it. Certainly, careful and well prepared installations are necessary to avoid many problems, but it will not exclude all occurrences. One practical and fair way to have further opportunities to find and eliminate future technical failures could be to increase the number and extent of full scale tests under as realistic conditions as possible. Alternatives may be to compensate technical deficiencies by better design of equipment, making it

[29] E.g. Insjö reports, id 1793, 921 and 894.

[30] E.g. Insjö report, id 1413.

easier for the operator to understand the system, and education, making the operator better prepared to handle unforeseen situations.

12.2 Human factor

Regardless of the amount of human factor in near-misses and the suspicion that it in reality may happen more often than reported, there are occurrences enough in both databases to motivate a suggestion for improvement of safety. Major sub-factors in this category are poor lookout (due to too few people on the bridge) and fatigue.

12.2.1 Poor lookout

The problem with poor lookout should be easy to deal with by ensuring that there is always a dedicated lookout in addition to the navigator. In spite of international rules saying that the navigator may be alone on the bridge during day-light only and under good enough circumstances (as traffic situation and visibility), it has on many ships turned into a routine to have the lookout working on deck instead[31]. This is confirmed by collisions and groundings recorded in the SOS database. In many of these, the navigator has been alone on the bridge, which has made the absence of the lookout a human factor. It is closely related to organisational and maybe management factors, but the condition that no effective watch was being kept must be taken into account as human factor.

Ensuring that the lookout is present on the bridge is not the full answer: except from being there, the lookout has to take an active part in the navigation work on bridge, if he or she really is going to be useful. Otherwise, the motivation for the lookout to carry on doing the job may decrease. And a lookout who is not motivated will not keep good watch.

12.2.2 Fatigue

People being fatigued is a major problem at sea, though it may not be obvious when checking the databases. In the near-miss database, the reports are not dealing with this problem very much, which is likely to be explained by the reluctance of the reporter to admit this kind of problem.

---

[31] Mårtensson et al. (2004). Swedish Maritime Safety Inspectorate (2003). MAIB (2004).

This is initially the same problem in the accident database, but as the investigation continues, it is sometimes possible for the investigator to define the problem and make it a factor. In doubtful cases, it is often defined as "other circumstances concerning human factor".[32] The problem with fatigue and the high frequency of occurrences, influenced by fatigue, is commonly documented.[33]

The risk of fatigue could be reduced radically if two-navigator ships manned up to be three-navigator ships. That is, however, still in the future since this matter has to be solved by international agreements and regulations, which takes a considerable time. There are already proposals in IMO for that solution, but it has shown that the world community, which is what IMO is representing, is not yet ready[34] .

12.2.3 Different solutions

There are some organisational or managing ways to ease this problem. The easiest way to achieve better conditions on two-navigator ships is to change relieving hours from traditional 00, 06, 12 and 18 to 03, 09, 15 and 21, which will decrease the risk of being fatigued.[35] Another is to develop the BRM-concept[36] onboard and thus involve the lookout in the navigation routines more thoroughly.

To consolidate better safety, a more radical change may be needed. The problem could be expressed as a combination of the navigator being fatigued and/or the lookout not being practically involved in the bridge-team work, if being on the bridge at all. A proposal for solution could be to mix experiences and routines from some cruise and passenger companies

---

[32] SOS database.

[33] Frodé et al. (2006). Greigård et al. (2004). IMO (2001) *MSC/Circ 1014*. IMO (2006). Lützhöft et al. (2007). MAIB (2004). Mårtensson et al. (2004). SMSI (2003).

[34] IMO (2006).

[35] Greigård et al. (2004).

[36] BRM: Bridge resource management, sometimes MRM, marine resource management.

with pilot/co-pilot system, DP-vessels[37] and two-navigator ships. The result could for example be a ship with two ordinary navigators and two assistant navigators or cadets, working in two navigator/assistant navigator **teams**, instead of two navigators and two lookouts. By sharing direct responsibility of the watch in one-hour shifts with one team member standing by, the working load and psychological pressure on the ordinary navigators would ease considerably. There would be time, in ordinary working hours, to perform administrative duties as well as having a relaxing sandwich and coffee for the ordinary officer as the assistant navigator is in charge, the latter knowing that the ordinary is near-by in case of uncertainty or emergency, and vice versa.

