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REPORT OF MEETING

IMO TRAINING COURSE ON MARITIME ACCIDENT INVESTIGATION

Suva, Fiji, 10 – 21 August 2009

Secretariat of the Pacific Community
Suva, Fiji
2009

IMO TRAINING COURSE ON MARITIME ACCIDENT INVESTIGATION

Report compiled by the Regional Maritime Programme of the Secretariat of the Pacific Community

Secretariat of the Pacific Community
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EXECUTIVE SUMMARY

The Secretariat of the Pacific Community's (SPC) Regional Maritime Programme (RMP), in conjunction with the International Maritime Organization (IMO), organised a training course on maritime accident investigation, which was held in Suva, Fiji, from 10 - 21 August 2009. The course was attended by 16 participants representing Cook Islands, Federated States of Micronesia (FSM), Fiji, Kiribati, Republic of Marshall Islands (RMI), Nauru, Niue, Palau, Papua New Guinea (PNG), Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu. The resource people for the course were Mr Kit Filor of Australia and Mr Marcel Ayeko of Canada.

The intensive ten-day course was designed to increase the knowledge and skills of senior managers and marine surveyors from Pacific Island nations in conducting maritime accident investigations in accordance with international standards and guidelines. Participants were made aware of important IMO instruments such as MSC Resolution 255 (84) Safety Investigation Code, Resolution A.884 (21), IMO Reason Model, IMO Resolution A.893 on pilotage and investigation into casualties in pilotage waters and IMO reporting requirements for marine accident investigations.

The participants were also exposed to several case studies to better understand scenarios and lessons learnt by undertaking appropriate analyses of situations. In addition, the course touched on other important topics such as understanding human factors, recognition of potentially dangerous attitudes, memory, decision making, situational awareness, ergonomics, risk assessment, fire and explosion, fatigue, and hours of work.

Deep regret was expressed at the recent maritime tragedies in Kiribati and Tonga, which held valuable lessons for maritime regulators and decision-makers in the region. The course was hence opportune as the need to reinforce better investigation techniques was high with the intention of producing accurate results to improve maritime safety in the region.

The course also required the participants to sit for a written exam on the final day. All 16 participants passed the exam, successfully fulfilling the requirements of the course.

TABLE OF CONTENT

PROGRAMME

Number	Day	Subject
1	Monday	i. International Maritime Organization (Accident Investigation Course) ii. The World Commercial Shipping Fleet iii. Casualty related Matters, Reports on Marine Casualty iv. Investigations
2	Tuesday	i. Analysis ii. Planning an Investigation and Investigator Safety iii. International Instruments iv. Investigating Specific accidents v. Development of safety Investigations vi. Incubation period
3	Wednesday	i. MSC Resolution 255 (84) Safety Investigation Code ii. Understanding Human Factors iii. Resolution A.884 (21) iv. Recognition of Potentially Dangerous Attitudes v. IMO Reason Model
4	Thursday	i. Memory ii. Decision Making and awareness iii. Decisions iv. Bias v. Ergonomics vi. Case Study Torrey Canyon
5	Friday	i. Risk Assessment and ISM Code ii. Case Study Exxon Valdez iii. Case Study Nego Kim
6	Monday	i. Electronic Evidence ii. Evidence – Unit Shipment wet or dry iii. Evidence and its Collection iv. Photography Evidence v. Case Study Relax Resort
7	Tuesday	i. Witness ii. Cognitive Interviewing
8	Wednesday	i. Fire and Explosion ii. Fatigue, Hours of work iii. Case Study Queen Elizabeth
9	Thursday	i. IMO Resolution A.893 – Pilotage and Investigation into Casualties in Pilotage Waters ii. Case Studies Marchioness and Bowbelle
10	Friday	i. IMO Reporting MSC-MEPC.3/Circ.1 ii. Exam

1. INTRODUCTION

The IMO Maritime Safety Committee (MSC), at its 84th session on 16 May 2008 adopted Resolution MSC 255(84) – Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (Casualty Investigation Code). In August 2009, IMO funded and co-hosted a training course with RMP in the Pacific Islands region to raise awareness of this Code among the region's maritime administrators.

2. PURPOSE

The purpose of the course was to:

a) Enhance the understanding of maritime administration marine investigating officers, surveyors and/or legal officers on the Casualty Investigation Code;

b) Inform practices on best practices in marine casualty and marine incident investigation and promote cooperation and a common approach to marine casualty and marine incident investigations among Pacific Island countries (PICs);

c) Upskill PICs administrators with the aims of the new code in applying consistent methodology and approach to these investigations ensuring discovery of casual factors and other safety risks; and provide reports to IMO to enable a wide dissemination of information to assist the international marine industry to address safety issues; and

d) Familiarise participants with SOLAS newly introduced regulation 6, additional requirements for the investigation of marine casualties and incidents and in conjunction with the requirements of the new code.

The objectives of the course were to:

(i) Determine the circumstances, contributing factors and safety issues, that need to be addressed and to facilitate safety actions that will identify safety issues;

(ii) Conduct marine casualty investigation, evidence collection, analyses and report preparation;

(iii) Document and record evidence, evidence collection and handling techniques.

(iv) Review and draft existing generic regulations under the Pacific Islands Maritime Laws (PIMLaws) to incorporate Casualty Investigation Code and any other important requirement for best practice suitable to PICs;

(v) Understand the common approach for PICs to adopt in the conduct of these investigations; and

(vi) Develop independent and relevant marine casualty reports as well as improve communication and networking among trained investigators in PICs.

3. VENUE, HOST AND PARTICIPANTS

The course, organised by RMP with funding assistance from IMO, was held in Suva, Fiji, from 10 - 21 August 2010. It was attended by 16 participants representing Cook Islands, Federated States of Micronesia (FSM), Fiji, Kiribati, Republic of Marshall Islands (RMI), Nauru, Niue, Palau, Papua New Guinea (PNG), Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu. The resource people for the course were Mr Kit Filor, an IMO consultant based in Australia and Mr Marcel Ayeko, Acting Director, Marine Investigations Branch, Transportation Safety Board of Canada, Canada.

A full list of participants is attached as Annex 1.

4. OPENING REMARKS

The event started off with a prayer by Taulapapa Captain Maselino Tominiko, Maritime Training and Audit Adviser at RMP. This was followed by opening speeches from Captain John Hogan, RMP Programme Manager, and Mr Carlos Ormaechea, Technical Officer, TC Implementation, Coordination Section, Maritime Safety Division, IMO.

Captain Hogan's opening speech is attached as Annex 2. Mr Ormaechea's speech is attached as Annex 3.

5. INTRODUCTION TO THE COURSE

Following the welcome notes and opening speeches, Mr Kit Filor introduced the course objectives and outline. The participants were also requested to introduce themselves and explain their roles within their respective administrations.

A moment of silence was observed to remember those who had lost their lives and loved ones in the recent maritime accidents in Kiribati and Tonga.

Mr Filor impressed upon the participants the purpose of the course and its linkage with IMO's introduction of the Casualty Investigation Code. The Code aimed to promote co-operation and a common approach to maritime accident investigations. Participants were made aware that the new Code would become mandatory from 1 January 2010.

It was expected that the course content would mainly constitute of presentations by resource people, complemented by breakout group sessions to discuss case studies. The final component of the course required participants to undertake a written exam in order to demonstrate a fair understanding of the course content.

The role of MAIIF was highlighted. The MAIIF conferences allowed representatives from various maritime organisations across the globe to meet annually to discuss common issues relating to maritime accidents, findings from investigations and lessons learnt.

An overview was provided on the different types of accidents and the range of investigation types that were available to suit the circumstances. Participants were also given information on the current status of the world commercial shipping fleets, the structure of the world fleet in terms of type and nationality; public perception and ship safety; accident trends and IMO's role in addressing ship safety.

6. CASE STUDY: *HERALD OF FREE ENTERPRISE*

A DVD on the *Herald of Free Enterprise* incident was shown. Participants were divided into three groups and each group was assigned the task of presenting the results of their discussion on what they thought may have caused the capsizing of *Herald of Free Enterprise*.

7. IMPLEMENTATION OF CONVENTIONS, CODES AND RESOLUTIONS

Mr Carlos Ormaechea of IMO delivered a presentation on how IMO developed, adopted and assisted its members in the implementation of the maritime conventions, codes and resolutions. Discussions led to the IMO Casualty Investigation Code. The Code has been designed to facilitate objective maritime safety investigations for the benefit of the flag states, coastal states, IMO and the shipping industry. The Code also required member countries to submit casualty reports to IMO for analysis. Participants were made aware of the types of submission forms available from IMO for incident reporting. Taking a step further, IMO had

already designated a working group to review casualty reports and see what lessons could be learnt from the incidents or accidents.

8. TYPES OF INVESTIGATIONS

Mr Marcel Ayeko delivered a presentation on the different types of maritime accident investigations and their specific purpose. A point that was emphasised in this presentation was that all casualty investigations had to be backed up by a legal framework. Investigators needed empowerment through legislative provisions of the state, allowing them to act within the legal framework. It was important for an investigator to:

- be appointed under applicable legislation.
- have suitable identification.
- know the legislation and the scope of his or her powers.
- act within the limits of the legislation.

In addition, an investigator needed to have other key attributes such as initiative, integrity, decision-making ability, dedication and the required knowledge and experience. Participants were encouraged to conduct investigations by letting the evidence direct them and not having preconceived notions of what happened.

9. PLANNING AN INVESTIGATION AND PERSONAL PROTECTION FOR INVESTIGATORS

Mr Marcel Ayeko delivered a presentation on planning an investigation, which looked at the investigation structure, phases of investigation, setting up an investigation, investigator equipment, safety, and liaising with other interested parties. Participants were also familiarised with the different stages involved in an investigation such as data collection, analysis and report preparation. Participants were also reminded of the importance of providing prior notice to parties who would be investigated.

Further discussions took place on the types of safety clothing that was required for onsite investigations. TSBC in Canada had a generic list of personal protection clothing that investigators had to use when conducting investigations. Having a generic list of clothing and personal protection helped the investigators prepare easily at short notice.

10. PRACTICAL SESSION ON CONDUCTING ACCIDENT INVESTIGATION IN A LOGICAL PROCESS

Mr Kit Filor divided the participants into three groups and gave them the case study of the *Herald of free enterprise.* The case study allowed the participants apply the principles learnt in class and understand the importance of taking baby steps to sequentially analyse the events leading to the accident, understand the logical process of getting the evidence and assess the sequence of events that eventually caused the accident. The session outlined some basic analysis tools for event and condition charting, analysis charting, why/because Reason Model and the six tests of safe operation.

The IMO model from Resolution A.884 (21), the Swiss Cheese Model, Generic Error modelling and James reason theories were explained to broaden understanding of theories and approaches underpinning accident investigations. There was further discussion on investigating various kinds of accidents that may occur on a ship and the general information that needed to be collected.

Mr Filor explained to the participants the thinking behind the development of safety investigations, highlighting:

- A brief history of investigations;
- General categories of casualties;
- Public and technical inquiries;

- Failure of foresight - six stages of disaster;
- Sociological and psychological thinkers; and
- James Reason model.

11. ILO MARITIME CONVENTIONS

Mr Marcel Ayeko presented an overview of the maritime conventions developed by the International Labour Organisation (ILO) placing special focus on:

a) Maritime Labour Convention 2006: a consolidated instrument embodying as far as possible all up-to-date standards of existing ILO maritime conventions - has been ratified by Bahamas, Liberia, Marshall Islands, Norway, and Panama only.

b) ILO Recommendation 134 of 1970: concerning the prevention of occupational accidents to seafarers. For authorities to take necessary measures to ensure occupational accidents are reported, investigated and to prevent accidents, research shall be undertaken into trends and hazards;

c) ILO Recommendation 147 of 1978: countries that ratify the convention should hold an official inquiry into serious marine casualty involving ships registered in its territory, of which the report should be made public;

12. HUMAN FACTORS

Mr Kit Filor gave a presentation on human factors, explaining the role of human operators in complex systems. This was multi-disciplinary science that applied knowledge as well as capabilities and limitations on human performance to all aspects of design, manufacture, operation and maintenance of products and systems.

The presentation covered the following theories and models on human behaviour:
- Generic error modelling;
- Violations;
- Stress/performance;
- SHEL Model;
- Organizational culture;
- Reason Model; and
- Culpability.

13. IMO RESOLUTION A.884 (21)

Mr Marcel Ayeko gave a presentation on the amendments to the IMO Code for Investigation of Marine Casualties and Incidents. It was expected that the amendments would guide systematic investigation of human factors in marine casualties and incidents. This was necessary to ensure effective analysis of findings and successful implementation of preventive actions.

The IMO Resolution A.884(21) invited governments to implement the guidelines as soon as practicable with the intention of improving quality and competence of casualty investigations and reports.

The presentation also discussed the aim of the Casualty Investigation Code which is to promote a common approach to the investigation of marine casualties and incidents and to promote co-operation between states to:
- introduce best practice safety investigation.
- aid remedial action.
- promote uniform input to accident database.

- create uniform system which applies to seafarers where ever they are in the world.

The theory of sequence of events was explained, linking with what events occurred prior to the accident and what events took place after the accident. The presentation also provided information on collecting evidence during investigations such as interviews, documents and records search, observations and sample collection.

14. THE REASON MODEL

Participants were divided into groups to discuss some types of reason models, which included:
- Shel Model
- Reason Model
- The general nature of Reason Model
- Swiss Cheese model

The discussions highlighted:
- focus on sources of problems rather than symptoms;
- clear difference between active failures and latent conditions;
- latent conditions being present in all systems; and
- concepts of defences.

15. MEMORY

Mr Kit Filor delivered a presentation on the concepts of memory, including:

(i) The Sensory Store: where incoming information was held in store in two forms, the iconic memory and echoic memory;

(ii) Short Term memory: called the working memory which stores several pieces of information in memory at once. However, it has extremely limited capacity and information is forgotten in seconds without rehearsal;

(iii) Long term memory: has limitless capacity for all intents, information can potentially be stored forever, and it is disturbed and associative by nature.

Transfer of information to the brain was an active process. The brain actively processed information and did not just passively receive, store and retrieve information. The brain also constructed what is seen, what is remembered and then performs the interpretation process. The aim of this presentation was to help participants appreciate how memory functioned when a witness is interviewed after an accident.

16. DECISION MAKING AND SITUATIONAL AWARENESS

Mr Marcel Ayeko delivered a presentation on the decision-making process, which explained:
- Human information processing system;
- Decision-making;
- Situational awareness; and
- Basic ergonomic concept.

The issue of how situational awareness could assist in investigations was raised. Being aware of what is happening around and understanding what the information means now and in the future can help in taking the right decision. Situational awareness-oriented design and training creates efficient user-centred systems to increase interface usability and reduce human errors on the system.

17. BIAS

Mr Kit Filor delivered a presentation on bias and its effect on how people perceive things. He related this to accident scenarios where bias has been found to colour one's judgment and opinion as well as those of others. Bias could also influence decision-making. Further explanation was given on some forms of bias such as attribution bias, confirmation bias, availability bias and anchoring bias.

18. A CASE STUDY OF THE *TORREY CANYON*

A case study of the *Torrey Canyon* was presented to the participants. Attention was brought to *Torrey Canyon's* original construction. An expansion of the ship's structure doubled the ship's cargo carrying capacity from 60,000 tons to 120,000 tons. The case study looked at the extent of the disaster and the lack of contingency plans to handle a disaster of such magnitude. Many lessons were learnt from the disaster. One of the issues highlighted by this case was that risks could be reduced by using bridge resource management to minimise human error. After the combined session discussions, the participants were divided into three groups again and asked to use the reason models to determine the latent conditions that had existed prior to the accident as well as measures that could have been taken to avoid the accident.

19. ERGONOMICS

Mr Kit Filor presented the subject of ergonomics, which primarily dealt with the physical aspects of matching people with their work tasks, workstations, tools and equipment with which they work. The presentation also looked at the environmental factors influencing human performance. In relation to the shipping industry, one had to develop an understanding of the effects of marine and shipboard environment on seafarers, which could include:

- Temperature - too hold or too cold, humidity and the sources of heat
- Workplace management
- Noise - excessive noise can destroy rest and sleep
- Vibration - can increase discomfort and disrupt concentration.
- Sources of illumination, natural and artificial lighting
- Ship movement – if excessive can cause physical discomfort and seasickness.
- Smell - can cause seasickness, induce hunger or revulsion.

20. RISK ASSESSMENT AND ISM CODE

Mr Kit Filor delivered a presentation on risk assessment and the International Safety Management (ISM) Code. The session started with lessons on risks and perceptions, the risk management process, safety management and the ISM Code. Participants were briefed on the risk management process and its components such as creating the context, identifying the risk, analysing the risk, evaluating the risk, treating the risk and maintaining an ongoing monitoring and review process.

The presentation also discussed how the ISM Code was adopted by the IMO Assembly Resolution 741(18) and became mandatory by virtue of the entry into force of SOLAS Chapter IX on 1 July 1998. Further amendments followed in 2000 and 2008. It came into effect for the purpose of providing an international standard for safe management and operation of ships, pollution prevention and to minimise the scope of poor human decisions that contributed directly to a casualty or pollution incident.

The discussions further looked at what the flag state administrations responsibilities were and how ISM helped with safe operation of ships and shipping companies.

21. CASE STUDIES OF *EXXON VALDEZ* AND *NEGO KIM*

Participants were exposed to a case study involving *Exxon Valdez*, a crude oil tanker that ran aground on a reef off the Alaskan Coast on 24 March 1989, spilling 41.8 million litres of crude oil which contaminated about 1,300 miles of the coastline. The accident resulted from the ship's encounter with icebergs in the shipping lane. The Captain ordered his helmsman to take the *Valdez* out of the lane to go around the ice berg but it hit the Bligh Reef, splitting its side open, and releasing oil of reportedly an eight mile slick.

A case study of *Nego Kim* was also presented. When the incident happened, tank cleaning and painting was being carried out while the ship was at anchorage. The oxygen level analysis of port tank number one was conducted by the chief mate prior to the tanks being painted inside. The case study revealed that the lighting and electric fan used in the tank (while paint work was being carried out) and the portable VHF radio used to communicate were not intrinsically safe. The accident happened at 1640hrs. A large explosion ripped through the tank the crew were painting in and blew the tank apart. Three men were blasted down the length of the main deck and killed instantly. Four men were blown over the side of the ship and a spinning drum of burning thinners was projected aft along the main deck while a fire fuelled by burning paint and thinners erupted on the main deck near the aft end of the tank.

The two case studies prompted the participants to critically analyse the precursors to the accidents and what measures could have been taken to avoid the accident.

22. EVIDENCE

Mr Marcel Ayeko delivered a presentation on evidence which was the most critical component of all accident investigations. He pointed out that some evidence could perish over time and therefore needed to be preserved, recorded, receipted and secured properly. To avoid loss of crucial evidence, it was important for investigations to start as soon as possible, ideally within 24 hours. Participants were made aware that they had to resist the temptation to look for evidence that supported a particular theory. Depending on the nature of accident, the types of evidence could include:

- Physical – material, debris, metal fatigue;
- Personnel or human – witness accounts;
- Electronic - voyage data recorders (VDR);
- Photographic – still and video;
- Documentary – charts, logs, orders and letters;
- Environmental – weather, sea state;
- Historical – refits or maintenance; and
- Underwater – wrecks on seabed.

In marine accident investigations, the burden of proof was generally accepted as being on the balance of probability rather than beyond reasonable doubt. A recommended way of analysing evidence was through a peer group review to access more expert views on the matter.

23. CASE STUDY OF SMALL INVESTIGATION, RELAX RESORT'S WORK BOATS

The case study scenario involved a boat incident at a resort called Relax Resorts. One of the resort boats disappeared with five resort guests and two crew members while on a short trip to one of the islands. To simulate the accident investigation, the participants were divided into groups with each group acting as an investigative team. Background information on the case was provided such as the management issues with the skipper of the boat, the vessel's outfit with respect to fuel storage, standard operating procedures, communication equipment on board, first aid kit, bilge pump, vessel's registered length, the boat's passenger carrying capacity and the survey requirements that the boat had to comply with. The

participants were encouraged to use the techniques learnt from the training on how to critically analyse the accident. After group discussions, representatives from each group presented their findings on the cause of the accident and what measures could have been taken to avoid the accident.

24. PICTs MARITIME ACCIDENT INVESTIGATION LEGISLATION

Participants were asked to discuss the status of legislation in their respective countries with regards to maritime accident investigation.

Fiji: A preliminary investigation is conducted by FIMSA to establish the cause of the accident. The preliminary report is presented to the Marine Board who authorise a Marine Board inquiry to be conducted. After the inquiry report is presented to the Marine Board, the board decides what penalty will be applied. A court inquiry may be carried out which may include other penalties. There is a provision on preliminary accident investigations in Fiji's Marine Act. Fiji had yet to confirm how the new IMO Casualty Investigation Code would fit into the current legislative provisions.

Kiribati: The Marine Act doesn't cover maritime accident investigations. When an accident occurs, the maritime administration files a request to the police department to investigate. When there is a serious case that results in a public outcry, the country's President appoints a public enquiry to investigate the accident. After the recent maritime accident, which involved 22 casualties, the country's President asked New Zealand to help with the investigation. Kiribati explained that the maritime administration does have procedures similar in nature to Fiji's for preliminary investigations and board inquiry. Kiribati also cited a case where a Kiribati shipowner wanted the maritime administration to sack the master of his ship in a grounding case but the Marine Act had no provisions for penalties that could be applied in this case.

Samoa: In Samoa, the Secretary had the power to authorise accident investigations and make the final decision on the investigation report. However, if the report or decision is challenged, then the matter can be settled in court. Samoa had provision in their legislation for marine accident investigations.

Marshall Islands: Marshall Islands had a big open ship registry for its international shipping, with a high number of maritime legislation and regulations in place. The current legislation and regulations work well for the open registry but not for the domestic shipping sector. Marshall Islands could consider using the IMO's Casualty Investigation Code.

Cook Islands: The Cook Islands Marine Department has not conducted any maritime accident investigations. A Shipping Act has been drawn up and submitted to the parliament. The ministry had no records of investigation reports and this was mainly because they did not have any trained accident investigators to conduct investigations for the Ministry.

Nauru: A case was highlighted where one of the phosphate vessels was briefly grounded. The incident caused the shipowner to finds ways to close the Nauru Port, claiming that the port of Nauru was unsafe. The Maritime Act was already drawn up but not passed in parliament yet. Currently there was no legislation to authorise an accident investigator to investigate groundings. Mr Filor said that the issue of ships prosecuting ports is a common issue. In Nauru's case, there is only one port facility that caters for foreign vessels so it must have proper legislation in place to address these issues.

25. INTERVIEW TECHNIQUES

Mr Marcel Ayeko delivered a session on interview techniques using a combination of theory and practical lessons. Topics discussed included types of interview, witness limitation and the stages of an interview. The presentation ended with a lesson on the nine alleged ways to establish the truth of an account. Participants were reminded that investigators were human too so they were subject to the same problems of acquisition, retention and recall.

Mr Filor of AMSA gave a presentation on fires and explosions on ships. The session discussed some issues facing ship fire investigators, and what they needed to be mindful of when approaching a fire scene, investigating the causes of the fire, and ensuring investigator personal protection.

The class was shown a sample questionnaire that was used to gather information in 2001 for a ship-fire investigation involving the *Spirit of Tasmania* incident in Australia. This example was used to demonstrate the usefulness of questionnaires in obtaining evidence from a large number of eyewitnesses.

Participants were divided into groups of three with one group acting as a witness, another as an investigator and the third one as an observer. The case study involved a car accident and a video of the incident was shown to the groups. The role play revealed that eyewitnesses do have difficulty in recalling exact details of accidents when interviewed as witnesses. It also proved that misinformation from eyewitnesses can mislead investigators.

26. THE SINKING OF *MV OVALAU* AND A FIRE ACCIDENT ON AN INDONESIAN FERRY

Mr Philip Ranauld, Deputy Port Master, Fiji Islands Maritime Safety Administration (FIMSA), presented the *MV Ovalau* case in Fiji. The presentation detailed the cause of the incident, surrounding events and the actions of maritime regulators, skipper, crew and shipowners.

Mr Kit Filor presented a fire accident case involving an Indonesian ferry that killed about fifty people. The two practical case studies used the reasons model to show the root cause of the accidents.

RMP's Legal Adviser commented on the Maritime Accident Investigation Regulation that had been drafted recently by the Pacific International Maritime Law Association (PIMLA) for Pacific island countries. Maritime administrations were urged to pass the regulation to their Attorney General's office for it to be adopted into the existing Maritime Act or Shipping Act. This instrument will provide maritime administrators the authority to conduct maritime accident investigations. RMP also distributed a policy paper with recommended practices to the participants on this matter.

Concerns were raised on the cost of conducting accident investigations and who was responsible for meeting the costs. RMP's Legal Adviser explained that the relevant legislation or regulation had to clearly state the name of the agency that would be responsible for the undertaking.

Participants were also reminded that countries that were party to the SOLAS Convention would have to comply with the IMO Casualty Investigation Code which was going to come into effect in January 2010.

27. THE EFFECTS OF FATIGUE

Mr Marcel Ayeko delivered a presentation on fatigue and its effect on the human body. Detailed explanation was given on how fatigue led to a reduction in physical and or mental capability which may impair physical abilities, strength, speed, reaction time, coordination, decision making and balance.

The presentation went on to explain acute and chronic fatigue as well the human circadian clock, sleep cycles, and STCW watchkeeping hours. Explanation was provided on methods of quantifying fatigue such as the pilot's sleep credit/deficit chart, USCG fatigue index score and blood alcohol concentration with hours of wakefulness.

Moderate levels of fatigue produced performance decrements that were comparable to the effects of alcohol on the body. It was necessary for participants to understand why fatigue was linked to human error induced accidents.

28. CASE STUDY OF THE PASSENGER CRUISE LINER *QUEEN ELIZABETH*

Mr Kit Filor presented a case study on the grounding of a passenger liner, *Queen Elizabeth*, which happened on 7 August 1992. The case study looked at how the actions of the Master, watch officers and the pilot caused the ship to hit the seabed. Other factors were looked at such as the personnel on board, ship's navigation equipment, departure plan, the departure, charts and sailing directions. The case study showed how with nobody monitoring the echo sounders, the ship may have been within 0.3048m of the sea bed. The timing was noted when heavy vibrations were felt on the ship and the propeller being brought to zero. It subsequently transpired that the ship had contacted the sea bed and water was found to have entered into previously empty double bottom tanks. Also the findings revealed that the area of grounding had last been surveyed in 1939. The participants re-grouped to discuss the factors that caused the grounding.

29. IMO RESOLUTION A.893: GUIDELINES FOR VOYAGE PLANNING

Mr Kit Filor gave a presentation on IMO Resolution 893, which covered the area of voyage and passage planning that applied to all vessels. The presentation included factors that may impede safe navigation of vessels. The four stages of planning were discussed: planning, execution, monitoring and appraisal. Discussions stressed the importance of voyage planning and the need to ensure that the plans covered the entire voyage or passage from berth to berth, including those areas where the services of a pilot would be used. Reference was made to bridge procedures guide, STCW Convention 1995, SOLAS Convention 1974, IMO resolution A.893(21) paragraph 3.1, and ISM Code. Participants were advised on the need to handle media properly by having only trained personnel address any interviews. Media's presence was unavoidable in the event of an accident or incident, therefore, the administration responsible for conducting investigations needed to have appropriate policy and guidelines in place to handle media properly. Mr Kit and Marcel highlighted some forms of media training that could be used for those who conduct accident investigations.

30. CASE STUDY: *MARCHIONESS* AND *BOWBELLE*

Mr Kit Filor presented a case study which looked at an accident involving a pleasure craft, *Marchioness,* and a dredger, *Bowbelle*. A video was shown to the participants which provided details of the events that took place prior to the accident that night. The *Marchioness* was full of party goers and the disco music was very loud while the *Bowbelle* was making its way quietly through the night on the river. Mr Kit gave the participants a brief history of the pleasure craft and the dredger as well as the party that was going on the pleasure craft prior to the tragic accident. The class was divided into their usual groups to analyse the situation and present their findings to the class.