A problem with such a solution is the absence of method to measure the effectiveness. The safety value, if any, of such a change in manning structure would not be possible to notice until after several years, depending on how many ships had the change and the number of groundings and collisions these ships had, and then compare that number with other ships. Instead, a method to measure awareness would be handy in this case. Different physiological methods are possible to use but a really good and easy method, possible and practical to use for a long time of period, is hard to find. Maybe an answer is a discreet lamp on the forecastle, randomly switched on by a computer, and a switch to turn it off when seen by the team on the bridge? By noting the time until switched off, a kind of “awareness indicator” could be calculated. By comparing ships with different manning systems, an objective result would be possible to obtain after some time, without waiting for the accidents to be counted.

12.2.4 Aptitude test

Some human factors, such as an operator having a tendency to act incorrectly, e.g. by becoming nervous and pressing the wrong button, are not included in the above mentioned reasoning. Related occurrences would consequently not be avoided. In these matters other solutions are desirable.

---

[37] DP, dynamic positioning: high precision positioning, based on specific electronic equipment operated by a team of two navigators, one acting and the other one standing by.

Training and education together with experience will eventually form good operators. It has, however, to be noted that occasionally there will still be individuals not fit for the job. Consequently, there might be people at sea who do not really have the personal qualifications for doing a good job in all aspects. There are for example people having difficulties in learning how to manoeuvre a ship. To supply young people with a tool to assist them in making a good decision for their future as well as supplying the industry with suitable officers (and avoid unsuitable ones), there should be some kind of aptitude test available before starting maritime academy studies. The test could be voluntary but still give the potential future maritime officer a hint for the future. To motivate students to perform the test, a successful outcome could give the applicant a benefit when applying for maritime academy. It seems as a decent step for the industry to take to supply with such an instrument for future seafarers.

13 For the Future

This paper leads to the conclusion that near-miss reports and databases are important tools to develop future strategies in maritime safety. It also confirms that near-miss databases already have a potential to collect a great number of reports, or rather descriptions of situations that might have gone wrong, that would otherwise not have been commonly known. The relation near-misses/accidents in the near-miss database used here is about 50:50. *The work to make progress by using near-miss databases should continue*.

Another finding is that the human factor in accidents is lower than generally suggested. This paper comes to the conclusion that slightly more than 60 % of the accidents are consequences of human factor behaviour at the sharp end.

In near-misses, the human factor part is even lower, only 38 %. That leaves us with factors **other** than human influencing accidents and near-misses as high as 36 % and 62 %, respectively. *Efforts should not be spared to reduce risks regarding human factors as well as technical and others*.

An approach to a more proactive way in safety development could be reached by focusing on system functions in complex technical systems. *A necessary part of doing that is to use full-scale tests as often as possible*.

Yet another approach is to deal with human factors. Poor lookout as well as fatigue is highly frequented factors in accidents. *A study of possibilities to develop manning conditions in order to spread responsibilities and hence minimize the risks should be initiated*.

It can not be denied that some people have less possibility to successfully act as ship's officers. *Available aptitude test should be considered for those who want to become officers.*

Finally, it must not be forgotten, that in real life, a number of accidents are prevented every day by intervention by an operator. People do break in into technical system, take over the operation and in this manner they prevent accidents.

That is also the *human factor*.

14 References

Bråfelt, Olle (2006). *Analys från Insjö.* Reported at Insjö meeting November 2006. *In Swedish.*

Frodé, Pettersson, Rudolfsson (2006). *Trötthetsfaktorer till sjöss.* Kalmar Maritime Academy, Sweden. *In Swedish.*

Greigård, Lindgren (2004). *Trötthet – ett sjösäkerhetsproblem. Hur kan man förutsäga och undvika kritiska nivåer?!* Kalmar Maritime Academy, Sweden. *In Swedish.*

Grimvall, Lindgren (1995). *Risker och riskbedömningar.* Studentlitteratur, Lund. *In Swedish.*

Grimvall, Jacobsson, Thedéen (1998). *Risker i tekniska system.* Stockholm. *In Swedish.*

IMO (2000). *Marine accident and incident investigation. Training manual.* International Maritime Organization, London, UK: Ashford Open Learning Ltd.

IMO (2001). *Guidance on fatigue mitigation and management. MSC/Circ 1014*. International Maritime Organization, London, UK

IMO (2001). *MSC/Circ 1015*. Retrieved May 2006, from http://www.imo.org. International Maritime Organization, London, UK

IMO (2006). *STW 38/13/7/Rev.1* 24 November 2006. International Maritime Organization, London, UK

Insjö (2007). www.insjo.org http://www.insjo.org/Erfarenhetsbanken/ErfarenhetsbankenRapporteratillerfarenhetsbanken.asp

Lützhöft, Thorslund, Kircher, Gillberg (2007). *Fatigue at sea. A field study in Swedish shipping.* VTI, Linköping.

MAIB (2004). *Bridge Watchkeeping Safety Study.* Safety study 1/2004. Maritime Accident Investigation Branch, Southampton, UK.

Malmberg, Lars-Göran (2000). *Haveriutredningar. En rättslig studie över undersökningar i samband med olyckor i luften och till sjöss.* Stockholm. *In Swedish.*

Mårtensson, Söderberg, Widlund (2004). *Trötthetsrelaterade olyckor.* Kalmar Maritime Academy, Sweden. *In Swedish.*

Nationalencyklopedin (1991). Höganäs, Sweden. Bokförlaget Bra Böcker. *In Swedish.*

Nationalencyklopedin (1994). Höganäs, Sweden. Bokförlaget Bra Böcker. *In Swedish.*

Renborg, Jonsson, Broqvist, Keski-Seppälä (2007). *Hantering av händelser, nära misstag.* SKI Rapport 2007:16. Retrieved June 2007, from http://www.ski.se. *In Swedish.*

van der Schaaf, Kanse (2004). *Biases in incident reporting databases: an empirical study in the chemical process industry.* Safety Science, 42(1), 57-67.

SOU (1996:182). *Handlingsprogram för ökad sjösäkerhet*. Stockholm. Statens offentliga utredningar. *In Swedish.*

Swedish Maritime Safety Inspectorate, SMSI (2003). *Studie av visst statistiskt material..*. Norrköping, Sweden. *In Swedish.*

Swedish Maritime Administration (2006). *Sjöfartsverkets meddelande nr 1 2006.* Norrköping.

Swedish Work Environment Authority (2007). www.av.se http://www.av.se/blanketter/paragraf2/forklaring_tillbud.aspx

15 Appendix

Causes in database SOS *(In Swedish only)*

Yttre faktorer

Annan känd orsak
Mycket hårt väder/naturkatastrof/orkan/svår storm
Ström, vind, tidvatten o.dyl. som förorsakat drift-/manövrering
Kolliderat med flytande föremål, som ej kunnat upptäckas eller undvikas i tid
Fel på navigationssystem utanför fartyget – t.ex. fyrar, bojar, ljus, loran, decca, satellit
Fel på sjökort och/eller nautiska publikationer
Tekniskt fel på annat fartyg (inkl. bogserbåt, isbrytare o.s.v.)
Felaktigt handhavande av annat fartyg/andra fartyg
Tekniskt fel vid lastning/lossning/bunkring/kaj/sluss o.s.v. som ej beror på fartyget
Felaktig hantering vid lastning/lossning/bunkring/kaj/sluss som ej kan lastas på fartyget
”Blow-out” eller annat externt förhållande på oljeplattform/rigg
Andra förhållanden utanför fartyget
Isförhållanden som påverkat fartygets navigering/manövrering
Farvattnets beskaffenhet, grunt/trångt o.s.v.
Felaktiga uppgifter från landorganisation
Dålig sikt
Hårt väder/storm o.dyl.