31. REPORTING MARITIME ACCIDENT INVESTIGATIONS TO IMO

Mr Marcel Ayeko delivered a presentation on the IMO requirements for reporting marine accidents as specified in MSC-MEPC.3/Circ.1. Under SOLAS regulation 1/21 and MARPOL articles 8 and 12, administrations which conduct an investigation into any casualty occurring to ships under its flag, subject to those conventions, were required to supply IMO with pertinent information concerning the findings of such investigations. The reporting structure for submission of the reports was explained in detail.

32. EXAM FOR THE COURSE

After ten days of intensive training, the participants sat for an exam. Results of the exam were made available to the participants the same day. All participants passed the exam and expressed their gratitude to the trainers, SPC and IMO for the training opportunity which was extremely relevant to their line of work in the region. Note: PowerPoint presentations used in the course are attached as annexes to this report.

ANNEX 1

SECRETARIAT OF THE PACIFIC COMMUNITY

IMO GTCP on SIDs LCDs training course on marine accident investigation

Suva, Fiji, 10 - 21 Aug 2009

LIST OF PARTICIPANTS

PARTICIPANTS BY COUNTRY

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Tominiko, Captain Taulapapa Maselino Maritime Training & Audit Adviser	Secretariat of the Pacific Community - Suva Private Mail Bag Suva	Tel: +679 337 9329 Fax: +679 337 0146 Email: maselinot@spc.int

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Transportation Safety Board of Canada

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Transportation Safety Board of Canada
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ANNEX 2

REGIONAL TRAINING COURSE ON MARINE CASUALTY INVESTIGATION
Suva, Fiji, 10 to 21 August 2009

OPENING REMARKS BY CAPTAIN JOHN P HOGAN,
MANAGER, REGIONAL MARITIME PROGRAMME,
SECRETARIAT OF THE PACIFIC COMMUNITY, SUVA, FIJI

The tragic events of the last few weeks, the ferry sinking in Kiribati, Monday 13 July with over 20 people missing and the sinking of the ferry Princess Ashika last Wednesday night with the loss of over 60 people, highlights the need for the ability to investigate these accidents to prevent these types of accidents happening again.

IMO through its Technical Cooperation Fund has been working on a number of maritime safety initiatives over the last few years of which this course is one of them.

Another course sponsored by IMO to be held later in the year is on the safety of ro-ro passenger ferries, which together with this course will assist those from the Administrations in the region improve safety of domestic shipping.

There are approximately 1600 domestic ships registered in Pacific Island countries and although a lot of these ships are old, this does not mean they are not suitable for the trade they are engaged in. On this course you will no doubt discuss to look at all the factors involved in an accident or incident not just the obvious one.

The current media feeding frenzy surrounding these incidents can also be a distraction to professional accident investigation and some of the sensationalist reporting over the last few days makes the investigators job even more difficult.

As we are all aware shipping plays such a vital link to the well being of all Pacific Islands people that safe and secure shipping becomes even more important.

Accidents do happen and the role of the accident investigator is to investigate an accident in order to learn lessons that can be used to prevent these types of accidents happening again.

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ANNEX 3

Regional Training Course on Marine Casualty Investigation
Suva, Fiji, 10 to 21 August 2009

OPENING ADDRESS BY Mr. CARLOS ORMAECHEA

Captain John P. B. Hogan, Manager, Regional Maritime Programme, Secretariat of the Pacific Community; Captain Maselino Tominiko; Ms.Inise Rabukawaqa; Mr. Alobi Bomo Rigam; Course Participants.

Please let me begin giving our condolences to **Tonga** and **Kiribati** for the recently ferry accidents. It is always sad to receive these notices. However, they remind us the need to reinforce our commitment to prevent any marine accident as well as the importance to increase our efforts on this matter.

It is a great pleasure for me to address this Regional Course on Marine Accident and Casualty Investigation. On behalf of the Secretary-General, Mr. Mitropoulos, I would like to thank the Secretariat of the Pacific Community for its acceptance and support for this training course which is aimed at assisting the national maritime Administrations in the region to uniformly carry out investigations into marine casualties and incidents in accordance with IMO Casualty Investigation Code adopted during MSC 84.

The IMO through its first resolution, A.173 (ES.IV), adopted in November 1968 which has been followed by a number of other resolutions related to marine casualty, has encouraged co-operation and recognition of mutual interest.

These individual resolutions were amalgamated and expanded into the Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (Casualty Investigation Code), adopted by Res. MSC 255(84) in May 2008. While it specifies some mandatory requirements, it also recognizes the variations in international and national laws in relation to the investigation of marine casualties and marine incidents. The Code has been designed to facilitate objective marine safety investigations for the benefit of flag States, coastal States, organizations and the shipping industry in general.

Ladies and Gentlemen, Distinguished participants,
The sovereignty of a coastal State extends beyond its land and inland waters to the extent of its territorial sea, giving its jurisdiction and an inherent right to investigate marine casualties and marine incidents connected with its territory. Most national Administrations have legal provisions to cover the investigation of a shipping incident within its inland waters and territorial sea, regardless of the flag.

In this context, the IMO adopted, in December 2005, the "Guidelines on Fair Treatment of Seafarers in the Event of a Maritime Accident" through resolution A.987(24), which was promulgated by the IMO and the ILO on 1 July 2006.

We now ask ourselves: What is the way forward?

The way forward for the marine accident and casualty investigation presents many challenges and again it would require the continued commitment and willingness of Member States to deliver their share of responsibilities. A thorough look at the documentation for this matter lead one to think of a daunting task ahead, mired with complexities, extensive procedures and not least both human and financial resource implications. However, proper planning and legislation would minimize any initial difficulties and negative impact that could possibly appear.

The Secretary-General of IMO, in his opening address of MSC 84, where the last version of the Casualty Investigation Code was adopted, reiterated the importance and timeless need on establishing a robust mandatory framework for the conduct of investigations into casualty and the reporting of their findings, preferably through the collaboration among substantially interested States, while being respectful of human rights, should guide your decision.

I say again that you have a major role to play in your countries. Please at the end of the course do not go back to your in-trays which I am sure would be overflowing with work and shove this course under the shelves. We expect to see you, in the near future, participate within the casualty investigation working groups on behalf of your governments at every FSI Sub-committee meeting, as well as to become part of the corresponding group that work on intercessional basis dealing with the analysis of different casualties.

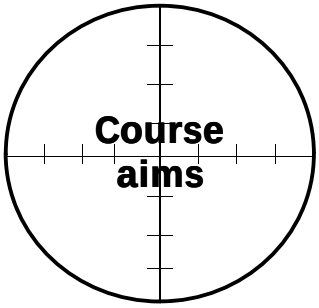
During these two weeks, you will benefit from the knowledge and experience of Mr. Kit Filor (Australia) and Mr. Marcel Ayeko (Canada). They kindly and competently will lead you through the course material and I hope this vision will inspire you to success and I humbly request that you apply as much of your time to the course so that your future work associated with this matter will bring the success we all desire.

Thank you.

_____

International Maritime Organization

Marine Accident and Incident Investigation Course



- **to introduce the idea of a systemic safety investigation**
- **to provide participants with a starting 'kit' to help investigate accidents**

COURSE FOCUS

- **Conducting a marine casualty investigation**
- **Evidence (including interviewing)**
- **Analysis, and**
- **Reporting**

What is an accident?

"The word '*accident*' is not a technical legal term with a clearly defined meaning. Speaking generally, . . . , an accident means any unintended or unexpected occurrence which produces hurt or loss.

Lord Lindley (1903)

ACCIDENT

" . . . it seems to me that an '*accident*' in this context is perfectly capable of being applied to an untoward occurrence which has physical results, notwithstanding that one event in the chain of events that led to the untoward consequence was a deliberate act on the part of some mischievous person."

Chief Constable of West Midlands Police v Billingham [1979]

2 AllER 182 at 186, per Bridge LJ

A steward brining a tray of coffee to the ship's office trips over the storm sill and drops the tray.

Is this an accident?

Would you use resources to investigate it?

Same steward – same tray – same office – same storm sill, only this time the coffee spills over the cargo computer and knocks it out. The mate has to do all the cargo calculations by 'long hand'. The ship sails and capsizes.

Is this an accident?

Would you use resources to investigate it?

What is the difference?

Two levels of investigation

Individual operator/owner

Understand the context in which the accident occurred in terms of individual responsibility and relevant regulations.

Involving an organisation/company

Understand the context and organisational environment in which the accident occurred and the different levels of responsibility.

Potential weaknesses in the regulatory framework.

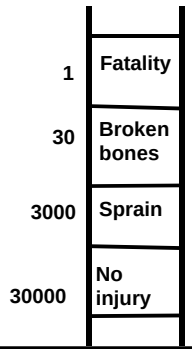
Individual Accidents

The individual or work group likely to be both the agent and victim of the accident.

Organisational Accidents

Likely to be disastrous, affecting not only those immediately involved but also assets and people outside the immediate work group.

An unsecured ladder moves



How do accidents occur?

An accident happens when an error is made in the presence of a hazard.

People work in conditions that increase the risk of error. These are known as 'error inducing properties.'

Concept of error inducing conditions

24 Hr operation – shift work
Technological change
Environmental factors
The number of players
Differing equipment
Lack of uniform operating environment

Disrupted domestic life
Lack of social interaction
Equipment inertia
Monotony
Stress levels

- **Immense diversity and complexity**
- **Rapid technological change**
- **Ships are 'slow' systems**
- **A dynamic environment - weather, tides**
- **The need for continuous training.**
- **Complex communication**

The Human Element

- **UK Health and Safety Executive – 80% of work place accidents in the UK**
- **ICAO 75% of aviation accidents**
- **UK Department of Transport 90% of shipping collision and groundings**

Is this the full story?

Humans operate, design, maintain, regulate transport systems.

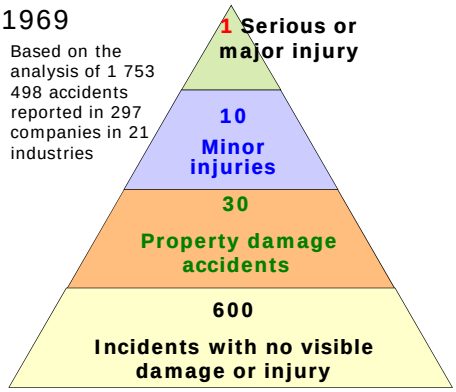
Having an appreciation of human factors is a critical part of any investigation into transport accidents.

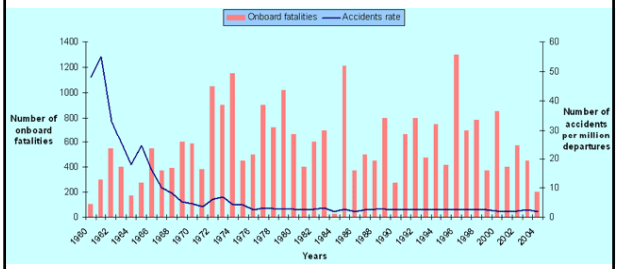
SHIPS ARE NAVIGATED WITH FAR TOO RECKLESS A CONFIDENCE IN THE PERSONAL INSTINCT AND SKILL OF THOSE IN COMMAND AND THEIR ABILITY TO GET OUT OF A SCRAPE IN TIME. METHODICAL SYSTEMS AND MECHANICAL MEANS OF ENSURING ACCURACY ARE FAR TOO MUCH NEGLECTED.

From a memorandum from the Great Eastern Company, circa 1850

Frank Bird
1969

Based on the analysis of 1 753 498 accidents reported in 297 companies in 21 industries





Six basic requirements for safe operation

1. Hazards must be recognised and understood.
2. Equipment must be 'fit for purpose'.
3. The systems and procedures must maintain programme integrity.
4. Staff should be fully trained and competent to do their job.
5. There must be plans for foreseeable emergencies.
6. There should be a system to monitor performance – effective audit.

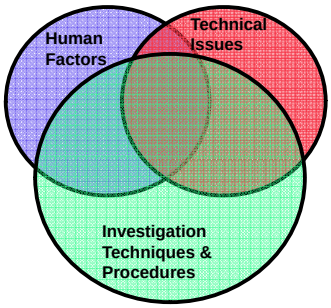
Six tests of Safe Operation

1. **Were the risk factors identified or identifiable?**
2. **Was the equipment fit for purpose?**
3. **Were the systems and procedures effective to maintain safe operation?**
4. **Were the individuals involved fit, competent and effective?**
5. **Were defences and emergency procedures effective?**
6. **Was there a management system in place to monitor performance?**

What is an investigation?

An exercise in critical thinking to systematically inquire or search for answers.

Elements of an Investigation



Critical thinking

1. uses evidence skillfully and impartially
2. organise thoughts concisely and coherently
3. distinguishes between logically valid and invalid inferences
4. suspends judgment in the absence of sufficient evidence
5. differentiates between reasoning and rationalising
6. uses appropriate intellectual disciplines to arrive at conclusions
7. habitually questions own views and how they were formulated
8. differentiates between the validity of belief and intensity of belief
9. recognises the limitations of one's own understanding
10. recognises the risk of bias clouding judgement

Never waste (a good?) accident!!

Presumption of Negligence

Where a ship grounds or sustains contact damage, the assumption is that the accident must have been caused by the person or persons operating the ship as a fixed object cannot move and a properly navigated ship, in the normal course of business, do not strike fixed object or run aground.

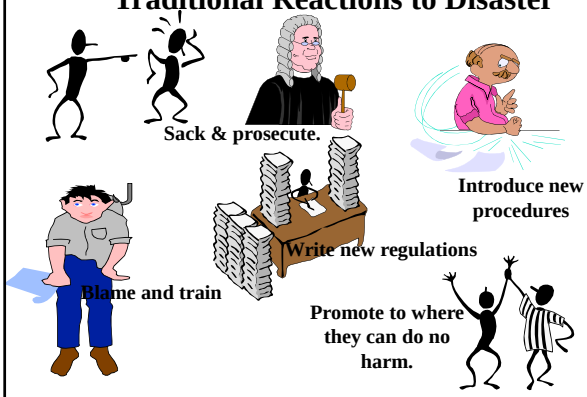
This presumption can be overcome if the mariner can show that he/she was without fault.

The presumption of negligence places on the investigator a very real duty to ensure that every aspect of a casualty are considered and the actions of the mariner(s) properly taken into account.

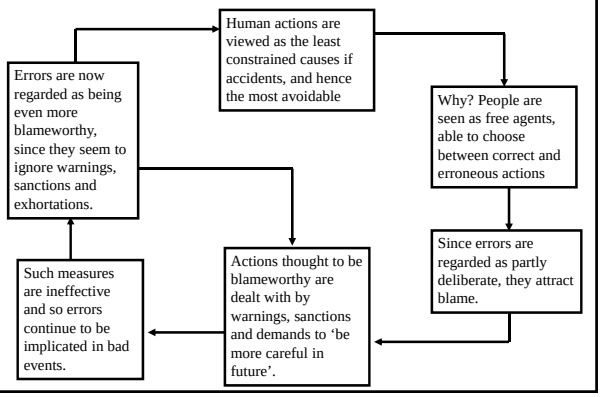
The idea of personal responsibility is deeply rooted in western cultures. The occurrence of man-made disaster leads inevitably to a search for human culprits. Given the ease with which the contributing human failures can subsequently be identified, such scapegoats are not hard to find.

Reason, J., 1990, *Human Error*, p.216

Traditional Reactions to Disaster



Blame cycle



Do not allow accident investigations conducted for the enforcement of laws or regulations, or for determining liability to interfere with accident investigations conducted for safety purposes. We have been conducting the former for so long they tend to get priority even though they produce few safety improvements.

Captain Dominic Callichio
USCG,
Investigation and Identification

Reference material.

The IMO Marine Accident and Incident Investigation Training Manual

IMO Resolution A. 884 (21)

Amendments to the Code for the Investigation of Marine Casualties and Incidents

The World Commercial Shipping Fleet

(Source UNCTAD 2008 *Review of Maritime Transport*)

More than 80 per cent of international trade is carried by sea.

Shipping is directly affected by the world economy and is subject to *boom and bust* cycles.

Oil tankers and bulk carriers together represent 71.5 % of total merchant fleet tonnage. (UNCTAD)

World container fleet 13.3 million 20 foot TEUs

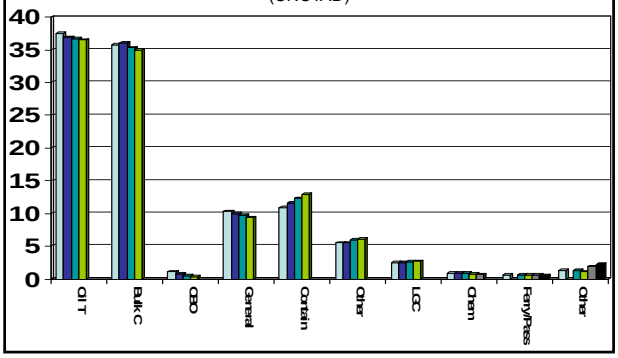
Chinese ports accounted for 28.4% of total world container port throughput.

Average age of the world fleet 11.8 years

The World Commercial Shipping Fleet

By percentage of principle ship-types 2005-2008 in deadweight

(UNCTAD)

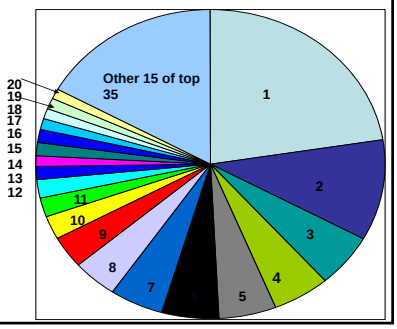


The World Commercial Shipping Fleet

1. Panama
2. Liberia
3. Greece
4. Bahamas
5. Marshall Islands
6. Hong Kong, China
7. Singapore
8. Malta
9. China
10. Cyprus
11. Rep of Korea
12. Norway (NIS)
13. India
14. Germany
15. Japan
16. Isle of Man
17. UK
18. Italy
19. USA
20. Antigua & Barbuda

Share in D'wt Tonnes of top 35 flags of registration

(UNCTAD)



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13. India
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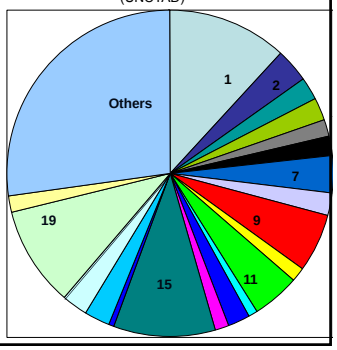
16. Isle of Man
17. UK
18. Italy
19. USA
20. Antigua & Barbuda

Share in number of registered ships of top 35 flags of registration

(UNCTAD)



The World Commercial Shipping Fleet

Top 20 national fleet in numbers of registered vessels 2008

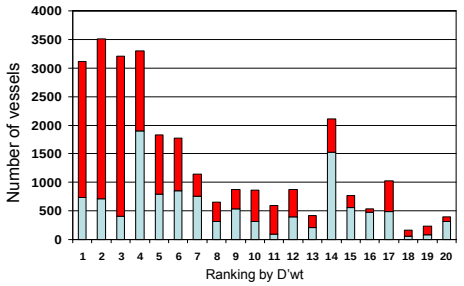
(UNCTAD)

20 Malaysia	1.18	1. Panama	7.81
19 HK China	1.27	**2. Japan**	**6.61**
18 Netherlands	1.28	3. USA	6.58
17 Turkey	1.28	4. Indonesia	4.59
16 India	1.46	5. China	3.91
15 Bahamas	1.46	6. Russ Fed	3.55
14 Malta	1.48	7. R of Korea	3.04
13 Greece	1.52		
12 Italy	1.60		
11 UK	1.67		
10 Philippines	1.82		
9. Liberia	2.23		
8. Singapore	2.3		

The World Commercial Shipping Fleet

"Controlled Fleets"

(UNCTAD)



1.Greece
2.Japan
3.Germany
4.China
5.Norway
6.USA
7.R of Korea
8.Hong Kong, China
9.Singapore
10.Denmark
11.Taiwan
12.UK
13.Canada
14.Russia Fed
15.Italy
16.India
17.Turkey
18.Saudi Arabia
19.Belgium
20.Malaysia

- What is IMO?
- What IMO does?
- How is IMO organized?

and

- IMO on Maritime Casualties

IMO

Carlos F. Ormaechea
Technical Officer, TCIC, MSD
International Maritime Organization

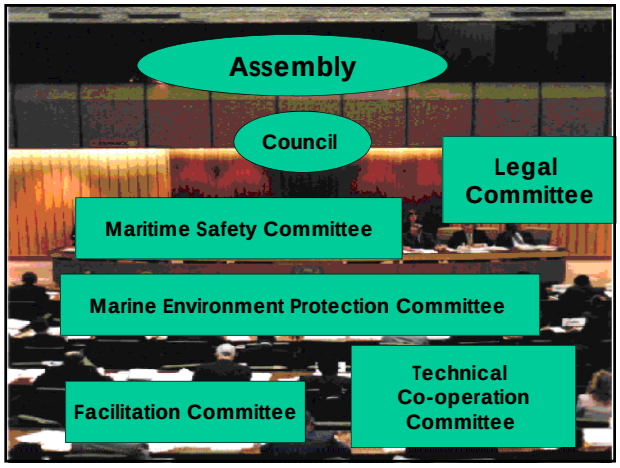
Suva, Fiji August 2009

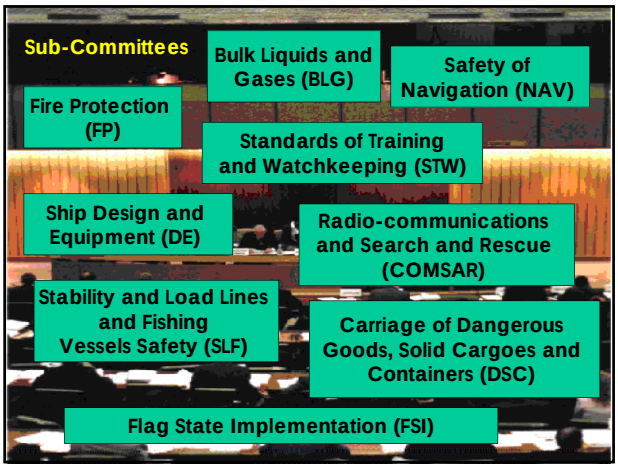
IMO

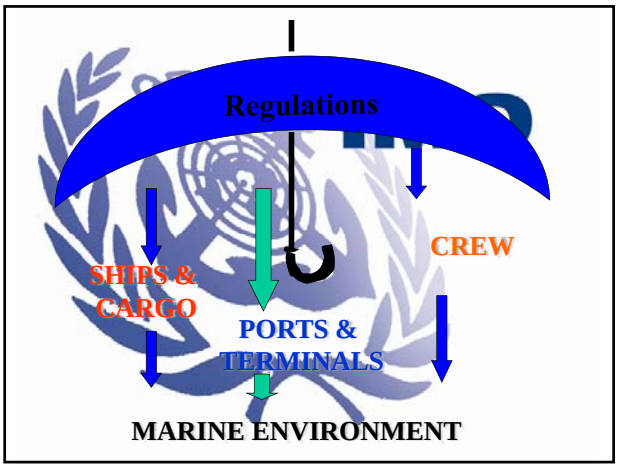
What is IMO ?

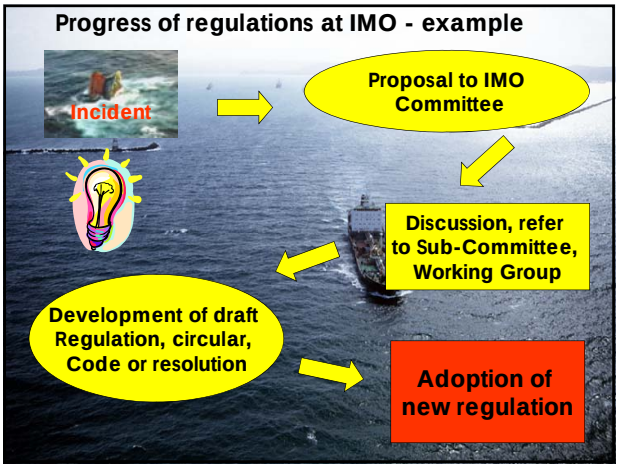
IMO

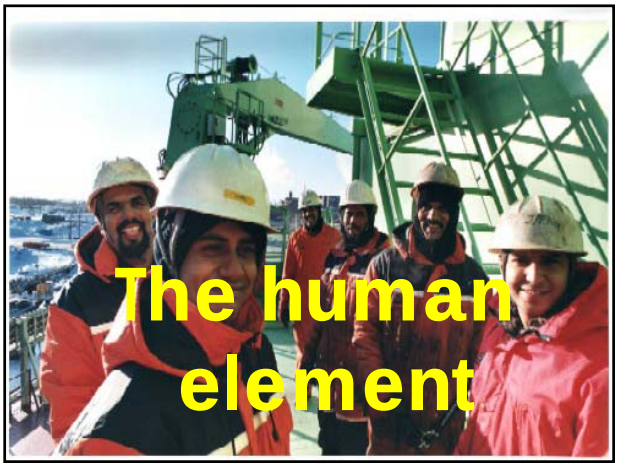
What IMO does?
and
How is IMO organized?




Sub-Committees
Bulk Liquids and Gases (BLG)
Safety of Navigation (NAV)
Fire Protection (FP)
Standards of Training and Watchkeeping (STW)
Ship Design and Equipment (DE)
Radio-communications and Search and Rescue (COMSAR)
Stability and Load Lines and Fishing Vessels Safety (SLF)
Carriage of Dangerous Goods, Solid Cargoes and Containers (DSC)
Flag State Implementation (FSI)


Regulations
SHIPS & CARGO
CREW
PORTS & TERMINALS
MARINE ENVIRONMENT


Progress of regulations at IMO - example
Incident
Proposal to IMO Committee
Discussion, refer to Sub-Committee, Working Group
Development of draft Regulation, circular, Code or resolution
Adoption of new regulation


The human element


Technical Coperation
Training
WMU
IMLI


MAERSK LINE


SOLAS, MARPOL,
STCW, SAR,
Load Lines, London Convention,
Safe Containers,
Tonnage, COLREGS,
OPRC, FUND,
LLMC, Salvage,
ISM Code, IMDG Code
IBC Code, HSC Code,
INF Code, ……..

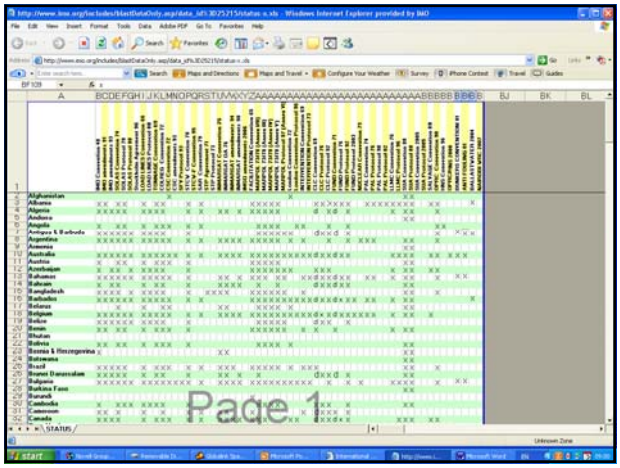

SOLAS chapter III
Life-saving
appliances and
arrangements

IMO Secretariat include the following Divisions:

- Maritime Safety,
- Marine Environment,
- Technical Co-operation,
- Legal,
- Administrations, and
- Conferences.

Some responsibilities of IMO, through the Maritime Sasfety Division:

- Flag State Implementation (FSI),
- Marine Casualties,
- GISIS, and
- Others: Port State Control (PSC), Cargos, Navigation, Security, SAR, Facilitation, etc.



Activities of IMO on Casualty Investigation:

- Adoption of regulations,
- Marine Safety Investigation Reports,
- FSI Sub-Commeette meetings,
- Correspondence Group on Casualty Analysis, and
- Working Group on Casualty Analysis.

Activities of IMO on Casualty Investigation:

Adoption of regulations:

- Res.A.173 (ES.IV), adopted in November 1968,
- Res.A849(20) amended by res. A.884(21),
- Res. MSC.255(84) and 257(84),
- MSC-MEPC.3/Circ.2, and
- MSC-MEPC.3/Circ.3

Activities of IMO on Casualty Investigation:

Marine Safety Investigation Reports:

- Definitions, paragraph 2.12, and
- Mandatory part of the Code, Chapter 14.

Submision of Reports:

- GISIS, or
- Hard copy.

Activities of IMO on Casualty Investigation:

FSI Sub-Committee meetings:

- Chapter 14 (Code): information of the reports should be reviewed in order to prevent such accidents in the future.

Correspondence Group on Casualty Analysis, and
Working Group on Casualty Analysis.

TOR for Correspondence Group on Casualty Analysis :

.1 based on the information received from Administrations on investigations into casualties, to conduct a review of the relevant casualty reports referred to the group by the Secretariat and prepare draft lessons learned for presentation to seafarers;

.2 to analyse the investigation report on the fire on the fishing factory vessel **Hercules** (Incident: C0006872);

.3 to analyse the final investigation report on the fire on board the ro-ro cargo ship **Und Adriyatik** (Incident: C0007200);

.4 to identify safety issues that need further consideration; and

.5 to submit a report to FSI 18.

TOR for Working Group on Casualty Analysis 1:

.1 confirm or otherwise the findings of the correspondence group based on the analysis of individual casualty investigation reports (FSI 18/6 and FSI 18/6/1 and GISIS), for the Sub-Committee's approval and authorization of their release to the public on GISIS;

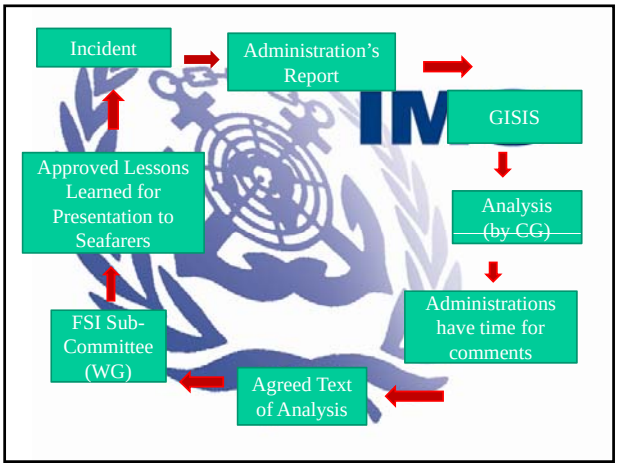
.2 confirm or otherwise the draft text of lessons learned for presentation to seafarers (FSI 18/6), for the Sub-Committee's approval and authorization of release on the IMO website in accordance with agreed procedure;

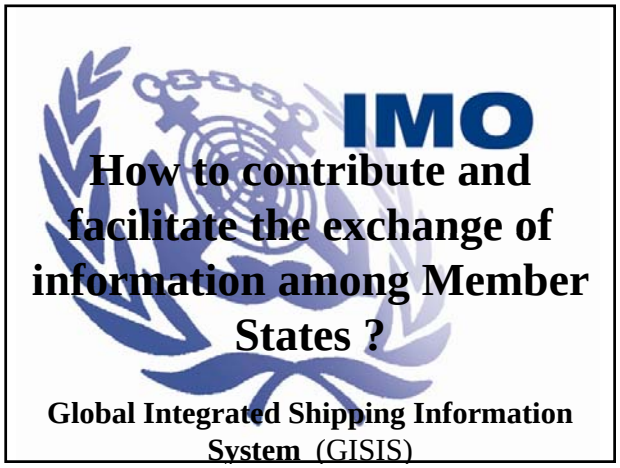
TOR for Working Group on Casualty Analysis 2:

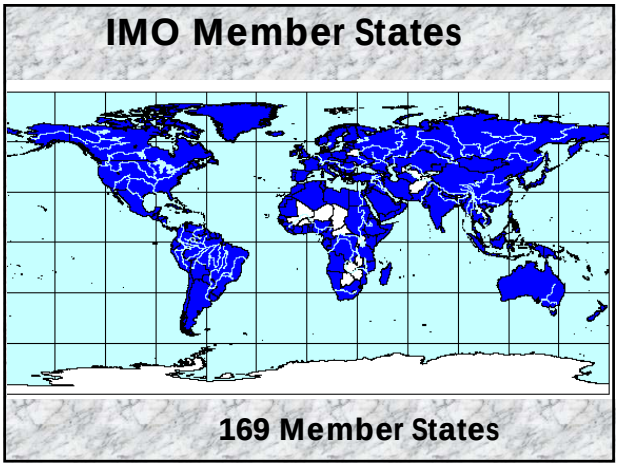
.3 consider and advise to refer to the relevant Committees and sub-committees those reports reviewed by the analysts and considered by the working group and which are of interest to them. In doing so, the working group should submit supporting information derived from the casualty analysis procedure used for the development of recommendations for consideration by the Committees and Sub-Committees (FSI 18/6);

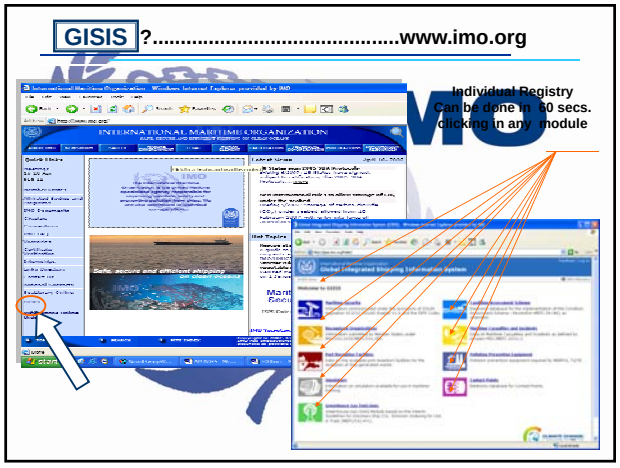
.4 advise on the re-establishment of the Correspondence Group on Casualty Analysis and, if so, prepare draft terms of reference for that group; and

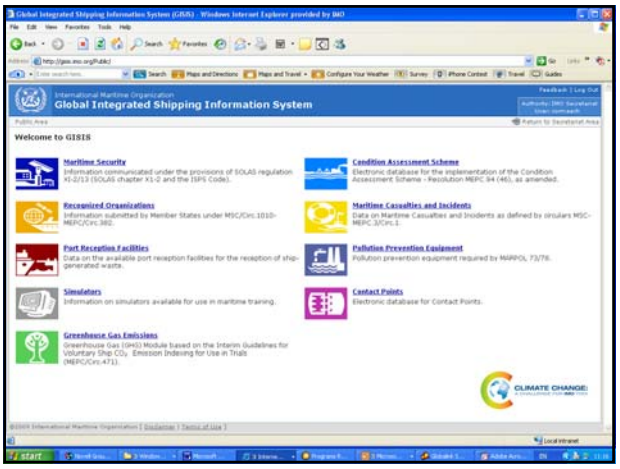
.5 present a written report to plenary.

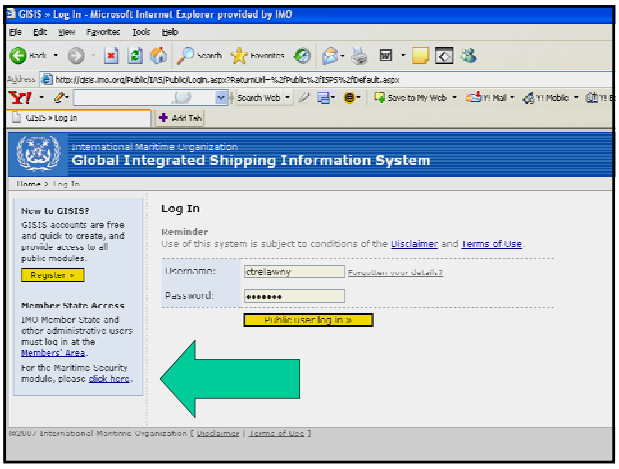


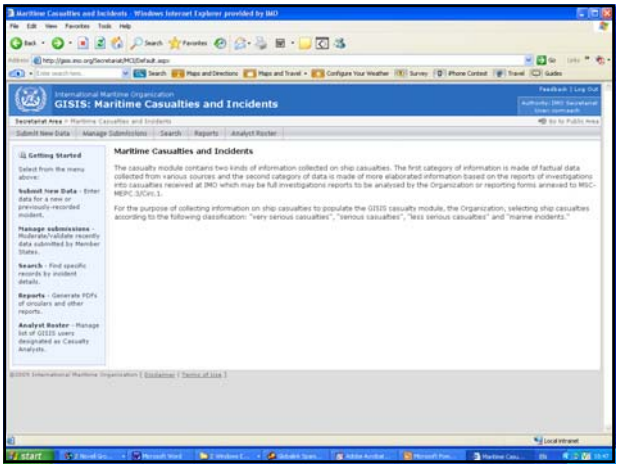


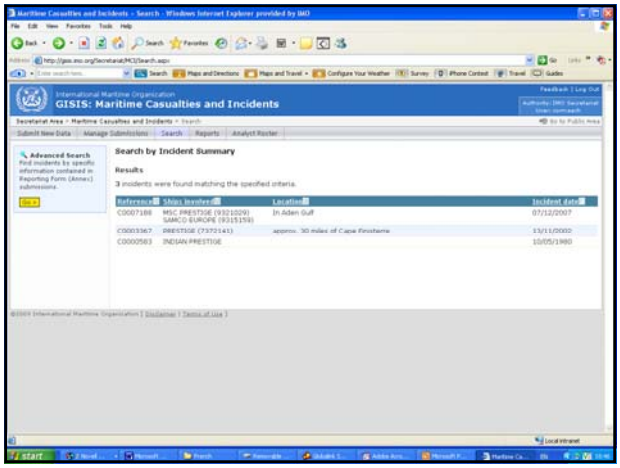


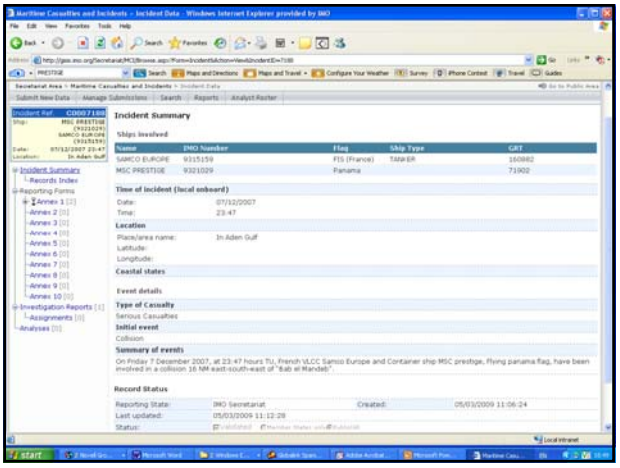



Global Integrated Shipping Information System
Welcome to GISIS
Maritime Security
Condition Assessment Scheme
Recognized Organizations
Maritime Casualties and Incidents
Port Reception Facilities
Pollution Prevention Equipment
Simulators
Contact Points
Greenhouse Gas Emissions
CLIMATE CHANGE


GISIS > Log In - Microsoft Internet Explorer provided by IMO
International Maritime Organization
Global Integrated Shipping Information System
New to GISIS?
Register
Member State Access
Log In
Reminder
Username:
Password:


GISIS: Maritime Casualties and Incidents
Maritime Casualties and Incidents


GISIS: Maritime Casualties and Incidents
Search by Incident Summary


Incident Summary


www.imo.org
IMO -
Safe, secure and
efficient shipping on
clean oceans


IMO
Questions ?

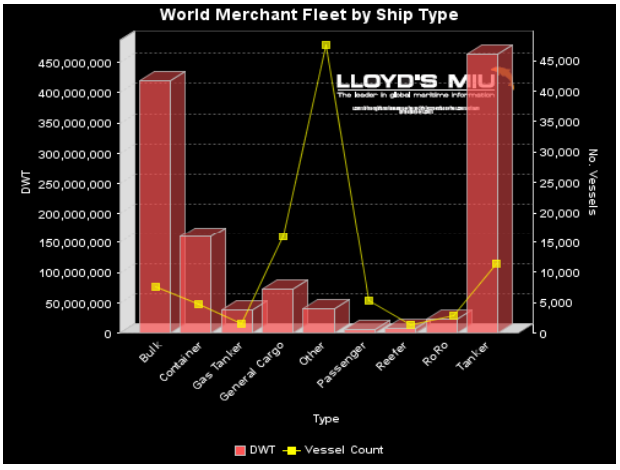
International Maritime Industry

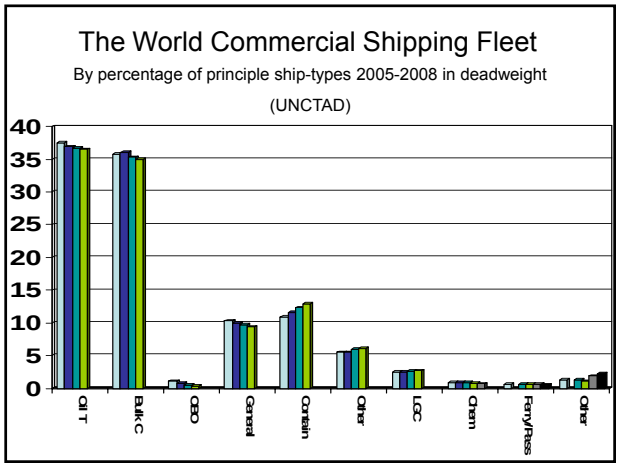
&

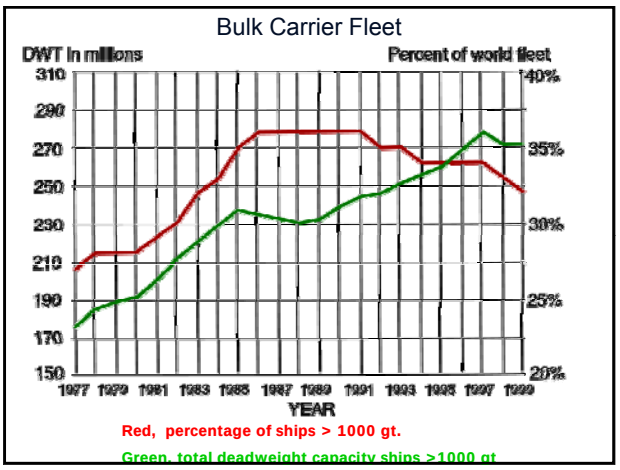
Public Perception of Safety at Sea

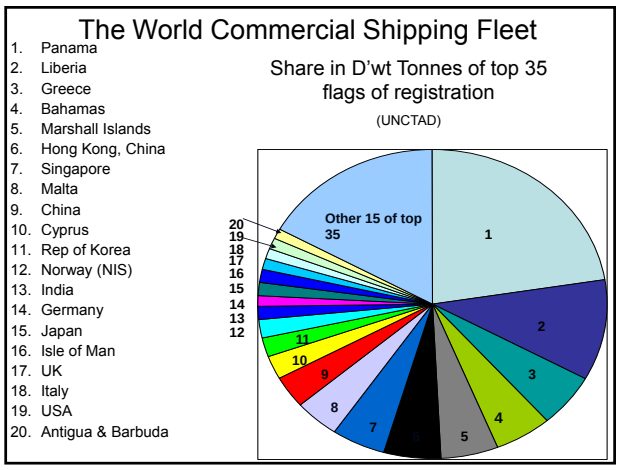
This session examines:

- the structure of the world fleet in terms of type and nationality
- Public perception of ship safety
- Accident trends
- IMOs role in addressing ship safety







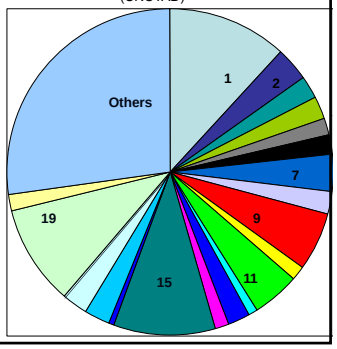


The World Commercial Shipping Fleet

1. Panama
2. Liberia
3. Greece
4. Bahamas
5. Marshall Islands
6. Hong Kong, China
7. Singapore
8. Malta
9. China
10. Cyprus
11. Rep of Korea
12. Norway (NIS)
13. India
14. Germany
15. Japan
16. Isle of Man
17. UK
18. Italy
19. USA
20. Antigua & Barbuda

Share in number of registered ships of top 35 flags of registration

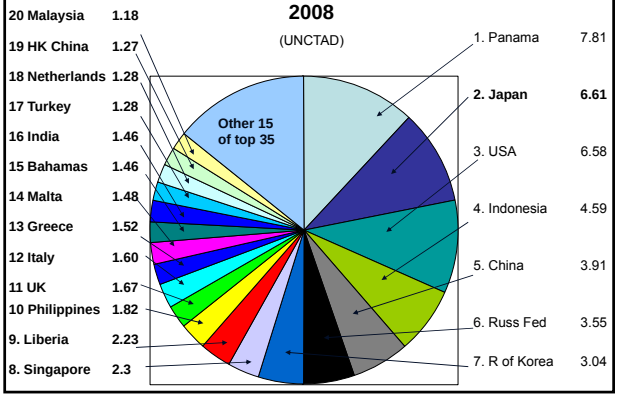
(UNCTAD)



The World Commercial Shipping Fleet

Top 20 national fleet in numbers of registered vessels 2008

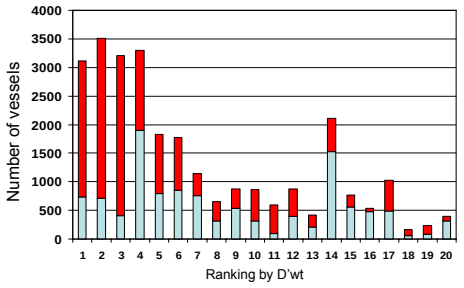
(UNCTAD)



The World Commercial Shipping Fleet

"Controlled Fleets"

(UNCTAD)

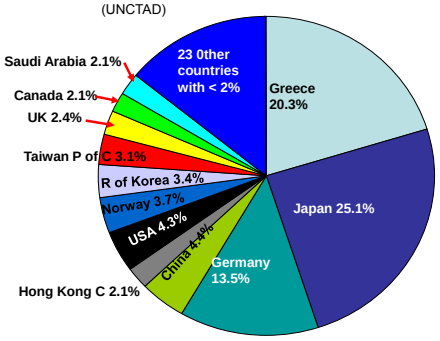


1.Greece
2.Japan
3.Germany
4.China
5.Norway
6.USA
7.R of Korea
8.Hong Kong, China
9.Singapore
10.Denmark
11.Taiwan
12.UK
13.Canada
14.Russia Fed
15.Italy
16.India
17.Turkey
18.Saudi Arabia
19.Belgium
20.Malaysia

The World Commercial Shipping Fleet

Beneficial States percentage of ships under International Registries tonnes d'wt

(UNCTAD)



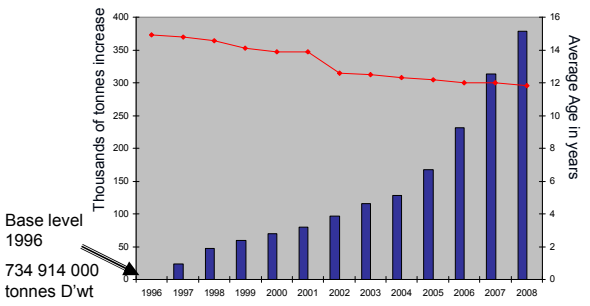
Note:

Cyprus nationals own 10.1 % of Cyprus flag ships or 1.2% of all ships in International registries

The World Commercial Shipping Fleet

(UNCTAD)

World Tonnage growth and fleet average age 1996-2008



International Association of Classification Societies

American Bureau of Shipping (ABS)

Bureau Veritas (BV)

China Classification Society (CCS)

Germanischer Lloyd (GL)

Korean Registry (KR)

Lloyd's Register (LR)

Nippon Kaiji Kyokai (NK)

Registro Italiano Navale (RINA)

Russian Maritime Register of Shipping (RS)

Associate Member
Indian Register of Shipping (RS)

The World Commercial Shipping Fleet

(Source UNCTAD 2008 *Review of Maritime Transport*)

More than 80 per cent of international trade is carried by sea.

Shipping is directly affected by the world economy and is subject to *boom and bust* cycles.

Oil tankers and bulk carriers together represent 71.5 % of total merchant fleet tonnage. (UNCTAD)

World container fleet 13.3 million 20 foot TEUs

Chinese ports accounted for 28.4% of total world container port throughput.

Average age of the world fleet in 2008 - 11.8 years

Public Perception?

Environment

NOx

Pollution

Passenger Safety

1969	**Marpessa 206,850 dwt**	**12 December**
	Mactra 208,560 dwt	**29 December**
	Kong Haakon VII 219,000 dwt	**30 December**

IMO Standards

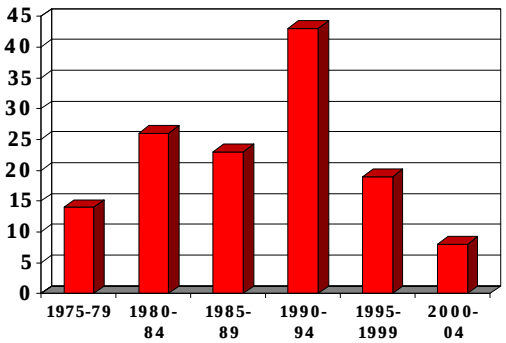
Inert gas

Crude oil washing

Double hull tankers

STCW Tanker endorsement

Number of bulk carriers >10000gt lost from structural or hatch failure or classed as missing

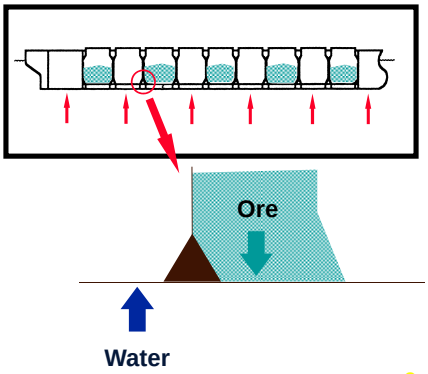


Bulk Carrier Losses

In 1990, 20 bulk carriers sank with the loss of 94 lives.

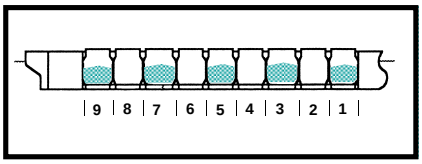
In 1991, 24 bulk carriers sank with the loss of 154 lives.

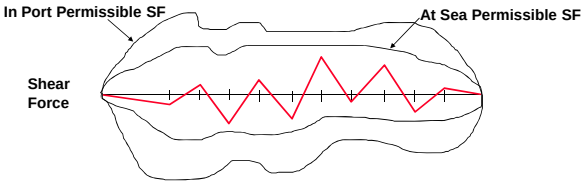
Shear Force



Courtesy of ABS

Shear Force at Full Load

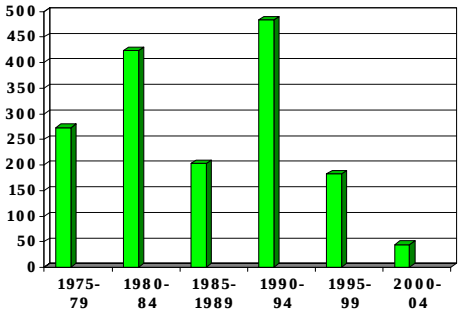




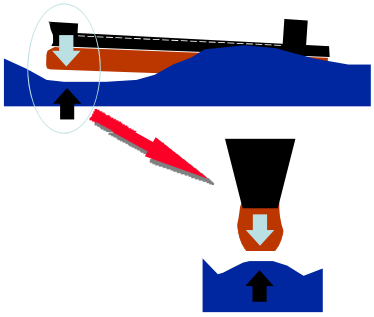
In Port and at Sea Permissible Shear Force

Courtesy of ABS

Lives lost – Bulk Carriers . 10000gt aboard vessels lost from structural or hatch failure or from ships listed as missing

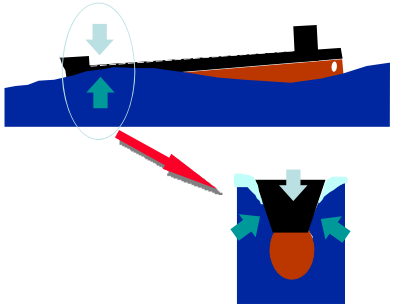


Bottom Slamming Impact Load



Courtesy of ABS

Bow Flare Impact



Courtesy of ABS

A study by Lloyd's Register discovered that ".operational damage was accepted as the norm by the operators of bulkers and OBO's; second there was little awareness as to the significance of this damage and its likely consequences of the ship under adverse operating conditions."

This might be put down to thoughtlessness, but that excuse cannot be made for shipowners who purposely move their vessels from one trade to another – to escape vigilant port State control inspections. That is what happened when Australia, alarmed by a number of accidents involving elderly bulk carriers visiting its ports, tightened its port control procedures.

The result was a rapid switch of tonnage from the Pacific to the Atlantic where inspections were apparently not so rigorous. According to Lloyd's list " in the first nine months of 1989 there were nine voyages with Capsize vessels aged 20 year or more in the trans Atlantic trades. In the corresponding 1993 period that figure had increased to 152."

It is difficult to avoid the conclusion that the owners of at least some . . .

From Focus on IMO September 1999 – IMO and the Safety of Bulk Carriers

IMO introduced new and enhanced measures to address the dangers in the bulk carrier trade, these included but are not confined to:

Improved implementation of existing regulations

FSI Sub-Committee

Regional Port State Control

Better exchange of information between administrations

Enhanced inspections @ survey

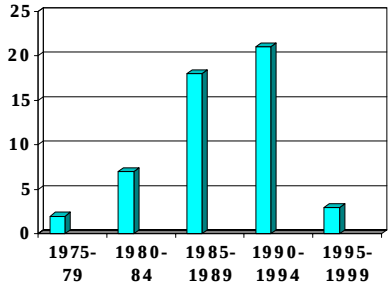
Concept of 'special surveys for tankers and bulk carriers

Cargo handling

Proper planning of cargo operations

SOLAS new Chapter XII

Cruise and Ferry ship losses



Ro-Ro Problem Areas?

On 6 March 1987 the British flag ferry *Herald of Free Enterprise* foundered and sank of Zeebrugge with 193 fatalities.

As a direct result, in response to a UK request, a series of MSC meetings were held resulting in a series of amendments to SOLAS Chapter II-1.

1988 (April) Amendments
1988 (October) Amendments
1989 (April) Amendments
1990 (May) Amendments
1991 (May) Amendments
1992 (April) Amendments
1992 (December) Amendments
1994 (May) Amendments

On 7 April 1990 the Bahamian ferry *Scandinavian Star* caught fire in the Baltic with 165 fatalities.

April 1992 amendments made to SOLAS Chapter II-2

Chapter IX - ISM

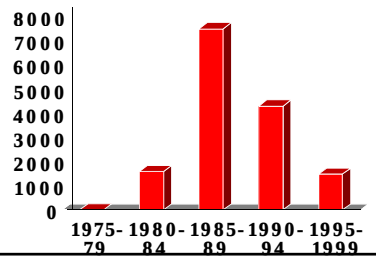
On 28 September 1994 the Estonian ferry *Estonia* capsized and sank with the loss of 852 lives

Res. A.793(19) Strength and securing locking arrangements of shell doors on . . .

Res. A.794 (19) Survey and Inspection of ro-ro passenger ships

Res. A795 (19) Navigational guidance and information scheme for ro-ro ferry operations.