Fartygets konstruktion

Fartygets konstruktion för vek
Fartygets konstruktion försvagad genom svetsarbete, rost o.dyl.
Fartygets manöverförmåga ej tillfredsställande
Maskinrumsarrangemang, placering av utrustning o.dyl. felaktigt konstruerat
Olycklig placering/utformning av lastrum, tankar, förråd
Olycklig placering/utformning av andra utrymmen ombord (ej bryggan)
Svåra/trånga besvärliga tillträden/ingångar för rengöring, underhåll, inspektion
Andra förhållanden rörande fartygets konstruktion och underhåll

Tekniskt fel på utrustning

Tekniskt fel på navigationsutrustningen
Tekniskt fel på styrinrättningen (inkl. styrmaskin)
Tekniskt fel på framdrivningsmaskineriet
Tekniskt fel på hjälpmaskineriet
Tekniskt fel på ankarspel/däcksmaskin (ej lossnings- och lastningsutrustning)
Tekniskt fel på övervaknings-, fjärrkontr. – autmatik och/eller varning
Tekniskt fel på lastnings- och lossningsutrustning
Tekniskt fel på säkerhetsutrustning inkl. brandsläckning
Tekniskt fel på borrutrustningen
Tekniskt fel rörande övrig ombordvarande utrustning

Tekniskt fel på bogpropellerns utrustning/motor
Tekniskt fel på ventiler/övrig maskinutrustning
Tekniskt fel på elsystemet i övrigt
Tekniskt fel på wires o.dyl./slitage

Handhavande/utformning av utrustning

Olycklig utformning av bryggan, saknad och/eller felaktig placering av instrument
Ologisk/felaktig utformning av kontrollorgan/instrument o.dyl.
Instrument/utrustning felplacerade
Föråldrade instrument. Dålig utrustning. Utrustning/publikation saknades
Andra förhållanden rörande användning/utformning av utrustning/manuell/maskin
Underhållet eftersatt
Slitage

Last/säkring

Självantändning i last/bunkers inkl. vid tankrengöring
Inertgassystem eller annan säkerhetsutrustning mot brand/explosion saknades
Stabiliteten inte tillfredsställande. Felplacerad last, ballast o.s.v.
Lasten otillräckligt säkrad
Läckage av last från fat, container, tankar o.s.v.
Skada/brott på last- eller bunkerledning
Andra förhållanden rörande last, säkringar av last samt bunkers

Kommunikation/organisation/rutin

Säkerhetsövningar var inte gjorda, eller inte i tillräcklig omfattning
Säkerhetsövningar gjorda, men inte på tillfredsställande sätt
Rutiner för säkerhetskontroller saknades, eller var inte tillfredsställande
Rutiner för säkerhetskontroller var kända men följdes inte
Säkerhetsbestämmelserna för svetsning följdes inte
Svetsarbete ledde till olyckan trots att säkerhetsbestämmelserna följts
Ej följt bestämmelserna angående provning av räddningsutrustning
Säkerhets-/skyddsutrustning användes inte
Felaktiga rutiner för inspektion och underhåll ombord
Stabiliteten okänd. Godkända stabilitetsberäkningar saknas
Otillräcklig ledning. Personliga motsättningar o.dyl.
För liten bemanning. Generellt eller vid händelsen t.ex. rorsman/utkik fanns inte
Bryggrutinerna var inte tillfredsställande i säkerhetssynpunkt
Bryggrutinerna tillfredsställande, men följdes inte
Kort och publikationer var inte rättade
Samarbetet mellan fartyg och landorganisation/ bogserbåt/ isbrytare/övriga inblandade var inte tillfredsställande
Andra förhållanden rörande kommunikation/ organisation/ rutiner ombord
Skyddsombud saknades
Skyddsombudet inaktivt
Skyddskommittén saknades

Skyddskommittén inaktiv
Förhållande mellan fartyg och rederi inte tillfredsställande

Mänskliga faktorer

Otillräckliga kunskaper för uppgiften
Otillräcklig kompetens
Uppgiften dåligt planerad
Tillgängliga varningssystem inte använda i tillräcklig utsträckning
Alternativt navigationsmedel inte använt
Tillgängligt navigationsmedel användes inte
Inte tillräckligt bra position av eget fartyg. ”Död räkning” inte avsatt i kortet
Felbedömning av annat fartygs rörelse
Felbedömning av eget fartygs rörelse
Försökt genomföra operationen, trots att omständigheterna inte var de rätta
Höll inte till styrbord i farleden
För hög fart
Speciella förhållanden (sjukdom, för lite sömn, för lång arbetstid)
Sovit på vakt
Alkohol eller andra berusningsmedel
Andra förhållanden där den mänskliga faktorn inverkat