Fatalities from cruise and ferry ship casualties



With SOLAS standards and Chapter IX of SOLAS the international shipping community has the tools to enhance marine safety.

However the potential weakness remains in:

- implementation
- human factors

INVESTIGATIONS

Learning Objectives

The objective is for the participants to understand :

- Different forms of investigations & their objectives.
- The need for safety investigations
- Essential Legal framework to support safety investigations
- The role of the investigator

INVESTIGATIONS

Definition:

A process of systematic search to uncover the WHO, WHAT, WHEN, WHERE, WHY & HOW of a mishap.

The thoroughness, scope, depth, and focus of the investigation should be directly proportional to the degree of mishap or the magnitude of "loss".

Some basic definitions.

Safety: State in which the risk of harm (to persons) or damage is limited to an acceptable level.

Hazard: any situation or condition which has a potential to cause adverse consequences; (e.g injury or loss of life, property damage, and/or environmental damage).

Risk: Probability during a period of activity that a hazard will result in an accident with definable consequences. (The degree of harm associated with a hazard in a given period of time.)

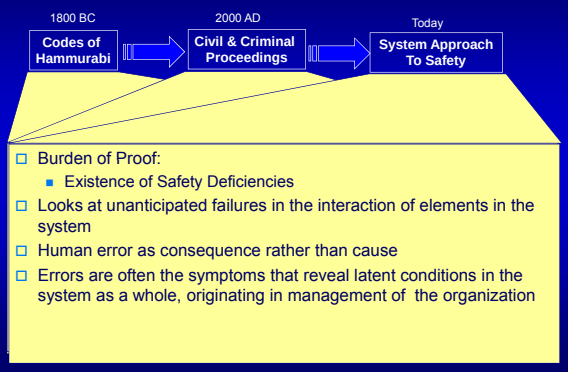
Cause: That which produces an effect, or give rise to an action. (Immediate, Contributing, Underlying or Root Cause.)

Why investigate accidents?

To establish WHAT happened and WHY it happened, so that the causal factors are fully understood and action can be taken to:

- prevent such an accident from happening again;
- ensure standards of safety and competence are maintained
- that reckless and irresponsible behaviour is punished.

Progress in Accident Prevention Concepts



What are the different types of investigation?

Criminal investigation

Civil litigation

Coronial Inquest

Competence (Administrative)

Safety investigation

Are the purposes of each type of investigation the same?

Proof of Guilt vs Root Cause

Criminal, civil, disciplinary investigations may be limited in scope, only addressing causal factors that meet the requirements of their legislation or liability.

They do not usually address root cause, or examine the organisational factors.

Types of investigations

- Criminal investigation
  - concerned with establishing and maintaining social order and protecting the community
  - Those who break these laws can be prosecuted. If they are found guilty, they can then be fined or sent to prison, or both.
  - presumes that each individual is innocent until proven guilty.
  - To prove the guilt beyond reasonable doubt.

Crime – an illegal act – an offence punishable by law.

Criminal Investigation

A criminal offence under common law requires:

Actus reus: a guilty act – an intentional act –; and
Mens rea: a guilty mind – an intentional wrongdoing

Criminal Investigation

In assessing criminality the following are considerations:

- Purpose or intention
- Oblique intention
- Knowingly
- Recklessness
- Negligence (reasonable man test)

Criminal Investigation

- Conducted by the police or other law enforcement agency .
- Evidence presented to a judge or magistrate in court.
- Burden of proof, usually beyond reasonable doubt.
- Investigation focuses on proving the breach of the law.
- Ignorance of the law is no defence
- Punishable by imprisonment or by fine

Civil Court Proceedings

- To seek individual redress for a wrong or loss
- Evidence presented in court before a judge or before an arbitrator
- Must prove the case on the balance of probabilities

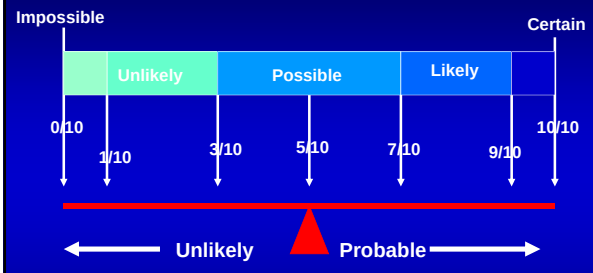
Civil Court Proceedings

Burden of proof - Preponderance of evidences.

- This degree of proof is sometimes called presenting a prima facie case, or "crossing the 51 percent line", because the plaintiff must outprove the defendant by more than half the evidence.

Investigation conducted by interested parties to establish or minimise liability.

Civil Court Proceedings



Balance of Probabilities

Disciplinary or hearings into competence

skill

The ability to perform consistently at a given level of qualification.

Disciplinary or hearings into competence

Evidence to assess whether or not:

- a person acted competently.
- a person was negligent.
- a person was professionally reckless.

Key elements:

- Element of Duty.
- Standard of Care.

Summing Up : What are the Differences?

Criminal – to prove a breach of the law beyond reasonable doubt. Once sufficient proof is obtained no need to go further.

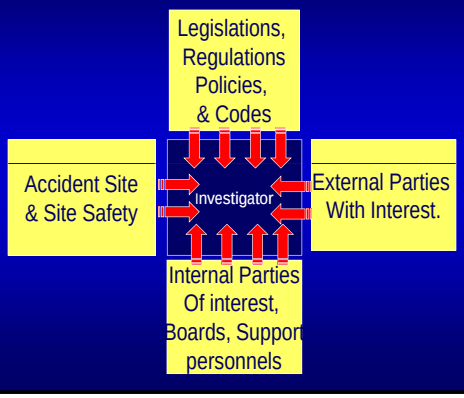
Coronial - to find the cause of death (or fire) and make recommendations-

Civil – To demonstrate that on the balance of probabilities a party is blameworthy and liable to compensate injured parties.

Competence – To assess whether an individual performed at an acceptable level of skill and ability .

Elements of an Investigation

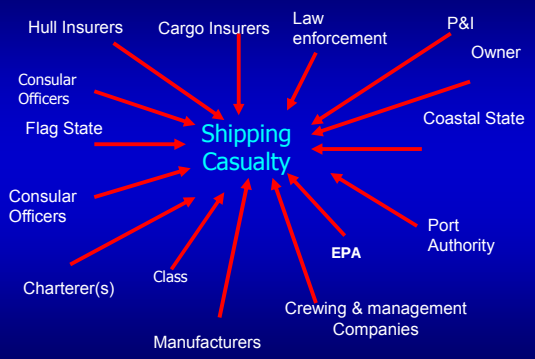
Parties of Interest



Who has an interest when a ship is involved in an accident?

List the parties

Parties with Interest in Investigation



Legislative Support: Essential to Enable Safety Investigations

All administrations have a ***criminal*** law code.

All administrations have a ***civil*** law code.

All administrations should have a process for reviewing ***competency*** as required under STCW.

Not all administrations have legislation to enable proper ***safety*** investigations.

Considerations for Legal Framework

- Maritime Safety Committee ***Resolution 255 (84)*** should be the catalyst for administrations adopting the principles of the Resolution.
- Any investigation must be governed by legal requirements.
  - Detach from criminal and civil investigations
  - Independence from Regulatory Agencies
  - Procedural Fairness
- All investigators must act within the legal framework.
  - Power of an Investigator

Considerations for Legal Framework

- Legislative object - to advance transportation safety.
- No finding of the investigation shall be construed as assigning fault or determining civil or criminal liability.
- The findings of the investigation are not binding on the parties to any legal, disciplinary or other proceedings.
- investigators are not or compellable to appear as witnesses in any proceedings
- Witness statements are privileged and shall be protected.

Power of an Investigator

Consistent with the legislative provisions of the land, Investigators must have power to:

- Search and seize
- Test things seized
- Exclude persons from particular areas
- Require the person to produce the information or to attend before the investigator
- Require the person to submit to a medical examination
- Require autopsy or medical exam

Traditional Approach to Marine investigations

Traditional approach has been:

A technical investigation to determine if a higher level inquiry is required (Preliminary Inquiry)

An inquisitorial court system (Formal investigation –UK: Marine Courts –Japan, R of Korea, Germany) These 'courts' made findings and dealt with issues of competence (often as a separate hearing)

The current move is towards an experts technical investigation and public report. Disciplinary and issues of competence are dealt with administratively.

These issues will be examined in more detail later in the course.

Investigations involving Human Factors

Res. 884(21)

"...Human error is a major contributory cause of 90% of accidents, 70% of which could have been prevented by management action."

HSE Accident Prevention Advisory Unit, 1995 (not much has changed since.)

Challenge is to find out why their assessments and actions made sense to them at the time. It is not to say what people failed to do. It is to understand why they did what they did, under the circumstance surrounded them at the time. (i.e tools, tasks and environment they were in at the time of the accident.).

IMO – No Blame culture of Safety Investigations

The objective is to explain behaviour and performance: not to blame, excuse or exonerate.

- Goal is to explain and understand the human behaviour leading to a particular occurrence
- Understanding the internal and external conditions which led to the behaviour allows us to devise changes to reduce the probability or consequences of repeating the occurrence

Key Characteristics of safety investigations

- The purpose must be clear – getting away from a blame culture and embracing a just culture.
- Focused on establishing root cause.
- As a minimum have equal status with criminal or other investigations.
- Offer protection against self incrimination when gathering documents and interviewing individuals.
- Have access to legally privileged documents.
- Be separate from other forms of enquiry.
- **Must be procedurally fair to all parties.**

What is an Investigator?

A person appointed under the provisions of relevant legislation, who searches for the truth in the interests of ~~upholding or enforcing the law~~ preventing similar accidents.

Such a person must conduct him/herself in accordance with the provisions of the legislation and the principles of natural justice.

Qualifications and Training of Investigators

Resolution 884 (21)

A variety of contributory factors can play a significant part in the events preceding a marine casualty and responsibility for investigating and analysing human factors therefore becomes important.

The skilled marine casualty investigator generally is the person best suited to conduct all but the most specialised aspects of human factor investigation.

An investigator should have appropriate experience and formal training in marine casualty investigation, which should include specific training in identification of human factors.

An Investigator must:

- be appointed under applicable legislation
- have suitable identification
- know the legislation and the scope of his/her powers
- act within the limits of the legislation

Attributes of a good Investigator

An investigator is more than a seeker of information and an analyst. In addition to analytical skills an investigator should posses a proper attitude and must be able to work with people:

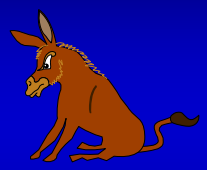
- knowledge and experience in the field under investigation
- dedication
- initiative
- integrity
- decision making ability

Advice to an Investigator

"..You can't have a preconceived notion of what happened. You have to let the evidence direct you to the solution..."

Andy Vita, Chief of Arson, Associate Director, US Bureau of Alcohol, Tobacco and Firearms, from *Blaze The Forensics of Fire,* Nicholas Faith

Piece of Advice: Never ever ASSUME



Assumptions make an
ASS* of *U* and *ME!
ASSUME

Don't Assume – Don't Judge too Quickly

Assumptions and Hypothesise

Assumptions are dangerous if we are not prepared to discard them.

Hypothesise are propositions (possibilities) made as a basis of reasoning without an assumption as to truth.

or

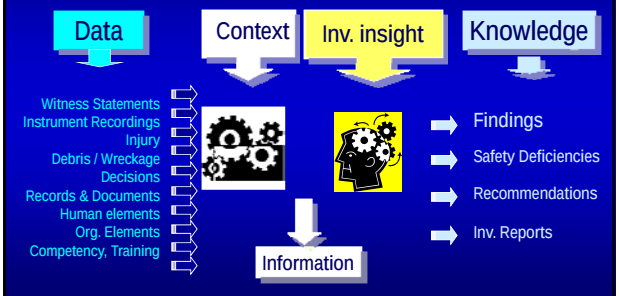
. . . supposition made as a starting point for further investigation from known facts.

Never leap to conclusions and do not dismiss the unlikely.

Recap: Safety Investigation

- A process of systematic search to uncover the WHO, WHAT, WHEN, WHERE, WHY & HOW of a mishap.
- **A seeking of knowledge, data, or the truth about something.**
- **An exercise in critical thinking to systematically inquire or search for answers.**

Essence of Safety Investigation



Wrap Up

Various forms of Investigation
- Criminal Investigation
- Civil litigation
- Coroner's inquest
- Disciplinary investigation

Legal Framework required to support Safety Investigations
- Key provisions of legal framework

Investigators
- Quality and training for investigators
- Power of an Investigator

Investigation involving Human Factors
Attributes of a good investigator
Essence of Safety Investigation

ANALYSIS

This session outlines some basic analysis tools to be applied to case studies

Event and condition charting

Why/Because

Reason Model

Six tests of safe operation

Analyse

Examine in detail the constitution or structure of . . .

Analysis

A detailed examination of the elements or structure of a substance etc.

Preliminary Analysis

A range of activities to convert data into a format suitable for analysis, to point investigators to lines of inquiry.

Analysis of factors and causal events

A structured series of steps to determine contributing safety factors, deficiencies in defences, violations, risks etc.

Analysis

Once facts are collected, they need to be analysed to help establish the sequence of events in the occurrence and to draw conclusions about safety deficiencies uncovered by investigations. Analysis is a disciplined activity that employs logic and reasoning to build a bridge between the factual information and the conclusions.

General areas of Analysis

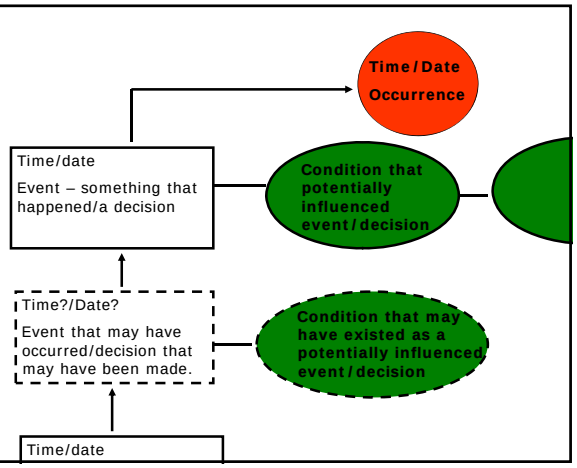
- **why safeguards in place were inadequate or failed;**
- **role of safety programs;**
- **problems relating to the effectiveness of regulations and instructions;**
- **management issues; and**
- **communication issues.**

ESSENTIAL REASONING

Test all issues/evidence relied upon for:

- Existence
- Influence
- Importance

Analysis - Charting



Six tests of Safe Operation

1. Were the risk factors identified or identifiable?
2. Was the equipment fit for purpose?
3. Were the systems and procedures effective to maintain safe operation?
4. Were the individuals involved fit, competent and effective?
5. Were defences and emergency procedures effective?
6. Was there a management system in place to monitor performance?

Why → Because

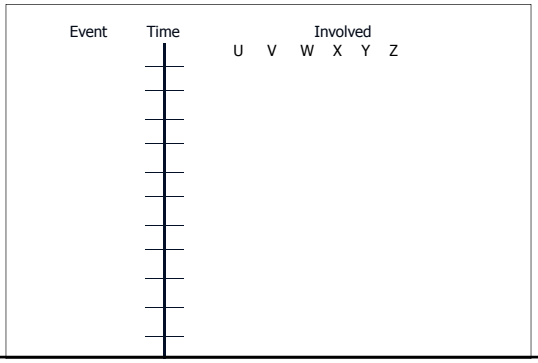
Helps to show when critical factors are missing by applying counterfactual test.

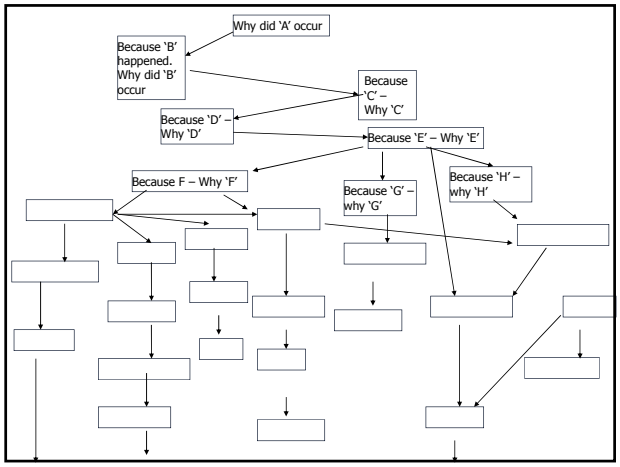
Causal factor *C* could not occur without causal factor *D.*

Causal factor *C* could not happen without causal factor *F*?

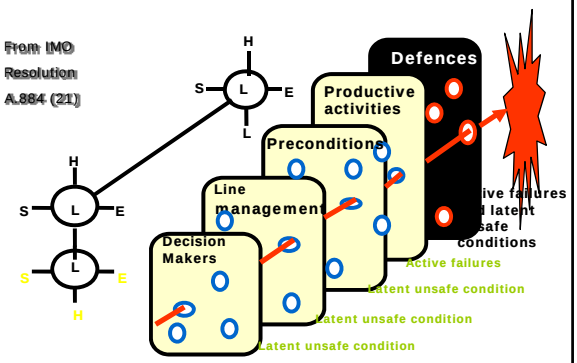
To establish this causal factors must be established between *C, D, E* and *F.*

1. **Develop a list of facts**
2. **Develop a time line**





Organisational Model



Six tests of Safe Operation

1. **Were the risk factors identified or identifiable?**
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5. **Were defences and emergency procedures effective?**
6. **Was there a management system in place to monitor performance?**

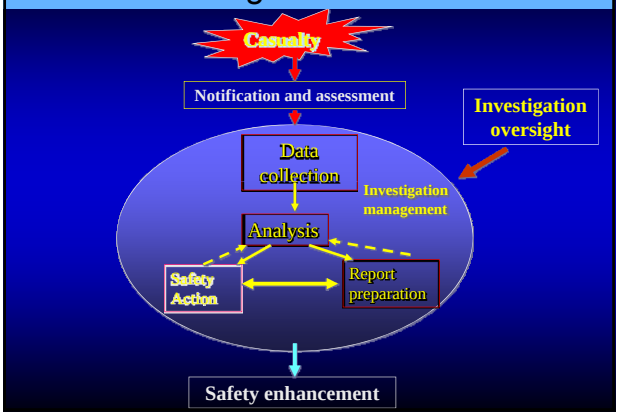
Planning of an Investigation and Investigator Safety

Learning Objectives

After completing this session, participants will understand

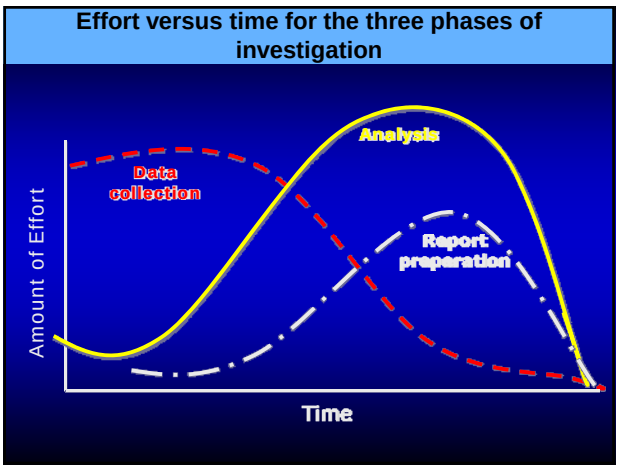
- **Investigation process/structure**
- **Process in setting up an investigation**
- **Three phases of an investigation**
- **Various steps in an investigation**
- **Process of liaising with parties with an interest**
- **Site safety & personnel safety**

Investigation Process

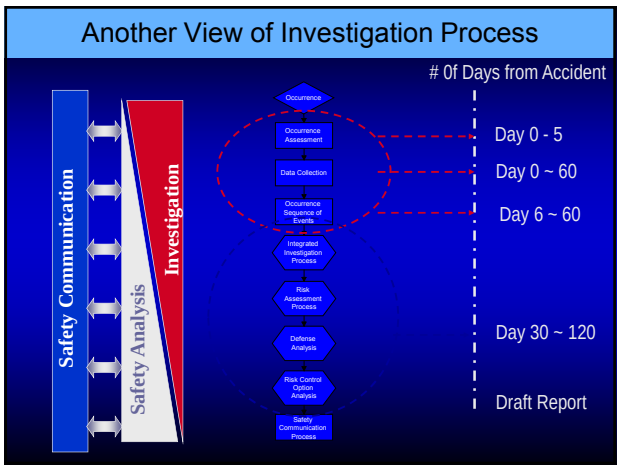


Can we divide an investigation into stages?

Effort versus time for the three phases of investigation



Another View of Investigation Process



Steps in an Investigations

List the steps that you anticipate

Steps in an Investigations 1/2

1. Appointment of Investigator
2. Terms of reference
3. Make safe
4. Determine initial facts
5. Secure the site / Physical Evidence
6. Gathering Evidences
   - Personnel
   - Environmental
   - Equipment/Workspace
   - Documentary
   - Organizational
   - Recorded evidences

Steps in an Investigation 2/2

7. Sequence of Events (WHAT of the accident)
8. Determine Safety-significant Events (What activity/event failed.)
9. Conduct an analysis (WHY of the accident)
10. Make Findings:
    - As to Causes and Contributing factors.
    - As to Risk
    - Others
11. Interim Safety Action – prevent a recurrence
12. Framing Recommendation
13. Communicate
    - NOK, Stake-holders, Media, Public

Pointers for an investigator

- Investigation Report Continuum
  - Factual Information Section
  - Analysis Section
  - Conclusion Section
  - Safety Action Section
- Gain as much factual information as possible.
- Establish the direction and focus of investigation.
- Beware of "confirmation bias" – No.1 enemy.
- Avoid making pre-mature conclusion
- Must be prepared to alter your initial judgement when new contradictory information comes to light.

Setting Up an Investigation

Who do you need to notify of the intention to investigate?

List

Notification to parties that you are investigating.

- Owners/Managers/Agents
- Ship's Master
- Substantially interested State – Flag State
- Counterpart Investigation Agency
- Own Administration /Minister as required
- Local Authorities (Port/Harbour Master, Pilotage Authority, Emergency Response Agencies, etc.)
- IMO (major incident, major loss of life, major pollution.)
- Next of Kin (Courtesy)

What organisations have an interest in a marine casualty. What interests may they have?

Parties With an Interest in Your Investigation

Selection of Investigator(s)

- ✓ Skills
  - ❖ Are they trained and experienced in investigation?
  - ❖ Do they meet the IMO criteria
- ✓ Knowledge
  - ❖ Have they the expertise to understand potential issues?
  - ❖ Could their credibility be challenged?
- ✓ Ability
  - ❖ While they may be qualified, do they have the ability?
- ✓ Seniority?
  - ❖ Who will the investigator(s) have to deal with
  - ❖ What is the possible public exposure?

Field Investigation

- ✓ Accident site examination/interviews
  - ❖ Single person or team
  - ❖ Single site or multiple sites involved
  - ❖ Data gathering plan
- ✓ Travel and accommodation
  - ❖ How do investigator(s) travel?
  - ❖ Have they a base and somewhere to stay
  - ❖ Administrative support (IT, Corporate services)
- ✓ Equipment
  - ❖ Do they have personal protective equipment (PPE)?
  - ❖ Do they have necessary investigation equipment?
  - ❖ Can they access cash?

Ongoing Investigation

- ✓ Additional resources
  - ❖ Is external expertise available?
  - ❖ Is there a protocol for accessing external experts?
  - ❖ Can additional funding be found?
- ✓ Recording and maintaining evidence
  - ❖ Is there a system/protocol for maintaining evidence?
  - ❖ Is the evidence/information secure?
- ✓ Additional Evidence
  - ❖ Have all sources of information been identified?
  - ❖ How will, and by whom, should additional information be sourced?
- ✓ Communications
  - ❖ Are senior officers briefed?
  - ❖ Investigation Update
  - ❖ Briefing to NOKs

Investigator's "Go Bag" – "Tool Box"

What are the basic tools for an investigator?

Make a list of the items that should make a basic investigator's "tool" kit.

Basic tools for an investigator 1/2

- Mobile Phone / Blackberry
- Note book – Ball pen
- Identity Card / Authority
- Camera / Video recorder
- Tape or Digital recorder
- Laptop computer (Remote Access capability preferred)

Basic tools for an investigator 2/2

- Satellite phone (for remote locations)
- Personal Protective Clothing
- Yellow tape
- Copy of Acts and legislation
- Knife
- Tape measure
- Evidence bags/ containers & labels

Investigator Safety

Ensuring the health and safety of employees is a basic requirement of any employer.

Employers have a '*duty of care.*'

(Failing to provide due diligence and duty of care is a criminal offence in many jurisdictions.)

General OH&S legislation & Corporate OH&S Policy

Make Safe

Ensure that any 'on site' visits are safe, and hazards are identified and mitigated.

When you suspect chemical contamination, restrict admittance to the occurrence site until a qualified medical authority or the Site Safety Officer has released the site.

Ensure that investigators and others on site are suitably equipped (Personal protection and appropriate equipment)

Health and Safety

What are the different risks at different accident scenes?

List six potential hazards that an investigator may face.

What hazards should you be aware of ?

Enclosed space entry
Dangerous goods
Pathological hazards
Fire scene debris
Electrical hazards
Hypothermia / Heat stroke

What are the risks at different accident scenes?

- Mechanical – explosion of a compound, airspace, or container, usually pressurised
- Thermal – freezing, hypothermia or burning
- Asphyxiation – oxygen deprivation or reduction
- Biohazard – Blood/Tissue pathogens
- Toxic Chemical – ingestion, inhalation, or contact
- Radiation – Radioactive material
- Falls, slips and trips
- Cuts, sharp edges

Personal Protection Equipment - PPE

What personal clothing and equipment should we provide?

What PPE (Personal Protection Equipment) we should provide for Investigators?

- Head protection (hard hats)
- Eye protection (safety glasses/goggles)
- Face protection (face masks/face shields)
- Ear protection (ear muffs/earplugs)
- Protective footwear
- Hand protection (gloves)
- Protective clothing (disposable coveralls)
- Breathing air protection (respirators and masks)
- Fire protection (fire extinguishers)
- Drowning and/or hypothermia protection (floater jackets, anti-exposure coveralls).
- Dust inhalation protection (nose and mouth mask).
- Protection against infection by handling (never used latex surgical gloves)

Personal protection & prevention

What sort of things can we do before any investigation to help keep the investigators safe?

- Immunisation
  - Hepatitis B (from exposure to infectious blood or body fluids containing blood.)
  - Tetanus (Infection through wound contamination and often involves a cut or deep puncture wound.)
- Health
  - Periodic Medical Check-ups
- Fitness
- CIS Management (train, debrief, support)

Session Summary

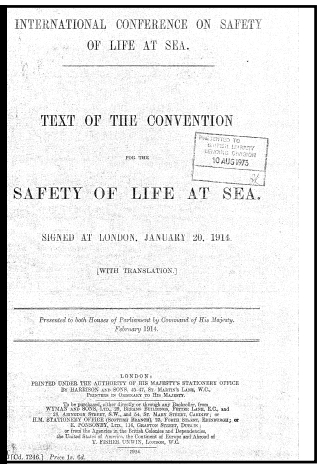
Phases of investigation
- Data Collection
- Analysis
- Report Preparation

Steps in Investigation

Setting up the investigation
- Notifying about the investigation
- Parties with an interest in investigation
- Selection of investigators
- Logistics during Field and on-going investigations
- Investigators' tool box.

Health and Safety
- Hazards & Risks
- PPE
- Protection (Immunisation, Health and Fitness)

International Instruments (06)



INTERNATIONAL CONFERENCE ON SAFETY OF LIFE AT SEA.

TEXT OF THE CONVENTION

FOR THE

SAFETY OF LIFE AT SEA.

SIGNED AT LONDON, JANUARY 20, 1914.

[WITH TRANSLATION.]

Presented to both Houses of Parliament by Command of His Majesty, February 1914.

LONDON:
PRINTED UNDER THE AUTHORITY OF HIS MAJESTY'S STATIONERY OFFICE
BY HARRISON AND SONS, 45-47, ST. MARTIN'S LANE, W.C.,
PRINTERS IN ORDINARY TO HIS MAJESTY.

[Cd. 7546.] Price 1s. 6d.

International Instruments

This session will outline:

- The making of national laws
- International law
- International Labour Organization
- IMO Resolutions, Circulars and recommendations

International Instruments

Law of the Sea

National Law

IMO

Convention
Resolutions
Circulars

Acts
Regulations
Orders

ILO

Conventions

Other International Conventions

UNITED NATIONS
LAW OF THE SEA CONVENTION

Article 2

Legal status of the territorial sea, of the air space over the territorial sea and of its beds and subsoils.

Article 94

Duties of the flag State

Article 94 (7) The flag State's obligation to conduct an inquiry into marine casualties.

UNITED NATIONS
LAW OF THE SEA CONVENTION

Article 2

Legal status of the territorial sea, of the air space over the territorial sea and of its bed and subsoil

1. The sovereignty of a coastal State extends, beyond its land territory and internal waters and, in the case of an archipelagic State, its archipelagic waters, to an adjacent belt of sea, described as the territorial sea.

2. This sovereignty extends to the air space over the territorial sea as well as to its bed and subsoil.

3. The sovereignty over the territorial sea is exercised subject to this Convention and to other rules of international law.

UNITED NATIONS
LAW OF THE SEA CONVENTION

Article 3
Breadth of the territorial sea

Every State has the right to establish the breadth of its territorial sea up to a limit not exceeding 12 nautical miles, measured from baselines determined in accordance with this Convention

UNITED NATIONS
LAW OF THE SEA CONVENTION

Article 94
Duties of the flag State

1. Every State shall effectively exercise its jurisdiction and control in administrative, technical and social matters over ships flying its flag.

UNITED NATIONS
LAW OF THE SEA CONVENTION

Article 94
Duties of the flag State

7. Each State shall cause an inquiry to be held by or before a suitably qualified person or persons into every marine casualty or incident of navigation on the high seas involving a ship flying its flag and causing loss of life or serious injury to nationals of another State or serious damage to ships or installations of another State or to the marine environment. The flag State and the other State shall co-operate in the conduct of any inquiry held by that other State into any such marine casualty or incident of navigation.

ILO
Maritime Labour Convention 2006

Desiring to create a single, coherent instrument embodying as far as possible all up-to-date standards of existing international maritime labour Conventions and Recommendations, as well as the fundamental principles to be found in other international labour Conventions, . . .

Currently Ratified by:

- Bahamas
- Liberia
- Marshall Islands
- Norway
- Panama

ILO
Maritime Labour Convention 2006

- C007 Minimum Age (Sea) Convention, 1920
- C008 Unemployment Indemnity (Shipwreck) Convention, 1920
- C009 Placing of Seamen Convention, 1920
- C016 Medical Examination of Young Persons (Sea) Convention, 1921
- C022 Seamen's Articles of Agreement Convention, 1926
- C023 Repatriation of Seamen Convention, 1926
- C053 Officers' Competency Certificates Convention, 1936
- C054 Holidays with Pay (Sea) Convention, 1936
- C055 Shipowners' Liability (Sick and Injured Seamen) Convention, 1936
- C056 Sickness Insurance (Sea) Convention, 1936

ILO
Maritime Labour Convention 2006

- C057 Hours of Work and Manning (Sea) Convention, 1936
- C058 Minimum Age (Sea) Convention (Revised), 1936
- C068 Food and Catering (Ships' Crews) Convention, 1946
- C069 Certification of Ships' Cooks Convention, 1946
- C070 Social Security (Seafarers) Convention, 1946
- C072 Paid Vacations (Seafarers) Convention, 1946 C073
- Medical Examination (Seafarers) Convention, 1946
- C074 Certification of Able Seamen Convention, 1946
- C075 Accommodation of Crews Convention, 1946

ILO
Maritime Labour Convention 2006

- C076 Wages, Hours of Work and Manning (Sea) Convention, 1946
- C091 Paid Vacations (Seafarers) Convention (Revised), 1949
- C092 Accommodation of Crews Convention (Revised), 1949
- C093 Wages, Hours of Work and Manning (Sea) Convention (Revised), 1949
- C109 Wages, Hours of Work and Manning (Sea) Convention (Revised), 1958
- C133 Accommodation of Crews (Supplementary Provisions) Convention, 1970
- C134 Prevention of Accidents (Seafarers) Convention, 1970
- C145 Continuity of Employment (Seafarers) Convention, 1976
- C146 Seafarers' Annual Leave with Pay Convention, 1976

ILO
Maritime Labour Convention 2006

- C147 Merchant Shipping (Minimum Standards) Convention, 1976
- P147 Protocol of 1996 to the Merchant Shipping (Minimum Standards) Convention, 1976
- C163 Seafarers' Welfare Convention, 1987
- C164 Health Protection and Medical Care (Seafarers) Convention, 1987
- C165 Social Security (Seafarers) Convention (Revised), 1987
- C166 Repatriation of Seafarers Convention (Revised), 1987
- C178 Labour Inspection (Seafarers) Convention, 1996
- C179 Recruitment and Placement of Seafarers Convention, 1996
- C180 Seafarers' Hours of Work and the Manning of Ships Convention, 1996

ILO
Convention 134 of 1970

Concerning the Prevention of Occupational Accidents to Seafarers

Article 2

The competent authority in each maritime country shall take necessary measures to ensure occupational accidents are reported, investigated as to cause and circumstance and subject to statistical analysis.

Article 3

To prevent accidents research shall be undertaken into trends and hazards

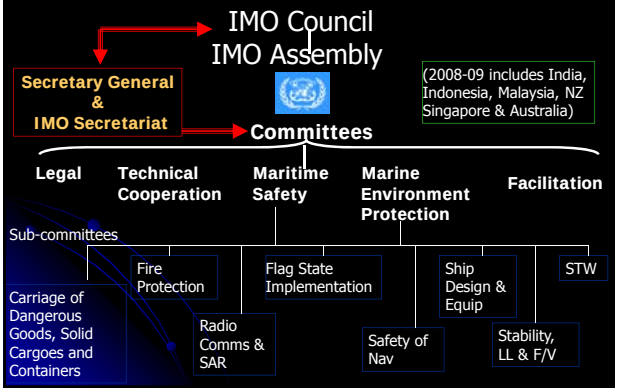
ILO
Convention 147 of 1978

Concerning Minimum Standards in Merchant Ships

Article 2 (g)

Each Member which ratifies this convention undertakes to hold an official inquiry into any serious marine casualty involving ships registered in its territory, particularly those involving injury and/or loss of life, the final report of such inquiry normally to be made public.

IMO
Organizational Structure



International Convention for the Safety of Life at Sea (SOLAS) 1974

as amended by the 1978 Protocol and subsequent Resolutions

.

Entered into force 1980

International Convention for the Safety of Life at Sea (SOLAS) 1974

Chapter I	General Provisions
Chapter II-1	Construction –subdivision and stability, machinery & electrical installations
Chapter II-2	Fire protection, fire detection and fire extinction
Chapter III	Life-saving appliances
Chapter IV	Radiotelegraphy & radiotelephony
Chapter V	Safety of Navigation
Chapter VI	Carriage of grain
Chapter VII	Carriage of dangerous goods
Chapter VIII	Nuclear ships
Chapter IX	Management for the safe operation of ships (1994)
Chapter X	Safety of high speed craft (1994)
Chapter XI	Special measures to enhance maritime safety (1994)
Chapter XII	Additional safety measures for bulk carriers (1997)

International Convention for the Safety of Life at Sea (SOLAS) 1974

as amended by the 1978 Protocol and subsequent Resolutions

.

Regulation 21

(a) Each Administration undertakes to conduct an investigation of any casualty occurring to any of its ships subject to the provisions of the present Convention when it judges that such an investigation may assist in determining what changes in the present regulations might be desirable.

International Convention on Load Lines, 1966

Article 23

(a) Each Administration undertakes to conduct an investigation of any casualty occurring to any of its ships subject to the provisions of the present Convention when it judges that such an investigation may assist in determining what changes in the present regulations might be desirable.

(b) Each Contracting Government undertakes to supply the Organization with pertinent information concerning the findings of such investigations. No reports or recommendations of the Organization based upon such information shall disclose the identity or nationality of the ships concerned or in any manner fix or imply responsibility upon any ship or person.

International Convention for the Prevention of Pollution from Ships, 1973

as amended by the Protocol of 1978
(MARPOL 73/78)

ARTICLE 8
Reports on Incidents involving harmful Substances

1) A report of an incident shall be made without delay to the fullest extent possible in accordance with the provisions of Protocol I to the present Convention.

2) . . .

International Convention for the Prevention of Pollution from Ships, 1973

MARPOL 73/78

ARTICLE 12

Casualties to Ships

1) Each Administration undertakes to conduct an investigation of any casualty occurring to any of its ships subject to the provisions of the Regulations if such casualty has produced a major deleterious effect upon the marine environment.

2) Each party to the Convention undertakes to supply the Organization with information concerning the finding of such investigation, when it judges that such information may assist in determining what changes in the present Convention might be desirable.

International Convention on Standards of Training Certification and Watchkeeping for Seafarers, 1978 (STCW)

as amended in 1995

Regulation I/4.1.3

Control of ships allows an "assessment" of the ability of the crew of a ship in the event of a casualty, illegal discharge, incident or if the ship "is otherwise being operated in such a manner as to pose danger to persons, property or the environment."

International Convention on Standards of Training Certification and Watchkeeping for Seafarers, 1978 (STCW)

as amended in 1995

I/5. National Provisions

1. Requires an impartial investigation of any reported incompetency, act or omission, that may pose a direct threat to safety of life or the environment.

2. Obligation to prescribes penalties.

3. Penalties must be enforced in certain cases.

4. Requires co-operation between States.

International Convention for the Safety of Fishing Vessels, 1977 (Torremolinos Convention)

(Each Party shall arrange for an investigation of any casualty occurring to any of its vessels subject to the provisions of the present Convention when it judges that such an investigation may assist in determining what changes in the present regulations may be desirable.

(Each Party shall supply the Organization with pertinent information concerning the findings of such investigations for circulation to all parties. No reports or recommendations of the Organization based upon such information shall disclose the identity or nationality of the ships concerned or in any manner fix or imply responsibility upon any ship or person.

International Regulations for Preventing Collisions at Sea 1972

As amended from time to time

International Maritime Organization Resolution A.849(20)

Code for the Investigation of Marine Casualties and Incidents

International Maritime Organization Resolution A.884(21)

Guidelines for the investigation of the human factor

27 November 1997

International Maritime Organization Resolution A.947(23)

Human Element Vision, Principles and Goals for the Organization

Principles;

a) The human element is a complex multi-dimensional issue that affects maritime safety, security and marine environmental protection. It involves the entire spectrum of human activities performed by ships' crews, shore based management and regulatory bodies, recognized organizations, shipyards, legislators, and other relevant parties, all of whom need to co-operate to address human element issues effectively.

International Maritime Organization Resolution A.947(23)

Human Element Vision, Principles and Goals for the Organization

Principles;

c) Effective remedial action following maritime casualties requires a sound understanding of human element involvement in accident causation. This is gained by thorough investigation and systematic analysis of casualties for the contributory factors and the causal chain of events.

International Maritime Organization
Resolution A.947(23)

Human Element Vision, Principles and Goals for the Organization

Principles;

d) In the process of developing regulations, it should be recognized that adequate safeguards must be in place to ensure that a single human error or organizational error will not cause an accident through the application of these regulations.

International Maritime Organization
Resolution A-947(23)

Human Element Vision, Principles and Goals for the Organization

Principles;

f) Crew endurance, defined as the ability to maintain performance within safety limits, is a function of many complex and interacting variables including individual capabilities, management policies, cultural factors, experience, training, job skills, and work environment.

h) Consideration of human element matters should aim at decreasing the possibility of human and organizational error as far as possible.

International Maritime Organization
Resolution A.973 (24)

Code for the Implementation of Mandatory IMO Instruments

International Maritime Organization
Resolution A.973 (24)

Resolutions (Res. A 973 (24))

Code for the Implementation of Mandatory IMO Instruments

Annex Part 1 – Common Areas

Objective

1 The objective of this Code is to enhance global maritime safety and protection of the Marine Environment.

Strategy

3. In order for a State to meet the objectives of this Code, a strategy should be developed covering the following issues:

.1 implementation and enforcement of relevant international mandatory instruments;

.2 adherence to international recommended practices;

.3 . . .

International Maritime Organization
Resolution A.973 (24)

Code for the Implementation of Mandatory IMO Instruments

Annex Part 2 – Flag States

Implementation

15 In order to effectively discharge their responsibilities and obligations, flag States should:

.1 implement policies through the issuance of national legislation and guidance which will assist in the implementation of the requirements of all safety and pollution and prevention conventions and protocols to which they are party; and

.2 assign responsibilities within their Administration to update and revise any relevant policies adopted, as necessary.

International Maritime Organization
Resolution A.973 (24)

Code for the Implementation of Mandatory IMO Instruments

Annex Part 2 – Flag States

Enforcement

23 Furthermore, the flag State should:

.1 ensure compliance with applicable IMO instruments through national legislation;

.2 provide an appropriate number of qualified personnel to implement and enforce the national legislation referred to in subparagraph 15.1, including personnel for performing **investigations** and surveys;

.3 . . .

International Maritime Organization Resolution A.973 (24)

Flag State investigations

38 Investigations should be carried out following a marine casualty or pollution incident. Casualty investigations should be conducted by suitably qualified investigators, competent in matters relating to the casualty. The flag State should be prepared to provide qualified investigators for this purpose, irrespective of the location of the casualty or incident.

International Maritime Organization Resolution A.973 (24)

Code for the Implementation of Mandatory IMO Instruments

Annex Part 2 – Flag States

39 The flag State should ensure that individual investigators have working knowledge and practical experience in those subject areas pertaining to their normal duties. Additionally, to assist individual investigators in performing their duties outside their normal assignments, the flag State should ensure ready access to expertise in the following areas, as necessary:

.1 navigation and the Collision Regulations;

.2 flag State regulations on certificates of competency;

.3 the causes of marine pollution;

.4 interviewing techniques;

.5 evidence gathering; and

.6 evaluation of the effects of the human element.

International Maritime Organization Resolution A.973 (24)

Code for the Implementation of Mandatory IMO Instruments

Annex Part 2 – Flag States

40 Any accident involving personal injury necessitating absence from duty for three days or more and any deaths resulting from occupational accidents and casualties to ships of the flag State should be investigated, and the results of such investigations made public.

41 Ship casualties should be investigated and reported in accordance with the relevant IMO conventions, and the guidelines developed by IMO. The report on the investigation should be forwarded to IMO together with the flag State's observations, in accordance with the guidelines referred to above.

International Maritime Organization Resolution A.987 (24)

Guidelines on Fair Treatment of Seafarers in the Event of a Marine Accident

The Code for the Investigation of Marine Casualties and Incidents MSC. 255(84)

The aim is to promote a common approach to the investigation of marine casualties and incidents and to promote co-operation between States, to:

- **to introduce best practice safety investigation**
- **aid remedial action**
- **promote uniform input to accident data base**
- **create a uniform system which applies to seafarers wherever they are in the world**

The Code for the Investigation of Marine Casualties and Incidents MSC. 255(84)

The Code aims to achieve:

- ❑ **Separation of the safety investigation process from disciplinary or criminal proceedings**
- ❑ **Qualified indemnity in disciplinary and criminal proceedings**
- ❑ **Confidentiality and anonymity**
- ❑ **Rapid, transparent, impartial, objective and accurate reporting**
- ❑ **A simple reporting format, which is followed by all States**
- ❑ **Publication and wide dissemination of reports and findings**
- ❑ **Consistent data input to IMO**

Other Significant IMO Assembly Resolutions

- Res. A. 861 (20):
  - *Performance Standards for Shipborne Voyage Data Recorders* (VDRs)
- Res. A. 890 (21):
  - *Principles of Safe Manning*
- Res. A 893 (21):
  - *Guidelines for Voyage Planning*
- Res. A 916 :
  - *Guidelines for the Recording of Events Related to Navigation*

Other Significant IMO MSC Circulars

- MSC/Circ. 1024 :
  - *Guidelines on Voyage Data Recorder (VDR) Ownership and Recovery*
- MSC/Circ. 1058 :
  - *Interim guidelines to assist flag States and other substantially interested States to establish and maintain and effective framework for consultation and cooperation in marine casualty investigations.*

Other Significant IMO MSC-MEPC and Circulars

- MSC-MEPC.7/Circ.5:
  - Guidelines for the operational Implementation of the International Safety Management (ISM) by Companies
- MSC – MEPC. 3 – Circ 1 :
  - Casualty Related Matters – Reports of Marine Casualties and Incidents

Other Significant IMO Assembly Resolutions

- Res. A 922 (22):
  - Code of Practice for the Investigation of the Crime of Piracy and Armed Robbery Against Ships
- Res. A 949 (23) :
  - Guidelines on Place of Refuge for Ships in Need of Assistance
- Res. A 983 (24) :
  - Guidelines for Facilitation of Response to a Pollution Incident

Global Integrated Shipping Information System (GISIS)

Maritime Security	Information communicated under the provisions of SOLAS regulation XI-2/13 (SOLAS Ch. XI-2 & ISPS Code
Condition Assessment Scheme	Electronic database for the implementation of the Condition Assessment Scheme – Res. MEPC.94 (46), as amended
Recognized Organizations	Information submitted by Member States under MSC/Circ.1010-MEPC/Cir.382
Maritime Casualties and Incidents	Data on Maritime Casualties and Incidents as defined by circulars MSC-MEPC.3/Circ.1.
Port Reception Facilities	Data on the available port reception facilities for the reception of ship-generated waste.


MAIIF
Australia
Bahamas
Belize
Canada
Chile
China
Cyprus
Fiji
Finland
Germany
Hong Kong, China
Isle of Man
Italy
Japan
Korea
Liberia
Luxembourg
Malaysia
Marshall Islands
Malta
Netherlands
New Zealand MSA
New Zealand TAIC
Panama
South Africa
Sweden
United Kingdom
USA USCG
USA NTSB
Vanuatu

The development of safety investigations

This session will cover the development and thinking behind the development of safety investigations, including:

- **a brief history of investigations**
- **General categories of casualties**
- **Public & technical inquiries**
- **Failure of Foresight – six stages of a disaster**
- **Sociological and psychological thinkers**
- **James Reason**

In 1836 the House of Commons

Select Committees

"That among the various causes of shipwreck which appear susceptible of removal or diminution, the following appear to be the most frequent and the most generally admitted.

1. ***Defective construction of ships.***
2. ***Inadequacy of equipment.***
3. ***Imperfect state of repair.***
4. ***Improper and excessive loading.***
5. ***Inappropriateness of form.***
6. ***Incompetency of masters and officers.***
7. ***Drunkenness of officers and men.***
8. ***Operation of marine insurance***
9. ***Want of harbours of refuge.***
10. ***Imperfection of charts***

"That drunkenness, either in the master, officers or men, is a frequent cause of ships being wrecked, leading often to improper and contradictory orders and directions . . . sleeping on lookout or at the helm . . . steering the wrong course."

"large quantities of ardent spirits as part of the stores of the ship . . ."

In 1846

the Act of 9 and 10 Vict., c.100

The stated aims were to:

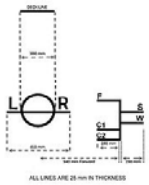
- **examine the causes of shipwreck;**
- **on one hand to censure owners and commanders for default and deficiencies and the other to acquit honourably those to whom no blame attached;**
- ***"To produce a salutary preventative effect by making the evidence and verdict in each case public in every part of the kingdom."***

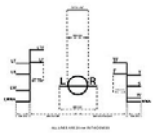
" . . . Thus further (and it is very important to mention this) the object of the inquiry is not so much to punish anyone, who may be at fault, as to prevent wrecks in the future, . . ."

In 1860, the Permanent Secretary to the Board of Trade, Sir Thomas Farrer

James Hall
Shipowner

William Leng
Editor
Sheffield Daily Telegraph





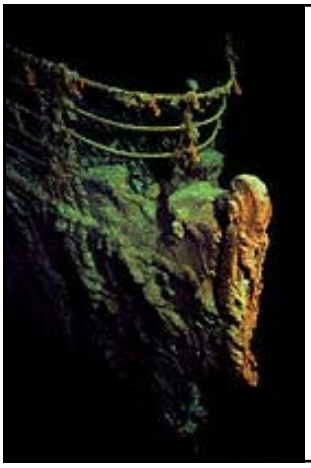
Samuel Plimsol
12 August 1876
Owners required to fix load bline

It was not until 1890 that load lines were fixed by the Board of Trade.

April 1912

R.M.S. Titanic

Sank in the Atlantic Ocean with the loss of 1503 lives



1914 Safety of Life Convention

Provisions included:

- provision of w/t bulkheads
- provision of fire-resistant bulkheads
- lifesaving appliances
- fire prevention
- fire fighting appliances
- radio telegraphy
- North Atlantic Ice Patrol

Safety of Life at Sea,
1914, 1929, 1948, 1960 and 1974

General Categories of Marine Casualties

- **Grounding / wrecked / stranded**
- **Collision**
- **Fire / Explosion**
- **Contact**
- **Foundering**
- **Missing**
- **Contact**
- **Hull / machinery**
- **Heavy weather / ice damage**
- **Other**

Three mile Island (1979)
Bhopal (1984)
Chernobyl (1986)
Challenger (1986)
Herald of Free Enterprise (1987)
Kings Cross (1987)
Dona Paz (1987)
Scandinavian Star (1990)
Estonia (1994)

"What is lacking is any scientifically sifted evidence as to the effect this sanction has on the minds of others concerned with navigation in general and the maintenance of schedules in particular." Adams, J

Between 1966 and 1991 – 12 tankers lost through fire and explosion.

Dec 1968 *Marpessa, Mactra & Kong Haakon* explosion while tank cleaning in tropics.

Between 1980 and 1991, 64 bulk carriers of > 15000 gross tonnes lost as a result of some structural failure

Dona Paz December 1987 (4386)

Al Salam Boccaccio 98
February 2006 (450)

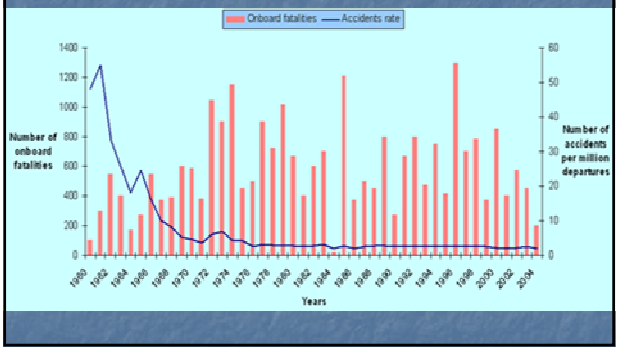
HFE March 87 (193)
Dona Marilyn October 88 (350
Scandinavian Star April 90 (165)
Saleem Express Dec 91 (464)
Jan Heweliusz January 93) (55)
Estonia September 94 (852)
Cebu City December 94 (140)
Gurita January 96 (338)
Bukoba May 96 (869)
Princess of Orient August 98 (150)
Harta Rimba February 99 (300)
Samina September 00 (143)
Salahuddin May 02 (450)
La Joola September 02 (1836)
Princess of Stars June 08 (862)
Teratai Prima January 2009 (230?)

How could such a toll on human life and ships continue for so long?

How could industry understand safety management if it did not understand how these losses were occurring?

Why, it was asked, could not the marine industry be more like the airline industry?

Commercial airline accident trends



Mr Justice Sheen's investigation was an interesting exception to the general tendency of post-accident inquiries to focus primarily upon active errors. James Reason

Public inquiries

The purpose of a public inquiry is thus to carry out a full, fair and fearless investigation into the relevant events and to expose the facts to public scrutiny. That is or should be the purpose of every public inquiry.

Clarke, LJ, Thames Safety Inquiry, Final Report, 1999 , para 5.10

Public inquiries

"In every formal investigation it is of great importance that members of the public should feel confident that a searching investigation has been held, that nothing has been swept under the carpet and no punches have been pulled."

Sheen,J, Formal Investigation into the capsize of *Herald of Free Enterprise*, 1987.

The public (and especially the survivors and the relatives and friends of those who lost their lives) has a legitimate interest in learning the truth of what happened, without anything being swept under under the carpet. In some cases that will necessitate a public inquiry, whereas in others it will not.

Clarke, LJ, *Thames Safety Inquiry*, Final Report, 1999, para 5.3.

Technical Investigations

Such inquiries may, for example, raise technical issues rather than issues of credibility . . .

Clarke, LJ, *Thames Safety Inquiry,* Final Report, 1999, para 6.6

. . . the creation of a (specialist investigation bureau) would avoid the need for public inquiries and thus save both time and cost, while nevertheless ensuring that the facts of an accident were properly investigated and the necessary lessons learned for the future.

Clarke, LJ, *Thames Safety Inquiry,* Final Report, 1999, para 7.2

Technical Investigations

13 . . . It is a report made by a body which has technical expertise, but it is not a report after any kind of judicial inquiry.

14. These technical inquiries are often held in private, although their reports are usually made public. The aim of such an inquiries is to ascertain the cause of the disaster and to make recommendations to avoid a future recurrence . . .

1997 Home Office (UK) Report of the Disasters and Inquests Working Group

Technical investigations, whether the findings are made public or not, will not usually assuage any desire on the part of the public (particularly relatives/friends of the deceased) for retribution.

I have no doubt that it was as a direct result of that assurance that the owners and managers of Bowbelle assisted the FI as fully as they did. Clarke LJ

Inquiries

All of these inquiries can overlap, get in each other's way and require the same evidence to be given by the same people several times. Insofar as there is any pattern at all it is one of the inconsistency that simply adds fuel to the anger and frustrations of the victims.

Michael Napier, address to the First European Conference on Traumatic Stress in Emergency Services Peacekeeping Operations and Humanitarian Aid Organisations (1996)

Evidence

Evidence obtained by police or regulatory authorities can lead to adverse outcomes for the provider of the information. To avoid this individuals and companies resist providing information, either through non-disclosure or 'legal privilege'.

Providing protection against self incrimination can provide important evidence to safety investigations.

Barry Turner –

Man-Made Disasters (1978)

The failure of foresight

Stages in the development of disasters

Stage I **– Initial beliefs and norms**

Stage II **– "Incubation period"**

Stage III **– Precipitating event**

Stage IV **– Onset**

Stage V **– Rescue and salvage**

Stage VI **– Full cultural readjustment**

Mega Borg – June 1990

Stage I **– Initial beliefs and norms**

Life as we know it

The way we always do it – leading to the development of rules/practices and procedures

Stability and certainty in a changing world

Stage II **– "Incubation period"**

Starts when the first discrepant event occurs

Under the assumption that success demonstrates competence, people drift into complacency, inattention and habitual routines.

Leads to risky attitudes.

Dangers of collective blindness

Structural beliefs that lead to rigidity of thought and erroneous but self-reinforcing opinions

Stage II **– "Incubation period"**

Starts when the first discrepant event occurs

Changes in practices occur that are either not noticed or ignored (not acknowledged)

Erroneous assumptions –institutional rigid beliefs and perceptions – rigidity of thought and resistance to change (particularly from external or lay sources) – decoy problems

Procedures/policies/rules/practices are at odds with new environment or new developments

Variable disjunctive information

Failure to acknowledge risk or to fear the worst

Formal rules not up-to-date, seen as irrelevant, rules violated

Barry Turner

Notionally normal starting point & Incubation period

Is the organisation or are individuals :

•high handed and dismissive of external criticism?

•subject to information difficulties – incomplete or fragmented communications?

•do they ignore regulations and procedures?

•do they minimise dangers?

Stage III **– Precipitating event**

The accident or disaster

The actual incident (fire, grounding, pollution, etc)

***Stage IV* – Onset**

Whether the occurrence is viewed as a an accident or disaster will depend on the consequence of the *precipitating* event and the severity of the effect on society. .

This will often influence the reaction of society.

(Individual accidents between 1 and 2 errors

Disasters multiple (Aberfan – 36; Hixton – 61; Summerland – 50.)

***Stage V* – Rescue and salvage**

***Stage VI* – Full cultural readjustment**

The investigation stage, readjustment following identification of the things that went wrong

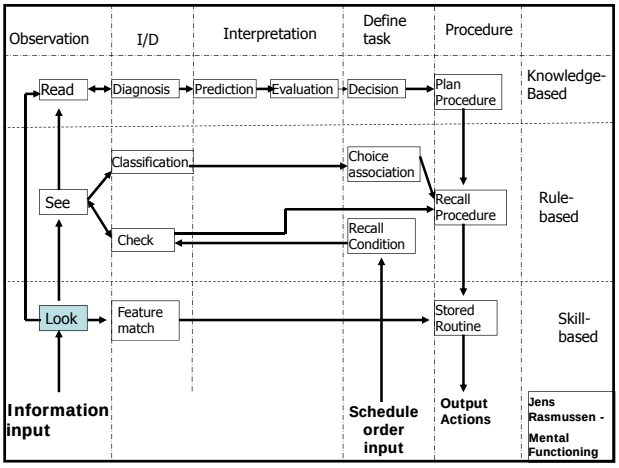
Barry Turner	**1978 Failure of foresight**
Jens Rasmussen	**1980 Skill, Rule, Knowledge based learning**
Hawkins	**1987 - SHEL**
James Reason	**1990 "Swiss Cheese" "GEMS"**
Kletz	**1993 Failure of Organisational Memory**
Charles Perrow	**1984 Lose and tightly coupled systems**
Andrew Hopkins	**2000 Safety, culture and risk**

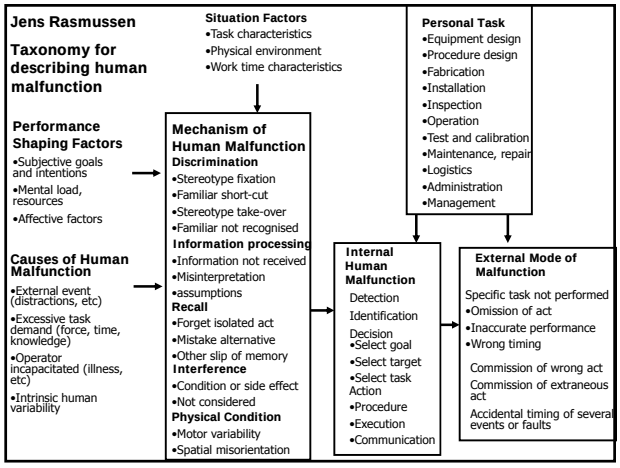
Jens Rasmussen

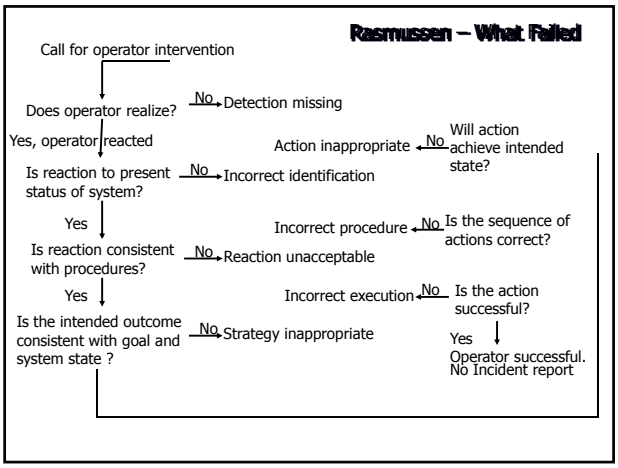
A taxonomy for describing human malfunction in industrial installations (1982)

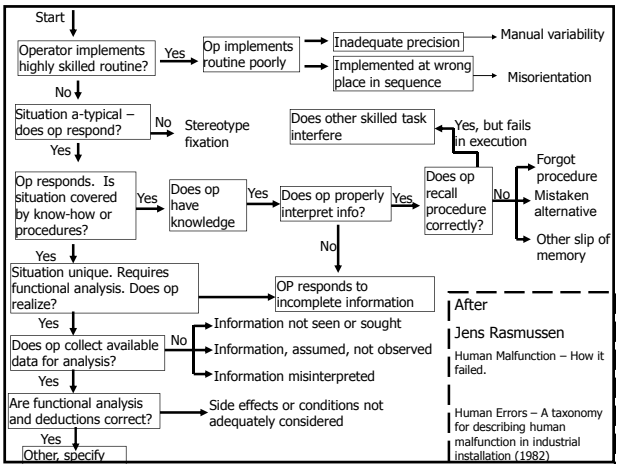
- Knowledge-based
- Rule-based, and
- Skill-based errors

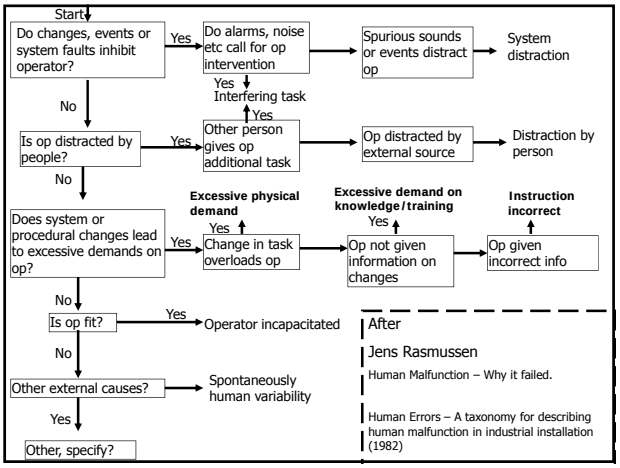
'Accidiagram'











Charles Perrow

Normal Accidents 1982

Normal Accident theory

Tightly coupled and loosely coupled systems

Andrew Hopkins

Managing Major Hazards – Lessons from Moura Mine Disaster 1999

Lessons from Longford 2000

Safety Culture and Risk - Organisational Causes of Disasters 2004

Hopkins

Influence Diagram – Hierarchical

Influences in an accident: -

- Society
- Sources of culture
- Cultural/Organisational Causes
- Specific Causes
- Outcomes

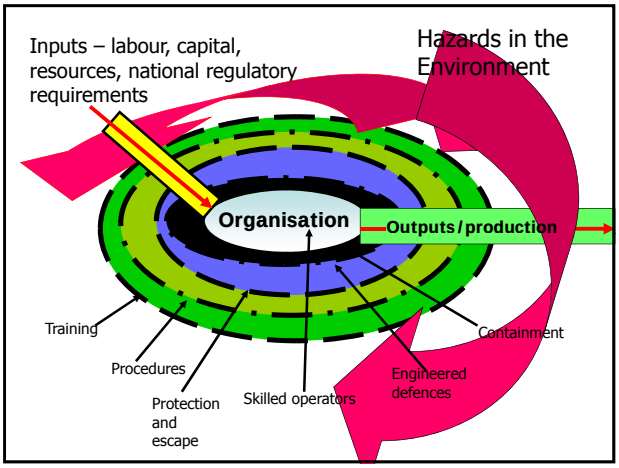
James Reason

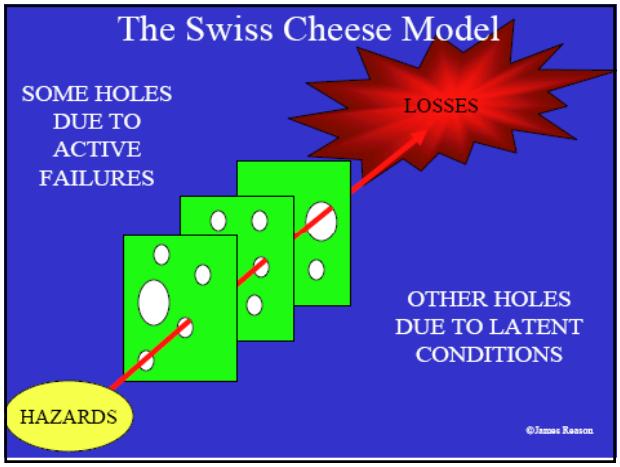
- Human Error (1990)
- Beyond Aviation Human Factors (1995) Reason et al
- Managing the Risks of Organizational Accidents (1997)

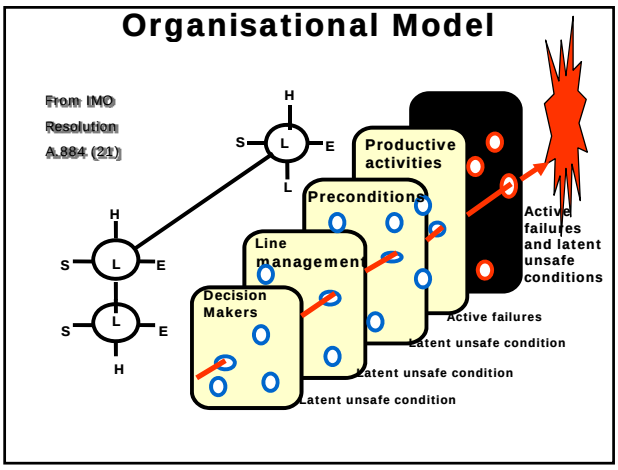
Organisational Accidents

Reason

- Swiss Cheese Model
- Generic Error Modeling System
- General Failure Types







ANALYSIS

This session revisits the issue of analysis and reviews:

- the stop rule
- ' why/because' analysis
- event and condition charting
- six tests of safe operation
- critical thinking
- diagrammatic representation
- testing conclusions
- the Reason/SHEL models
- Report structure

Analyse

Examine in detail the constitution or structure of . . .

Analysis

A detailed examination of the elements or structure of a substance etc.

Analysis

Once facts are collected, they need to be analysed to help establish the sequence of events in the occurrence and to draw conclusions about safety deficiencies uncovered by investigations. Analysis is a disciplined activity that employs logic and reasoning to build a bridge between the factual information and the conclusions.

Stop rule?

When the issues in question or the information will not affect the findings.

Company/in-house –

examine the failure of company systems and procedures and introduce remedial practices.

Criminal investigations -

establish beyond reasonable doubt that there has been a breach of law

Safety Investigation

for governments, on the other hand, it makes sense to go one step further and ask whether a failure of the regulatory system was the root cause, for this is a matter which governments can do something about.'

Some Basic Questions

- **why safeguards in place were inadequate or failed;**
- **role of safety programs;**
- **problems relating to the effectiveness of regulations and instructions;**
- **management issues; and**
- **communication issues.**

Logic

The science of reasoning, proof, thinking or inference

A chain of reasoning.

Why do accidents happen?

Failure of foresight

Risks not recognised or understood or risks ignored.

A significant part of the Analysis of an accident is to understand the risks involved.

What is an investigation?

An exercise in critical thinking to systematically inquire or search for answers.

Critical thinking

- uses evidence skillfully and impartially
- organise thoughts concisely and coherently
- distinguishes between logically valid and invalid inferences
- suspends judgment in the absence of sufficient evidence
- differentiates between reasoning and rationalising
- uses appropriate intellectual disciplines to arrive at conclusions
- habitually questions own views and how they were formulated
- differentiates between the validity of belief and intensity of belief
- recognises the limitations of one's own understanding
- recognises the risk of bias clouding judgement

Testing findings and conclusions

Is there evidence to support the statement?

- is all the relevant evidence conclusive?

- is there contrary evidence?

- has any conflicting evidence been explained?

- what level of possibility/probability should it be given?

Testing findings and conclusions

Is all the evidence reliable?

-What makes it reliable?

- what makes it unreliable? (i.e. will somebody be able to argue that all factors have not been taken into account)

- does the weight of evidence support the finding/conclusion?

- are there any biases or unsubstantiated assumptions?

Testing findings and conclusions

Where findings rely on more than one area of evidence, have all parts been substantiated?

- are all the different pieces of evidence consistent?
- can any inconsistencies in evidence be justified?
- are there any obvious errors of logic?

Testing findings and conclusions

If the report finds that 'there is no evidence for . . .'

- did the investigation look for evidence?
- is evidence available?
- is evidence required?
- is the lack of evidence an issue?

Testing findings and conclusions

Is the finding based on circumstantial evidence?

- is the circumstantial evidence strong enough to support finding?
- is the circumstantial evidence drawn from a number of sources?
- is there bias?

Testing findings and conclusions

Is the issue analyzed described in the narrative?

Does the analysis support the findings/conclusions?

Are the safety recommendations logical?

Could the safety recommendation create greater problems than they solve?

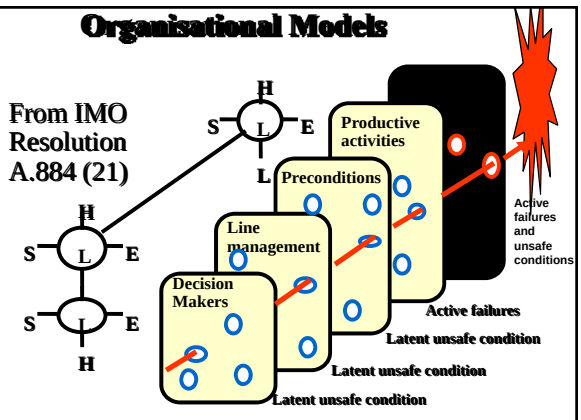
Testing findings and conclusions

Are any 'organisational' issues properly covered?

- decision making?
- line management?
- preconditions?
- defences?

Organisational Models

From IMO Resolution A.884 (21)



Why did the ISM Code provisions fail?

Is there evidence of previous similar incidents?

Is there a reporting culture?

Which organisation audits the SMS?

Six tests of Safe Operation

1. **Were the risk factors identified or identifiable?**
2. **Was the equipment fit for purpose?**
3. **Were the systems and procedures effective to maintain safe operation?**
4. **Were the individuals involved fit, competent and effective?**
5. **Were defences and emergency procedures effective?**
6. **Was there a management system in place to monitor performance?**

Resolution 884 (21)

2.4.1 cont

It should also be possible to identify active and underlying factors such as:

- **general ship's condition**
- **operational deviations;**
- **design aspects of hull structural failure;**
- **defects in resources and equipment;**
- **inappropriate use of resources and equipment;**
- **relevant personnel skill levels and their application;**
- **physiological factors (fatigue, stress, alcohol, illegal drugs, prescription medicine);**

Testing findings and conclusions

Active versus latent failures

- **Occur at different levels in the system**
- **Have different consequences**
- **Have different durations**
  - **Active failures are short lived**
  - **Latent failures may continue for many years**
- **Active failures are hard to anticipate**
- **Latent failures are present NOW**

Active errors happen at the 'sharp end'

- **Active failures have immediate effects**

Latent errors are the product of management decisions

- **Latent failures have delayed effects**

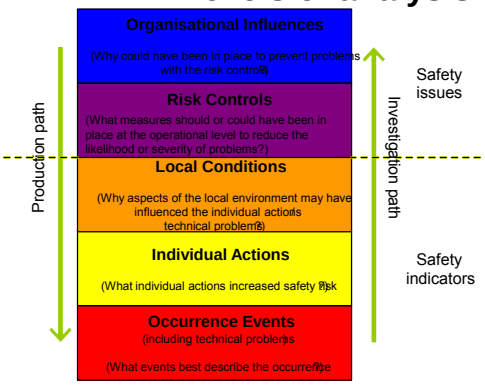
- **Offer different remedial solutions**

Humans are error prone – account for the active element in many accidents.

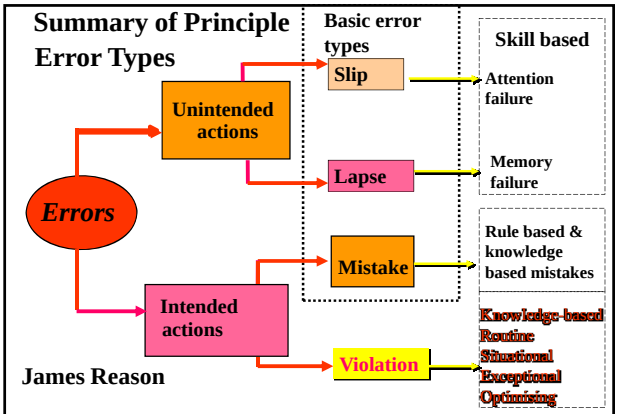
Defences (operational risk controls) exist in any organisation to reduce the chances of human error occurring, and if human error does occur to mitigate the results.

The operational risk controls may be influenced by legislation, company policy and particular (local) conditions under which people work.

Levels of analysis



Summary of Principle Error Types



Testing findings and conclusions

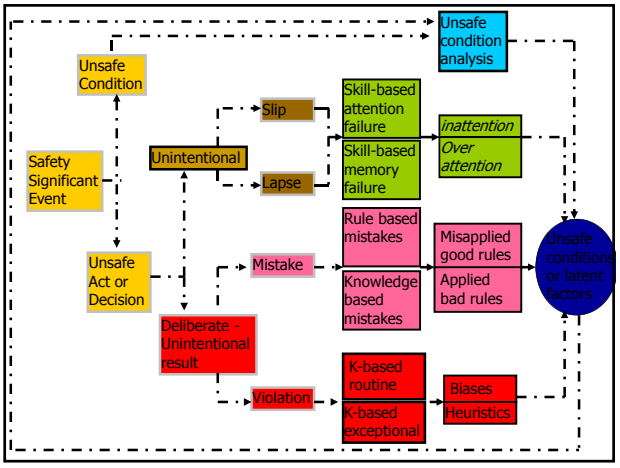
Have identification of any violations been identified and correctly categorized?

Violation types

- **Routine violations**
- **Optimising violations**
- **Necessary violations**
- **Exceptional violations**

World wide research in fields as diverse as oil production, medicine, airline operation, road transport and railways has indicated that intentional non-compliance with procedures is a significant safety problem. Violations may be involved in up to 70 per cent of accidents in some industries.

ATSB Rail Investigation Report R1/2000. Collision Between Freight Train 9784 and Ballast Train 9795, Ararat, Victoria. 26 November 1999

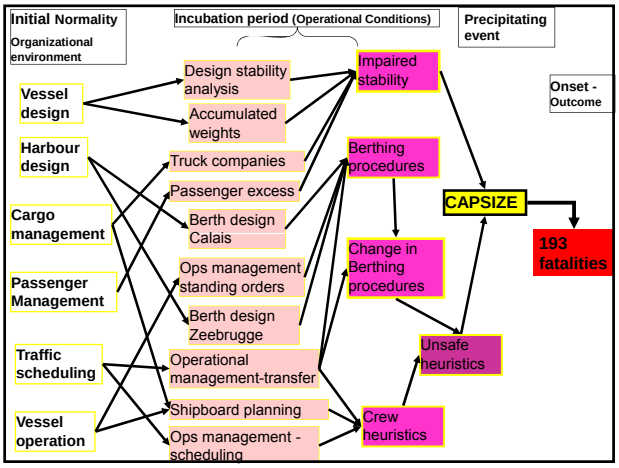


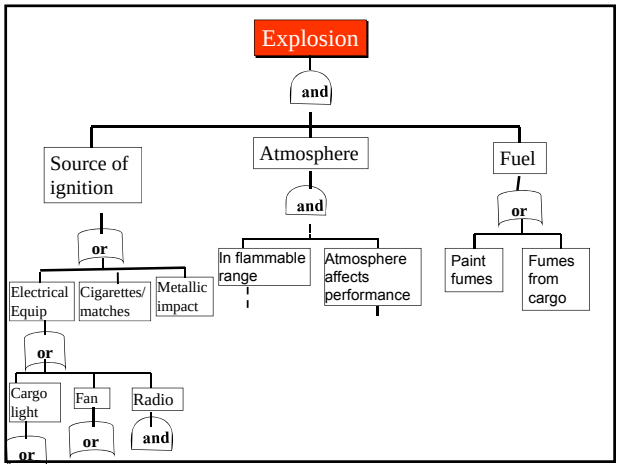
ESSENTIAL REASONING

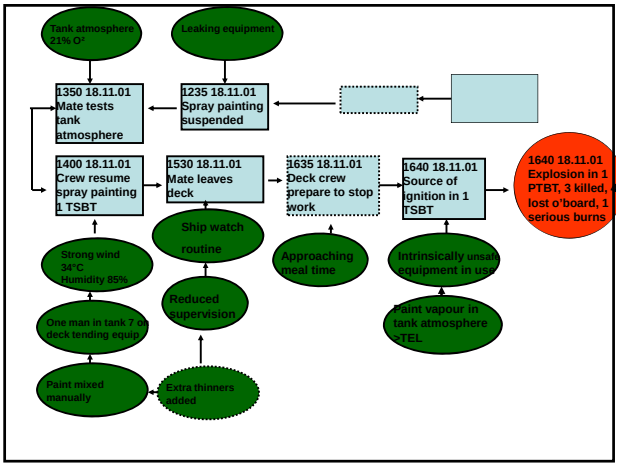
Test all issues/evidence relied upon for:

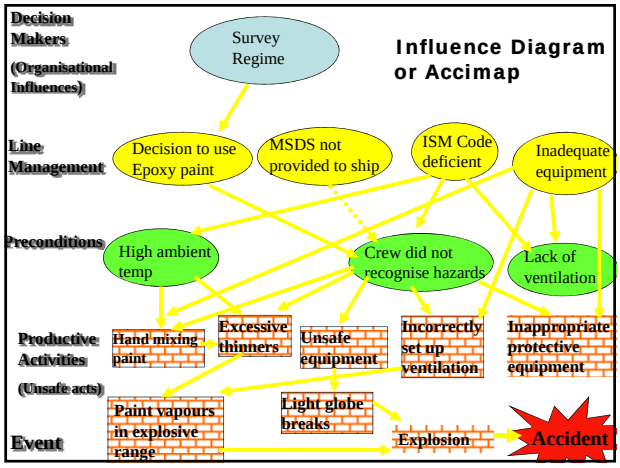
- Existence
- Influence
- Importance

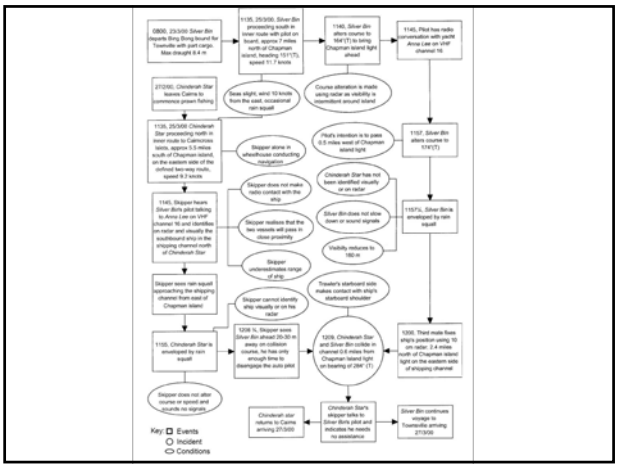
Analysis - Charting

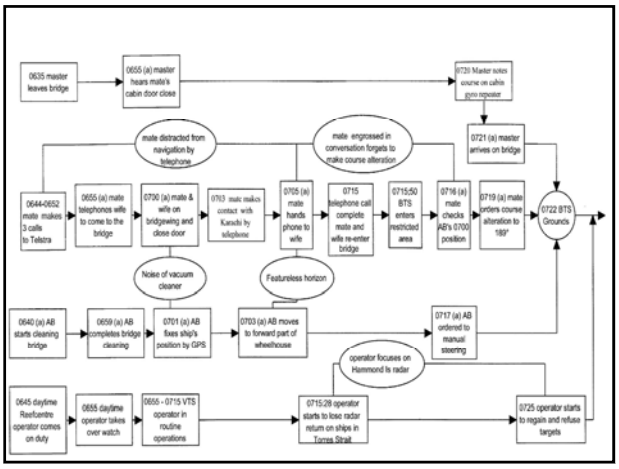












Why ⟶ Because

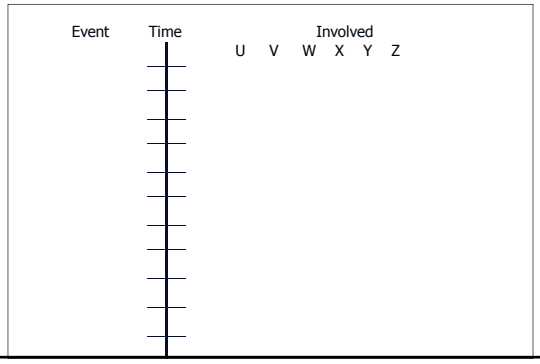
Helps to show when critical factors are missing by applying counterfactual test.

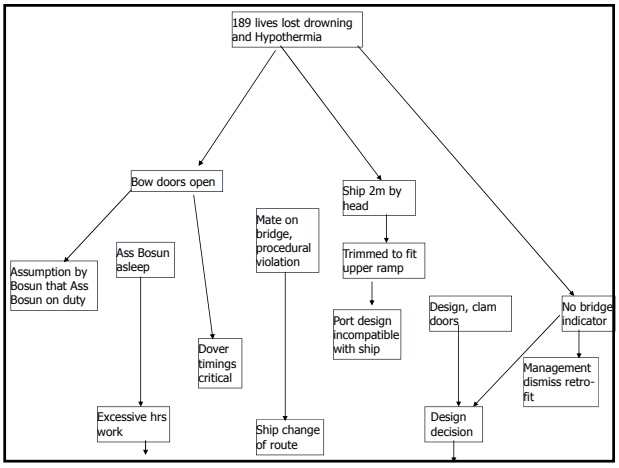
Causal factor *C* could not occur without causal factor *D.*

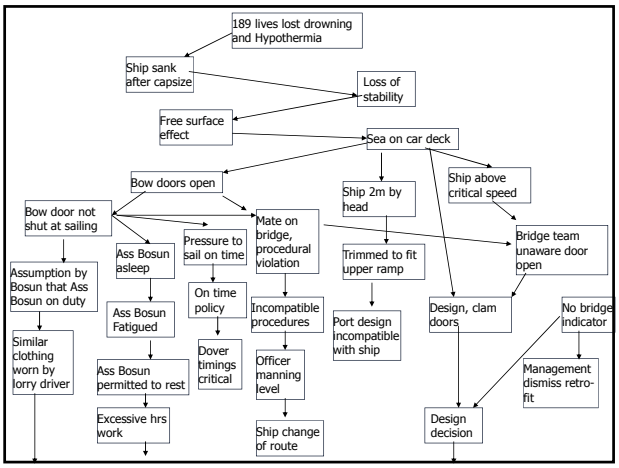
Causal factor *C* could not happen without causal factor *F*?

To establish this causal factors must be established between *C, D, E* and *F.*

1. **Develop a list of facts**
2. **Develop a time line**







Reporting

IMO Res. A.884 (21)

2.5 Safety action

2.5.1 The ultimate goal of a marine safety investigation is to advance maritime safety and protection of the marine environment. In the context of these Guidelines, this goal is achieved by identifying safety deficiencies through a systematic investigation of marine casualties and incidents, and then recommending or effecting change in the maritime system to correct these deficiencies.

2.5.2 In a report that clearly lays out the facts relevant to the occurrence, and then logically analyses those facts to draw reasoned conclusions including those relating to human factors, the required safety action may appear self-evident to the reader.

2.5.3 Recommended safety action in whatever form should clearly identify what needs to be done, who or what organization is responsible for effecting change, and, where possible, the urgency for completion of the change.

Reporting

IMO Res. A.884 (21)

3 REPORTING PROCEDURES

3.1 To facilitate the flow of information from casualty investigations, each report should conform to a basic format as outlined in section 14 of this resolution.

3.2 Reports should be made to IMO in accordance with established procedures.

3.3 Persons and/or organizations with a vested interest in a report should be given the opportunity to comment on the report or relevant parts thereof before it is finalized.

3.4 The final report should be distributed to relevant parties involved and should preferably be made public.

Report Structure

A generally accepted format is:

- ✓ Title Page
- ✓ List of contents
- ✓ Acknowledgements
- ✓ Executive summary
- ✓ Sources of information/References
- ✓ Narrative
- ✓ Analysis & Comment
- ✓ Conclusions
- ✓ Recommended Safety Actions *
- ✓ Potential safety recommendations*
- ✓ Ship particulars (often included after list of contents)
- ✓ Annexes (containing details not included in the report)

Report Content

Any 'Safety Action' must flow directly from the conclusions/findings.

Any conclusion/finding must be the subject of analysis.

Any subject analysed must have been identified in the narrative.

Report Structure

Use photographs

and

Diagrams

'One is worth ten thousand words.'

Investigating specific accident types

2.2 Collision General

Obstructions, if any, to manoeuvring, e.g. by a third vessel, shallow or narrow waters, beacon, buoy, etc.	Circumstances affecting visibility and audibility, e.g. state of the sun, dazzle of shore lights, strength of wind, ship-board noise and whether any door or window could obstruct look-out and/or audibility
Local or other special rules for navigation	Possibilities of interaction
Geographical plot	Name, IMO number, nationality and other details of other vessel

This session looks at the various kinds of accident that may occur on a ship and the general information that should be collected.

Types of casualty

- Collision (Involving vessels)
- Contact (e.g. Harbour wall)
- Fire/explosion
- Foundered (sunk, submerged)
- Missing/overdue
- Hull damage (holed, cracks, structural failure.)
- Machinery damage/failure (e.g. lost rudder, fouled propeller)
- Miscellaneous
- Piracy
- Wrecked/stranded (aground)

Number of Casualties by Region

Cause	Africa	Asia	Australasia	Europe	Indian S-Cont	Mid East	N America	Other	S. America/Caribbean	Total
Collision	18	220	8	221	18	15	70	2	12	584
Contact	3	16	4	104	1	2	61	2	5	198
Fire/ Explosion	3	36	10	104	6	12	38	6	14	229
Founder	6	34	2	33	11	11	30	5	2	134
Missing o'due	1	1	0	0	1	0	0	0	0	3
Hull damage	6	12	4	36	4	5	55	3	7	132
Machine/ damage	37	77	16	395	8	25	160	30	76	824
Misc	15	21	18	117	6	14	86	15	15	307
Piracy	16	3	0	0	2	2	0	0	0	23
Wrecked	10	68	12	224	7	23	113	9	43	509
Total	115	488	74	1238	64	109	613	72	174	2947

Source Lloyd's MIU

What is missing from this list is

personal death/injury in routine ship maintenance

Guidelines to the IMO Code

Introduction

The guidelines assist investigators.

Bear in mind the information required under the IMO marine casualties and incidents reporting system.

Investigators must be guided by the requirements of the legal system of the State in which the investigation is being conducted.

In particular:
- providing formal notification of an investigation to interested parties:
- boarding ships and securing documents;
- the rights of witnesses at interview;
- the role of lawyers or other third parties during an interview.

1.1 Particulars of the ship

Name, IMO number, nationality, port of registry, call sign	Name and address of owners and operators, if applicable, also, if an overseas ship, of agents
Type of ship	Name and address of charterer, and type of charter
Deadweight, net and gross tonnages, and principal dimensions	Means of propulsion; particulars of engines
When, where and by whom built	Any relevant structural peculiarities
Amount of fuel carried, and position of fuel tanks	Radio (type, make)
Radar (number, type, make)	Gyro compass (make, model)
Automatic pilot (make, model)	Electronic positioning equipment (make, model) (GPS, Decca, etc.)
Communications equipment	Life saving equipment (dates of survey/expiry)
Ownership history	Port State Control – history of detentions/deficiencies

Documentary Evidence

The following should be considered for copying as useful authoritative information – particularly after the ship has sailed and long gone.

Documentary Evidence

Certificates and Documents Required to be Carried on Board Ship are listed in the Annex to:

- FAL.2/Circ.87
- MEPC/Circ.426
- MSC/Circ.1151

Documents

The following should be considered for copying as useful authoritative information – particularly after the ship has sailed and long gone.

Statutory Certificates:

Load Line

Passenger and Safety Certificate

SOLAS (Construction, Equipment and Radio)

International Safety Management Certificate

International Oil Pollution Prevention IOPP Certificate

Tonnage Certificates

Anchors and Cables

Certificates of Competency

What are they evidence of?

Documents

Statutory Certificates:

- Load Line
- Passenger and Safety Certificate
- SOLAS (Construction, Equipment and Radio)
- International Safety Management Certificate
- International Oil Pollution Prevention IOPP Certificate
- Tonnage Certificates
- Anchors and Cables
- Certificates of Competency

What are they evidence of?

Certificates in and of themselves are not evidence of anything.

Paper does not sink ships

Certificates attest to a standard to which the ship should conform

Identify some useful paper documents.

- Ships register
- Bridge/Engine room log book
- Port/cargo log
- Course recorder chart
- Echo sounder trace
- Tank and bunker sounding books
- Record of chart corrections
- Crew list
- Engine Movement books
- Standing & Night Order books
- Passage Plan
- ISM Non-conformities
- Cargo manifests
- Trim & stability book/calculations
- Compass error book
- Planned maintenance schedules
- Repair/spares requisitions
- Equipment manuals
- GMDSS/Navtex records
- Record of safety drills
- Amver/Pos'n reporting
- Charter parties

Also collect

1.3 **Particulars of voyage**

Port of loading, voyage history	Details of cargo
Last port and date of departure	Draughts (forward, aft and midships) and any list
Port bound for at time of occurrence	General arrangement plan
Ship plans relevant to the incident	Weather conditions experienced
Details of cargo, bunkers, fresh water and ballast and consumption	Any incident during the voyage that may have a material bearing on the incident, or unusual occurrence

1.4 **Particulars of personnel involved in incident**

Full name	Age
Details of injury	Description of accident
Person supervising activity	First aid or other action on board
Capacity on board	Details of Certificate of Competency/Licence
Time spent on vessel concerned	Experience on similar vessels
Experience on other types of vessels	Experience in current capacity
Experience in other ranks	Number of hours spent on duty on that day and the previous days
Number of hours sleep in the 96 hours prior to the incident	Any other factors, on board or personal, that may have affected sleep.
Whether smoker, and if so, quantity	Normal alcohol habit
Alcohol consumption immediately prior to incident or in the previous 24 hours	Whether under prescribed medication
Any ingested non-prescribed drugs	Records of drug and alcohol tests

1.5 **Particulars of sea-state, weather and tide**

Direction and force of wind	Direction and state of sea and swell
Atmospheric conditions and visibility	State and height of tide
Tide and tidal stream information	Currents

Cross check with independent sources

1.6 **Particulars of the incident**

Type of incident	Date, time and place of incident
Details of incident and of the events leading up to it and following it	Details of the performance of relevant equipment with special regard to any malfunction
Persons on bridge	Persons in engine-room
Whereabouts of the master and chief engineer	Mode of steering (auto or manual)
Extracts from all relevant ship and, if applicable, shore documents including details of entries in official, bridge, scrap/rough and engine-room log books, data log printout, computer printouts, course and engine speed recorder, radar log, etc.	Details of communications made between vessel and radio stations, SAR centres and control centres, etc., with transcript of tape recordings where available
Details of any injuries/fatalities	Voyage data recorder information (if fitted) for analysis

1.6 **Particulars of the incident**

Type of incident	Date, time and place of incident
Details of incident and of the events leading up to it and following it	Details of the performance of relevant equipment with special regard to any malfunction
Persons on bridge	Persons in engine-room
Whereabouts of the master and chief engineer	Mode of steering (auto or manual)
Extracts from all relevant ship and, if applicable, shore documents including details of entries in official, bridge, scrap/rough and engine-room log books, data log printout, computer printouts, course and engine speed recorder, radar log, etc.	Details of communications made between vessel and radio stations, SAR centres and control centres, etc., with transcript of tape recordings where available
Details of any injuries/fatalities	Voyage data recorder information (if fitted) for analysis

1.7 **Assistance after the incident**

If assistance was summoned, what form and by what means	If assistance was offered or given, by whom and of what nature, and whether it was effective and competent
If assistance was offered and refused, the reason for refusal	

1.8 Authentication of documents by Master or officer-in-charge

1.9 Engine room orders – promptness of response.

1.10 External sources of information

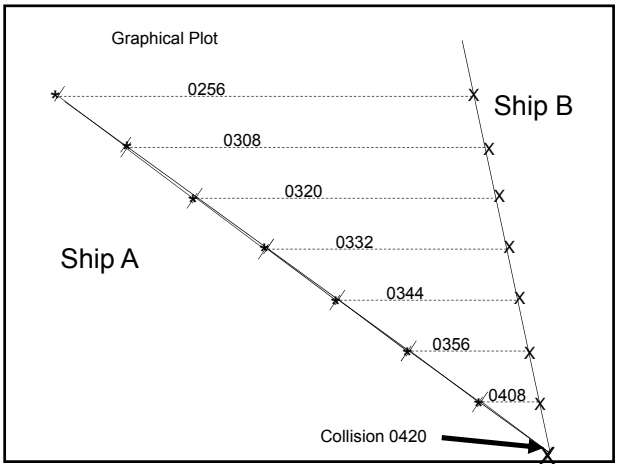
VTS, radio recordings, telecommunications providers, Rescue co-ordination centres, coroners, medical records, port authorities, pilots etc.

2.1 **Fire/Explosion**

How was the ship alerted to the fire	How was the individual alerted to the fire?
Where did it start? (	What was the immediate action taken?
Condition of fire-fighting equipment, supported by dates of survey/examination	Extinguishers available: Type available in the vicinity; Types available on the ship; Types used
Hoses available/used	Pumps available/used
Was water immediately available?	Were air vents closed off to the space?
What was the nature of the material on fire and surrounding the fire?	Fire retardant specification of bulkheads surrounding the fire
Restrictions caused by (a) smoke, (b) heat, (c) fumes	Freedom of access
Access availability for fire fighting equipment	Preparedness of crew - Frequency, duration, content and locations of fire musters and drills
Alarms/Alerts used	Response by land-based fire-fighting brigades

Collisions

General	Obstructions, if any, to manoeuvring, e.g. by a third vessel, shallow or narrow waters, beacon, buoy, etc.	Circumstances affecting visibility and audibility, e.g. state of the sun, dazzle of shore lights, strength of wind, ship-board noise and whether any door or window could obstruct look-out and/or audibility
Collision	Local or other special rules for navigation	Possibilities of interaction
2.2	Geographical plot	Name, IMO number, nationality and other details of other vessel



Collision - For each ship:	Time, position, course and speed (and method by which established), when presence of other ship first became known	Number of radars carried on ship, number operational at time of casualty, together with ranges used on each radar
	If other ship was plotted and by what method (auto-plot, reflection plotter, etc.), and copy of plot, if available	If a listening watch was kept on VHF radio channel 16, or other frequency, and any messages sent, received or overheard
	Bearing, distance and heading of other ship, if sighted visually, time of sighting, and subsequent alterations	Bearing and distance of other ship, if observed by radar, timing of observations and subsequent alterations of bearing
	Details of all subsequent alterations of course and speed up to collision by own ship	Lights/day signals carried and operated in ship, and those seen in other ship
	Check performance of equipment	Course recorder
	Sound signals, including fog signals, made by ship and when, and those heard from other ship and when	Whether steering by hand or automatic
	Check that steering was operating correctly	Details of look-out
	The parts of each ship which first came into contact and the angle between ships at that time	Nature and extent of damage
	Compliance with statutory requirement to give name and nationality to other ship and to stand by after collision	Bridge manning

2.3 Grounding	Details of voyage plan, or evidence of voyage planning	Last accurate position and how obtained, GPS, radio, radar or otherwise, or by lines of soundings and, if not taken, why not
	Chart datum comparison to WGS datum	Subsequent opportunities for fixing position or position lines, by celestial or terrestrial observations
	Subsequent weather and tidal or other currents experienced	Effect on compass of any magnetic cargo, electrical disturbance or local attraction
	Radar/s in use, respective ranges used, and evidence of radar performance monitoring and logging	Charts, sailing directions and relevant notices to mariners held, if corrected to date, and if any warnings they contain had been observed
	Depth sounding taken, when and by what means	Tank soundings taken, when and by what means
	Ship's squat table	Position of grounding and how determined
	Draught of ship before grounding and how determined	Readiness of anchors, their use and effectiveness
	Cause and nature of any engine or steering failure before the grounding	Action taken, and movements of ship, after grounding
	Nature and extent of damage	

2.4 Foundering	Draught and freeboard on leaving last port and changes consequent upon consumption of stores and fuel	Particulars of any alterations to hull or equipment, since survey, and by whom such alterations sanctioned
	Freeboard appropriate to zone and date	Loading procedures, hull stresses
	Condition of ship, possible effects on seaworthiness	Stability data and when determined
	Factors affecting stability, e.g. structural alterations, nature, weight, distribution and shift of any cargo and ballast, free surface in tanks or of loose water in ship	Subdivision by watertight bulkheads
	Position of, and watertight integrity of, hatches, scuttles, ports and other openings	Number and capacity of pumps and their effectiveness; the position of suctions
	Cause and nature of water first entering ship	Other circumstances leading up to foundering
	Measures taken to prevent foundering	Position where ship foundered and how established
	Life-saving appliances provided and used, and any difficulties experienced in their use	

Pollution Incident

2.5 **Pollution resulting from an incident**

Type of pollutant	UN number/IMO hazard class (if applicable)
Type of packaging (if applicable).	Quantity on board.
Quantity lost	Method of stowage and securing
Where stowed and quantities in each compartment/container	Tanks/spaces breached
Tanks/spaces liable to be breached	Action taken to prevent further loss
Action taken to mitigate pollution	Dispersant/neutraliser used, if any
Restricting boom used, if any	

The Code for the Investigation of Marine Casualties and Incidents MSC. 255(84)

The aim is to promote a common approach to the investigation of marine casualties and incidents and to promote co-operation between States, to:

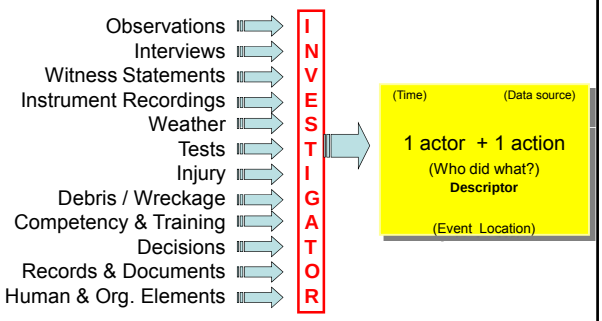
- **introduce best practice safety investigation**
- **aid remedial action**
- **promote uniform input to accident data base**
- **create a uniform system which applies to seafarers wherever they are in the world**

The Code for the Investigation of Marine Casualties and Incidents MSC. 255(84)

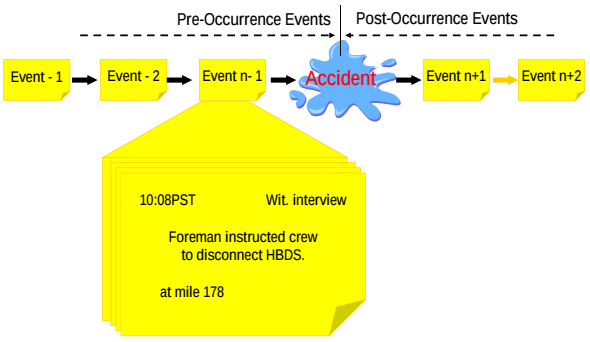
The "CODE"

- SOLAS Chapter XI 1 amended to make parts I and II of the Code mandatory. Part III of the Code contains related guidance and explanatory material.
- The Code will require a marine safety investigation to be conducted into every "very serious marine casualty"
- The Code will also recommend an investigation into other marine casualties and incidents, if it is considered likely that it would provide information that could be used to prevent future accidents
- The new regulations expand on SOLAS Regulation I/21, which requires Administrations to undertake to conduct an investigation of any casualty

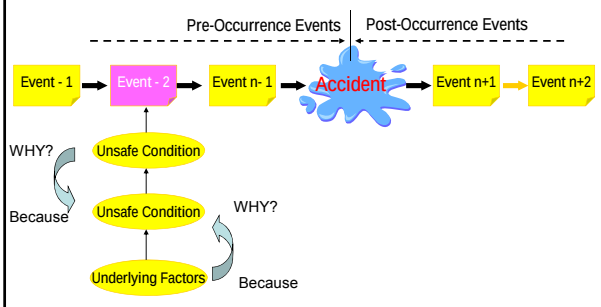
Module 3. Accident Sequence of Events



Sequence of Events - Convention



Sequence of Events - Convention



MSC Resolution 255 (84)

Code for the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident

This session covers the development and content of the Code for the Investigation of Marine Accidents and Incidents

Brief Historical Overview

1970 – Res. A.173 (ES IV) – Participation in Official Inquiries into Marine Casualties Submitted by Liberia

1980 – Res. A. 440 (XI) – Exchange of Information for Investigations into Marine Casualties

1990 – Res. A. 637 (16) – Cooperation in Marine Casualty Investigations submitted by Liberia (IRI – Bill Chadwick)

1992 – 14 administrations met in Ottawa and resolved to formulate ameasures equivalent to the ICAO Annex 13 provisions

1994 – Australia, Hong Kong & Vanuatu submitted a draft 'Code" of investigation. 1996 &1997 a Code formulated at FSI and approved in Res. A. 849 (20) Nov 97.

2004 – Australia, Canada & Vanuatu submitted a request for a review of Res.A.849 (20), a new mandatory Code. Code approved in 2007.

The Code for the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident will be given effect by MSC 257 (84) which creates Regulation 6 of SOLAS Ch.XI-1.

The Code deemed to be accepted as of 1 July 2009

The Code will come into force on 1 January 2010

The Code

Foreword

Part I – General Provisions

Part II - Mandatory Standards

Part III - Recommended Practices

The Foreword :

- outlines the background to the Code, citing early attempts to encourage cooperation in marine accident between flag States'.
- traces the development of SOLAS Regulation 21 from its adoption in SOLAS 48.
- emphasises that, increasingly, the coastal States exercise their jurisdiction over accidents occurring in their territorial sea.
- the need for special protection and fair treatment of seafarers.
- notes the changes in the maritime industry since the 1948 Convention and the number of States that may have an interest in a marine accident.
- recognises the variation in international and national laws governing the investigation of marine casualties.

The General Provisions

Chapter 1 - Purpose

- to adopt an international common approach to safety investigations
- is not to apportion liability or blame
- the emphasis on causal factors
- providing a report to the Organization
- separate and independent of other investigations
- to include flag State obligations and coastal/port State interests

Chapter 2 - Definitions

The General Provisions

Chapter 2 - Definitions

Interested Party – an organization or individual who, as determined by the Marine safety investigating State(s), has significant interests, rights or legitimate expectations with respect to the outcome of a marine safety Investigation.

Marine Safety Investigation – an investigation (or inquiry) conducted with the objective of preventing casualties in the future.

Marine safety record – includes all statements, communications relating to the ship or equipment, medical and private information, records of analysis or evidence gathered, VDR data.

Substantially Interested State – Flag State, Coastal State, States affected by pollution, States of deceased/injured, State of crew, State with important information, State adjudged to have significant interest.

Very serious marine casualty – means a Marine Casualty involving the total loss of a ship or a death or severe damage to the environment.

The Code – Part II

Chapter 3 – Application of Chapters in Parts II and III

- Part II of the Code contains mandatory provisions for marine safety investigations
- Part III contains recommended practices for safety investigations.

Chapter 4 – Marine Safety Investigation Authority

4.1 The Government of each State must provide the Organization with detailed contact information of the Marine Safety Investigation Authority(ies) carrying out Marine Safety Investigations within their State.

Chapter 5 - Notification

Covers the need for States to notify each other of marine casualties at the earliest opportunity.

Should contain as much of the information outlined in 5.4 as possible

The Code – Part II

Chapter 6 – Requirement to Investigate 'Very Serious' Marine Casualties

A marine casualty shall be conducted into every 'very serious' marine casualty. Subject to Chapter 7, the flag State shall be responsible for ensuring that the casualty is conducted in accordance with the Code.

Chapter 7 – Flag State's Agreement with Another Substantially Interested State to Conduct a Marine Safety Investigation

Where a casualty occurs within the territory of a coastal State, the coastal State will seek agreement on which State will be the Investigating State.

Where agreement is not reached the right remains for each State to conduct its own investigation.

By fully participating in an investigation under the Code conducted by another SIS, the flag State fulfils its obligations under this part.

The Code – Part II

Chapter 8 – Powers of an Investigation

Requires all States to ensure that their national laws provide investigator(s) with the ability to board ships, interview the master, crew and other persons involved and acquire evidence;

Chapter 9 – Parallel Investigations

Where an investigation is being conducted under the Code another substantially interested State (SIS) should be allowed to conduct its own separate investigation. This may require coordination for access to witnesses and evidence.

Chapter 10 – Co-operation

All SIS must co-operate with the marine safety investigating State(s) to the extent practicable. The marine safety investigating State(s) must provide for the participation of the SIS to the extent practicable.

The Code – Part II

Chapter 11 – Investigations not to be Subject to External Direction

Investigations must be impartial and objective and must not be subject to direction or influence of persons or organizations that my be affected by its outcome.

Chapter 12 – Obtaining Evidence from Seafarers

Evidence/interviews should be conducted at the earliest practicable opportunity.

Seafarers must be informed of the nature of the investigation. Seafarers must be allowed access to legal advice regarding:

- risks of incrimination
- any right to remain silent and not incriminate themselves
- protections that prevent their evidence being used against them.

The Code – Part II

Chapter 13 – Draft Marine Safety Report

When an investigation report is at the final draft stage it should be circulated to SIS for comment, but only when:

- the SIS guarantees not to circulate or publish the draft unless the investigating State gives consent or has already published the draft.
- the SIS does not agree to bar the report from any civil or criminal court proceedings.

The investigating State must invite the SIS to submit comments within an agreed period, such as 30 days. The Investigating State must consider the comments before preparing the final report and inform the SIS of those that have been accepted or rejected. If the investigating State does not receive comment within the time agreed the investigating State may proceed to finalize the report.

The investigating State must seek to fully verify the accuracy and completeness of the draft by the most practicable means.

The Code – Part II

Chapter 14 – Marine Safety Investigation Reports

Any marine safety investigation report into a 'very serious casualty must be submitted to IMO.

Marine safety investigations into marine casualties other than 'very serious casualties' that contain information which may prevent or lessen the seriousness of casualties or incidents must be submitted to IMO.

Reports must use all the information obtained in the investigation to ensure that all the relevant safety issues are included and understood as a basis fir taking safety actions.

Final reports must be made available to the public and the shipping industry.

The Code – Part III (Recommended practices)

Chapter 15 – Administrative Responsibilities

States should have sufficient material and financial resources and suitably qualified personnel to conduct investigations under the Code:

- Investigators should be appointed on the skills in Res.A.973(24)
- Experts with particular specialised skills may be appointed
- Investigators should operate in accordance with the Code.

The Code – Part III

Chapter 16 – Principles of Investigation

Marine Safety Investigations should :

• be unbiased and independent of parties involved in the casualty/incident, decision makers covering disciplinary and/or administrative action and judicial proceedings.

• be free from interference in collecting evidence, analysing and determining causal factors, distributing draft reports and framing recommendations.

• be safety focused.

• seek to maximise co-operation between SIS and all other parties.

• enjoy equal priority with other investigations (criminal, admin, etc.)

• have access to records held by SIS, survey records and all data.

• have access to evidence provided by Gov't employees, pilots. Etc.

• go beyond immediate causes and identify all underlying conditions that impacted on the chain of events leading to the casualty.

The Code – Part III

Chapter 17 – Investigations of Marine Casualties (Other Than Very Serious Casualties) and Marine Incidents.

A marine safety investigation should be carried out into any marine casualty (other than a very serious casualty) if it is considered that the investigation will provide information that can be used to prevent marine casualties and incidents in the future. The provisions of Chapter 7 should be followed where other SIS are involved.

The Code – Part III

Chapter 18 – Factors That Should Be Taken into account When Seeking Agreement Under Chapter 7 of Part II.

When seeking agreement on who will be the Investigating State the following factors should be taken into account:

- where the incident occurred;
- where the ship is physically located;
- the resources and commitment required to investigate;
- the scope of the investigation
- the SIS with best access to critical evidence;
- the impact of the casualty on other SIS
- the nationality of passengers, crew and other persons affected.

The Code – Part III

Chapter 19 – Acts of Unlawful Interference

If in the course of a safety investigation it becomes known or suspected that an offence has been committed under the Convention for the Suppression of Unlawful Acts Against the Safety of Marine Navigation, the maritime security authorities of that State should be informed.

The Code – Part III

Chapter 20 – Notification to Parties Involved and Commencement of an Investigation

When an investigation is to be undertaken, the master, the owner and agent should be informed of the investigation and:

- the incident under investigation
- time and place of starting the investigation
- contact details of the investigator and the investigating authority
- the relevant legislation governing the investigation
- the rights and obligations of the parties subject to investigation
- the rights and obligations of the investigating State
- each State should develop a form covering the above issues
- the investigating State should not delay any vessel than is absolutely necessary.

The Code – Part III

Chapter 21 – Co-ordinating an Investigation

The issues of co-operation and non-interference apply.

All States should ensure there is a framework for:

- appointing investigators
- supporting the investigation
- planning investigations
- liaising with other SIS
- investigating in accordance with Resolution A.884(21)
- taking into account instruments published by other Organizations
- the International Management Code for the Safe Operation of Ships and for Pollution Prevention procedures are taken into account
- allowing participating SIS to have access to evidence and witnesses

SIS should assist in ensuring access to records and relevant personnel (pilots, VTS operators etc)

Flag States should assist in making ships' crew available.

The Code – Part III

Chapter 22 – Collection of Evidence

- ships should not be delayed unnecessarily
- original documents or equipment should not be removed unless essential for the purposes of the investigation
- investigators should take copies of documents unless original documents are absolutely necessary
- records of interview and other evidence should be secure from outside personnel
- effective use should be made of the VDR
- State with resources to aid investigation should help those without such resources.

I have no doubt that it was as a direct result of that assurance that the owners and managers of Bowbelle assisted the FI as fully as they did. Clarke LJ

The Code – Part III

Chapter 23 – Confidentiality of Information

Information from a marine safety record should only be disclosed where:

- after taking into account the impact of such disclosure, it is necessary for transport safety, or
- it is allowed under the Code.

Generally, marine safety records should not be disclosed in disciplinary, civil, criminal or administrative proceedings.

Generally marine safety records should not appear in the safety report, unless pertinent to the analysis.

States need only supply information to a SIS where the principles of the Code are followed.

The Code – Part III

Chapter 24 – Protection for Witnesses and Involved Parties

If a person is required by law to provide evidence that may incriminate them, for the purposes of a Marine Safety Investigation, the evidence should, so far as national laws allow, be prevented from admission into evidence in civil or criminal proceedings against the individual.

A person from whom evidence is sought should be informed of the basis of the investigation, any potential risks in subsequent proceedings, their rights and protections offered.

The Code – Part III

Chapter 25 – Draft and Final Report

Investigation reports should be finished as quickly as possible.

Where practicable and where draft reports will not be disclosed, draft reports should be circulated to interested parties under natural justice principles.

Time should be allowed for comment and submissions on the draft report.

Where national law arrives, neither a draft report nor a final report should be admissible in proceedings that may lead to a criminal conviction, disciplinary measures, or the determination of civil liability.

At any stage of an investigation interim safety measures may be recommended.

Where an SIS disagrees with a final report, the SIS may submit its own report to IMO.

The Code – Part III

Chapter 26 – Re-opening an Investigation

The presentation of new evidence may alter the analysis and findings of a casualty which will require the investigation to be reopened. Such new evidence should be fully assessed by SIS.

Understanding human factors

This session covers some basic issues in the way people behave and includes:

- Knowledge based, rule based, skill based framework
- Generic error modelling system
- Violations (adaptations)
- Stress/performance
- SHEL model
- Organisational culture
- Reason Model
- Culpability

MAIB Safety Digest 3/2001

"The question the professional marine accident investigator repeatedly finds himself asking is why, with so much talk about the human factor, does the mariner understand so little about it, and why do people at sea - often well trained - make mistakes? ...

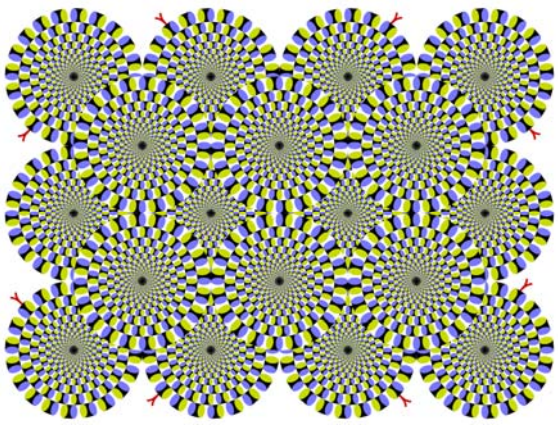
"Very little has ever been written on the subject for the man or woman at sea. There is an abundance of academic literature which quickly lapses into language that leaves the average seafarer totally bewildered, and few will have the foggiest idea what is meant by 'visual/tactile dissimilarity', 'cognitive aspects of safety', 'rule-based behaviour', 'latent conditions and pathogens' or 'non-optimised performance-shaping factors.' What the seafarer needs is a simple explanation about what is meant by human factors so he or she can better understand why it matters, and what needs to be done to improve safety and conditions of service"

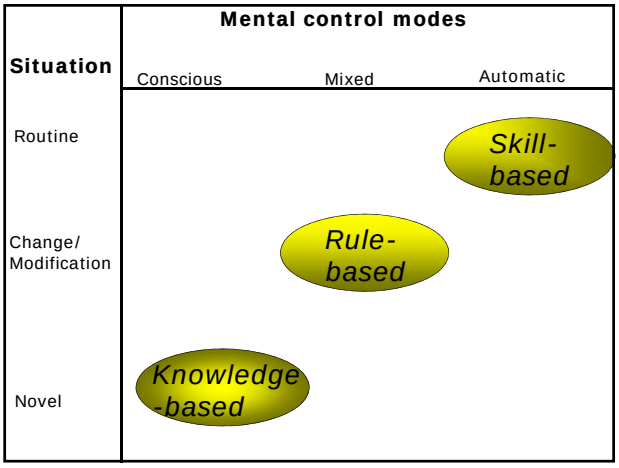
Rear Admiral John Lang Retired Chief Inspector of Marine Accidents

Human Factors?

Human factors is the multi-disciplinary science that applies knowledge about the capabilities and limitations of human performance to all aspects of the design, manufacture, operation, and maintenance of products and systems.

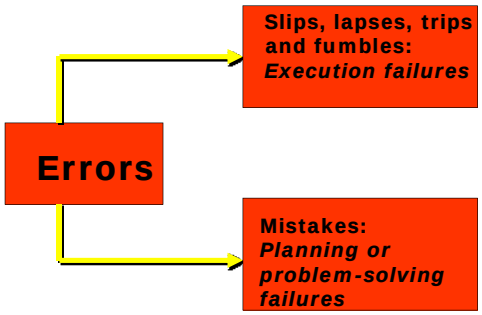
It considers the effects of physical, psychological, and environmental factors on human performance in different task environments, including the role of human operators in complex systems.

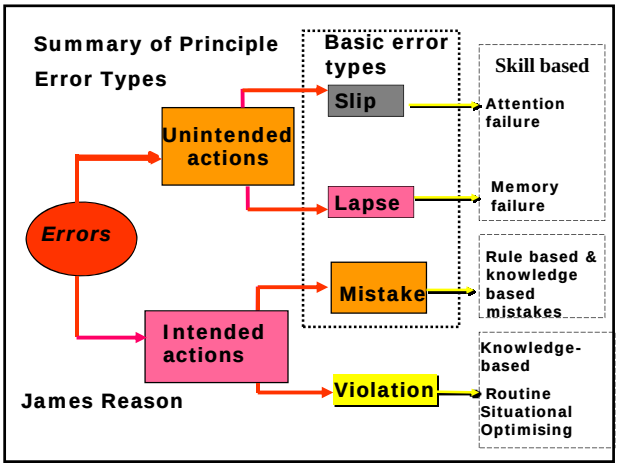




. . . , investigate how people's assessments and actions would have made sense at the time, given the circumstances that surrounded them.

Errors - The basic distinction





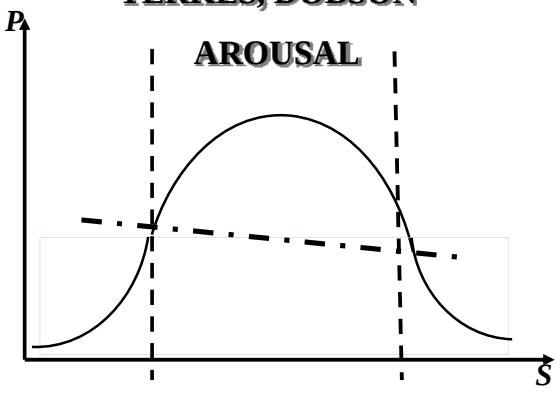
Violation types

- **Routine violations**
- **Situational/Exceptional violations**
- **Optimising violations**

Performance

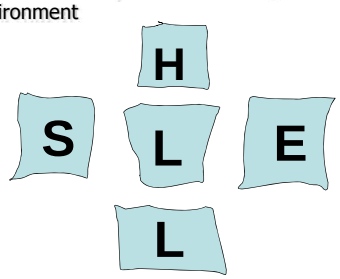
Competence	Aptitude	Psychological pre-disposition
Technical skills	**Non-technical skills**	Alertness
The ability to perform consistently at a given level of qualification.	Interpersonal • Communications • Leadership • Team functions • Workload management Cognitive • Situational awareness • Decision making • Metacognition	• Hours of work • Motivation • Stress • Psychological well being

YERKES, DOBSON AROUSAL



External Influences

Man's relationship with his working environment



L = Liveware

- The man (or woman). The most valuable, and flexible, component.
- Subject to great variations in performance
- People come in different shapes and sizes
- Deficiencies in "fuel" (food and drink) affect performance.
- Information processing ability is very limited
- Environmental tolerance limited

H=Hardware

- The man machine interface
- Matching displays to the information processing characteristics of man
- Controls must correspond to man's information processing ability
- Poor location of instruments, sources of information and controls

S=Software

- The non-physical aspects of a system
- Includes procedures, manuals, symbols and check lists
- Computer programmes

E=Environment

Measures to match man with his working environment

- Temperature and humidity controls
- Soundproofing and ear defenders
- Disturbances to sleep and rest
- Night and day considerations and lighting levels

L=Liveware

- The relationship between people
- The team that works together will always be better than the one that is in constant conflict
- Peer group pressures
- Personality interactions
- Encouragement is invariably more productive than constant criticism

Organisational Culture – Handling Safety Information Ron Westrum - 1992		
Pathological culture	Bureaucratic culture	Generative culture
• **Don't want to know** • **Responsibility is shirked** • **Failure is punished or concealed** • **Messengers are shot** • **New ideas actively discouraged**	• **May not find out** • **Messengers listened to if they arrive** • **Compartmentalised responsibility** • **Failures repaired locally** • **New ideas often present problems**	• **Actively seek it** • **Messengers are trained and awarded** • **Responsibility is shared** • **Failure leads to far-reaching reform** •**New ideas welcomed**

Three approaches to Safety Management - 1 The person Model

- Traditional occupational safety approach
- Persons free agents to choose between safe and unsafe behavior
- Errors shaped by psychological factors
- Individual motivation questioned – culpable recklessness
- Often measured by *'lost time injury'* data
- Underpinned by the '*iceberg*' or '*pyramid*' view of accidents

Three approaches to Safety Management - 2 The Engineering model

- Safety is engineered into the system
- Based on reliable equipment, and
- ergonomic design
- Failure to match equipment with operator
- Safety case
- Highly technical operations (nuclear power etc)

Three approaches to Safety Management - 3 The Organizational Model

- Human error, a consequence rather than cause
- Errors are symptoms that expose latent conditions
- The concept of defences
- Emphasis on '*safety health*'
- Need for continual reform
- Mismatches the result of prior decisions at senior levels

Individual V Organisational

Exclusive control?

Accidents in which the individual or the group is both the initiator and victim. Limited in effect.

Shared responsibility?

Involves people at all levels of an organisation. Multi-causal with severe external effect

Two levels of investigation

Individual operator/owner

Understand the context in which the accident occurred in terms of individual responsibility and relevant regulations.

Involving an organization/company

Understand the context and organizational environment in which the accident occurred and the different levels of responsibility.

Potential weaknesses in the accreditation/regulation system.

What are the elements of an organization or company?

How does it operate?

Systemic investigations

Systemic – concerned with the whole body – not confined to a particular part.

What is a system?

An assemblage or combination of things or parts forming a complex or unitary whole.

Macquarie Dictionary

A complex whole: a set of connected things or parts.

Oxford Concise Dictionary

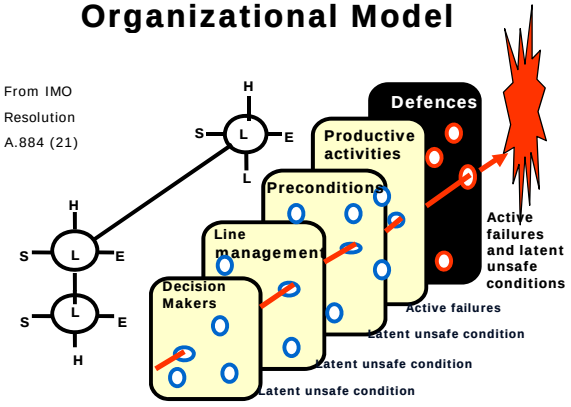
For those who pick over the bones of other people's disasters, it often seems incredible that these warnings and human failures, seemingly so obvious in retrospect should have gone unnoticed at the time.

Being blessed with both uninvolvement and hindsight, it is a great temptation for retrospective observers to slip into a censorious frame of mind and to wonder at how these people could have been so blind, stupid, arrogant, ignorant or reckless . . ."

Human Error, Reason J, 1991

Organizational Model

From IMO Resolution A.884 (21)



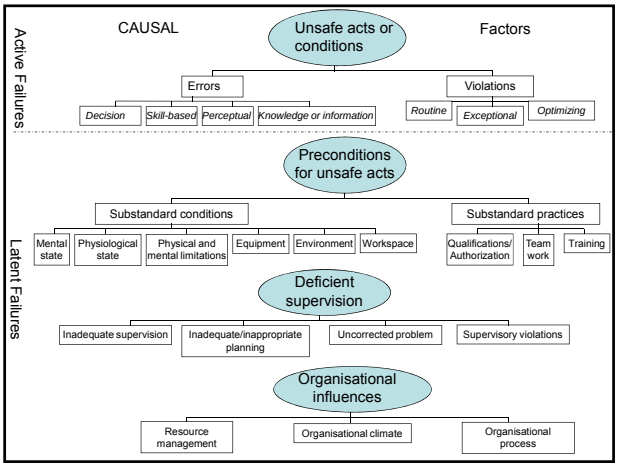
Active Failures Compared to Latent Conditions

- Occur at different levels in the system
  - Active errors happen at the "sharp end"
  - Latent failures are the product of management decisions
- Have different consequences
  - Active failures have immediate effects
  - Latent failures have delayed effects
- Have different durations
  - Active failures are short lived
  - Latent failures may continue for many years
- Offers different remedial solutions
  - Active failures are hard to anticipate
  - Latent failures are present *NOW*

An unsafe condition is a potential error in the system which will be activated by particular hazard which exposes the unsafe condition.

Reason Model

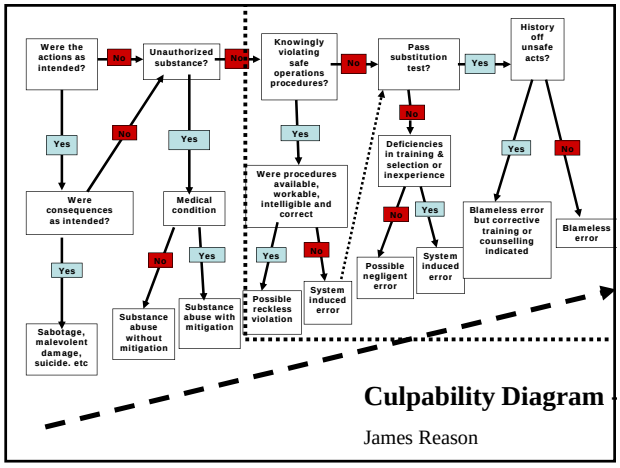
- **Focuses on sources of problems rather than symptoms.**
- **Clear difference between *active failures* and *latent conditions* (though both lead to flaws in defences).**
- **Latent conditions are present in all systems.**
- **Concept of defences (and also failures or problems in depth).**



An error becomes and 'unsafe act' when made in the presence of a hazard.

". . . If a lesson is to be learned from this book it is that the next time one hears about a disaster as a result of 'human error', 'operator error', 'pilot error', 'faulty technical design', or 'interlocking complexities' one should think twice about the account that is being offered."

Robert Allinson,
Global Disasters,
(1990)



This session reviews the human factors issues in terms of the IMO Guidelines

Accidents appear to be the result of highly complex coincidences which could rarely be foreseen by the people involved.

Wageneer & Groenweg 1988

Reason Model

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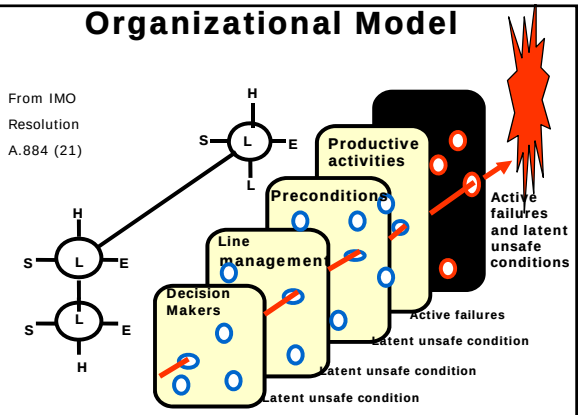
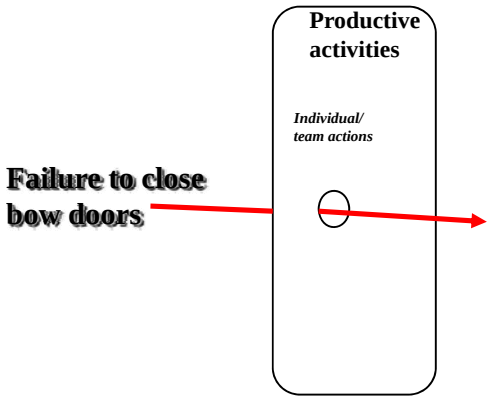
Organizational Model

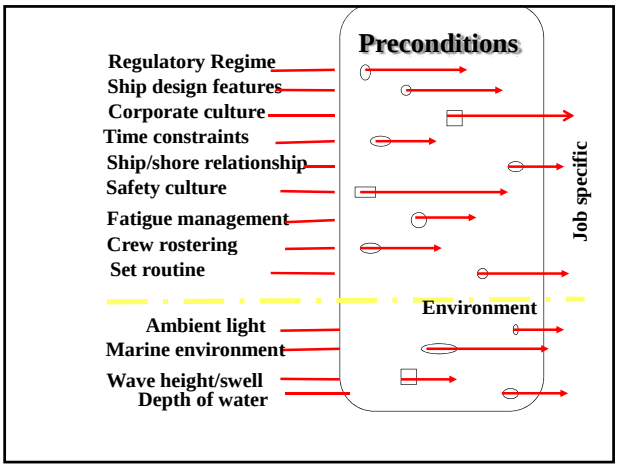
From IMO Resolution A.884 (21)

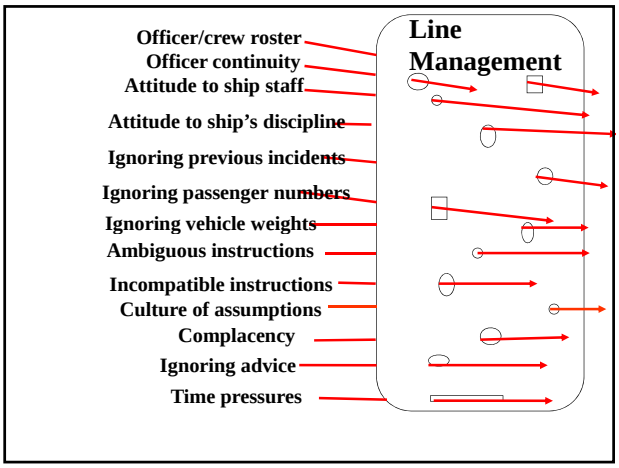


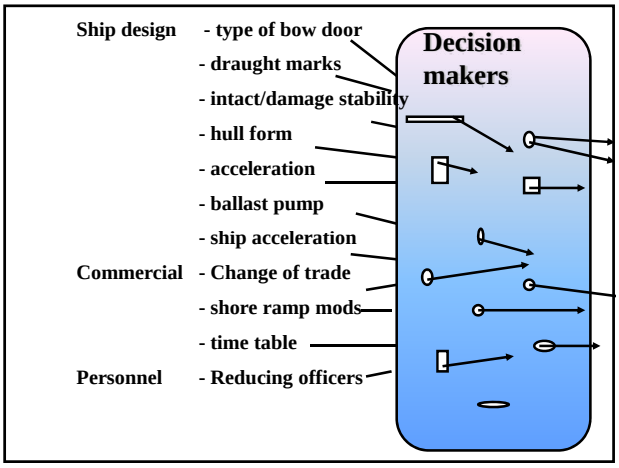
The general nature of the Reason Model

According to the model, accidents rarely result solely from the actions of system operators. Rather most accidents are due to a combination of failures originating at all levels of the organization and from factors outside the organisation.









What are 'defences'?

- **Measures put in place by an organization to facilitate and assure safe performance of the operation and its parts.**
- **Prevent hazards resulting in losses**
- **A critical output of a management system.**
- **Things that can be changed to improve safety in the future**
- **If weak or deficient or missing can be termed a safety deficiency.**

Types of defence

Preventative and recovery

Types of defence

Preventative (functions)–

- Prevent or minimise exposure to hazards
- Give clear guidance on how to operate safely
- Create understanding and awareness of local hazards

Types of defence

Preventative –

- procedures and check lists
- training and education
- task design
- equipment design
- equipment availability (right tools)
- job design (the correct way of doing the job)
- work schedules
- staffing levels
- employee selection (right person for the job)
- performance monitoring, supervision (and feedback)
- regulations

Types of defence

Recovery (functions)

- Provide alarms and warnings of danger
- Restore system to a safe state
- Put barriers between people and hazards
- Contain and eliminate hazards
- Provide means of escape

Types of defence

Recovery

- warning systems
- suppression systems
- restoration systems
- emergency equipment
- emergency procedures
- emergency training
- design of ship.

FAILED OR MISSING DEFENCES

Awareness (understanding, guidance)	Detection / warning	Restore / recover	Protection	Contain / eliminate	Escape / rescue
Routine Procedures	Door alarms	Freeboard deck scuppers	Training	Ship design	Lifeboats
Alertness to danger	Water on deck alarms	Pumps of sufficient capacity	Job skill	Damage stability criteria	Life rafts
Experience	Car-deck watch	Protection against free-surface	Fatigue management	Depth of margin line	Exits
Safe work roster	Visibility from bridge		Safety culture		Ladders
	Reporting		Procedures		Emergency training
			Reduce free surface		Life jackets

A matrix for locating specific latent failures

Maurino, Reason, Johnston and Lee

Mode / Function	Engineered safety features	Standards, policies controls	Procedures, instructions, supervision	Training, briefings, drill	Personal protective equipment
Awareness	Alarms	Notices/Experience /safety culture	Procedures safe working		
Detection	Sensors	Safety culture	Procedures		
Protection	Ship's hull	Maintenance policy	Procedures	Training	
Recover	get rid of water	Two person check	Procedures	Emergency training	
Contain	Design to reduce free surface		Procedures	Emergency training Experience	
Escape	Lifeboats, liferafts	Evacuation planning	Evacuation procedures	Evacuation training	Lifejackets Survival clothing

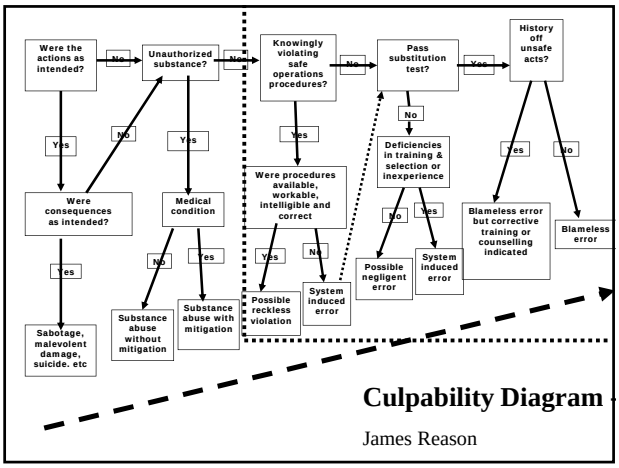
"From top to bottom the body corporate was infected with the disease of sloppiness.

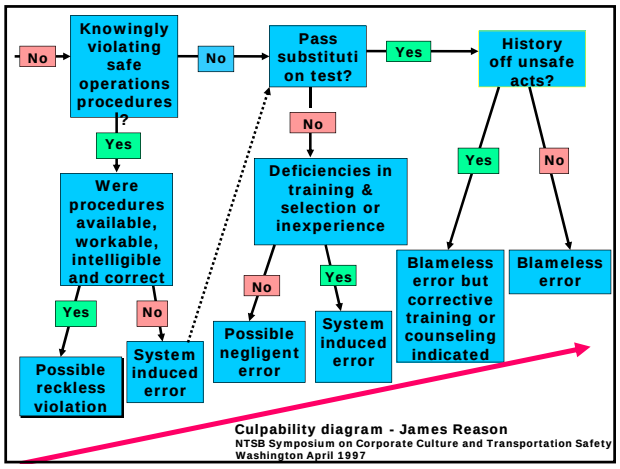
. . . The failure on the part of the shore management to give proper and clear direction was a contributory cause of the disaster. . . . "

Mr Justice Sheen, Wreck Commissioner,

Report of Court No.8074

Formal Investigation, mv *Herald of Free Enterprise*


Were the actions as intended?
Unauthorized substance?
Knowingly violating safe operations procedures?
Pass substitution test?
History off unsafe acts?
Were consequences as intended?
Medical condition
Were procedures available, workable, intelligible and correct
Deficiencies in training & selection or inexperience
Blameless error but corrective training or counselling indicated
Blameless error
Sabotage, malevolent damage, suicide. etc
Substance abuse without mitigation
Substance abuse with mitigation
Possible reckless violation
System induced error
Possible negligent error
System induced error
Culpability Diagram
James Reason


Knowingly violating safe operations procedures?
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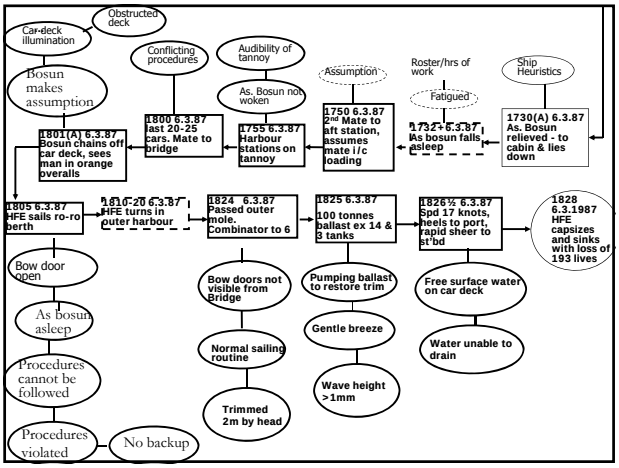
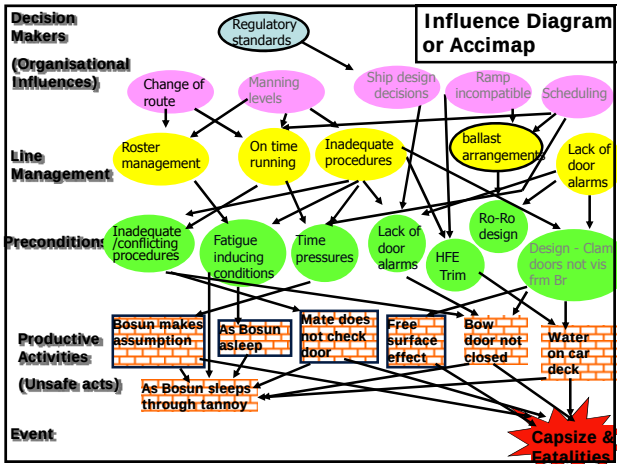
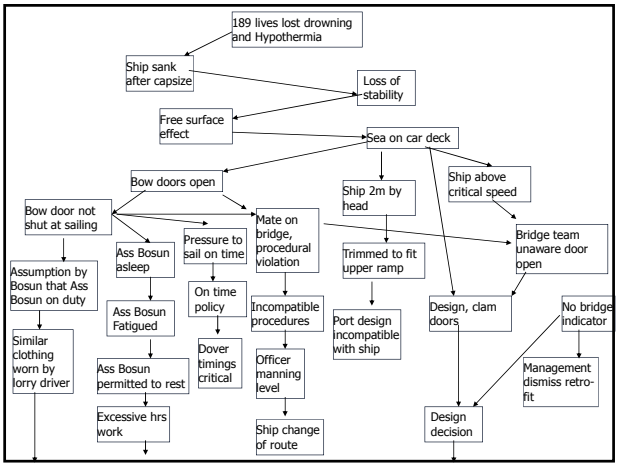
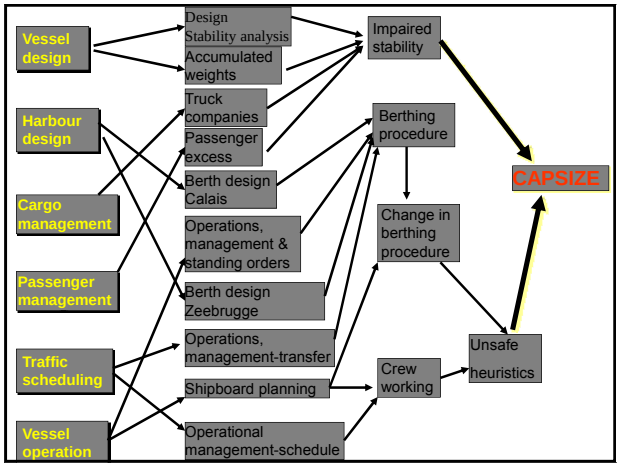
Blameless error
Possible reckless violation
System induced error
Possible negligent error
System induced error
Culpability diagram - James Reason
NTSB Symposium on Corporate Culture and Transportation Safety
Washington April 1997


Obstructed deck
Car deck illumination
Conflicting procedures
Audibility of tannoy
Bosun makes assumption
As. Bosun not woken
Assumption
Roster/hrs of work
Fatigued
Ship Heuristics
1801(A) 6.3.87 Bosun chains off car deck, sees man in orange overalls
1800 6.3.87 last 20-25 cars. Mate to bridge
1755 6.3.87 Harbour stations on tannoy
1750 6.3.87 2nd Mate to aft station, assumes mate i/c loading
1732 6.3.87 As bosun falls asleep
1730(A) 6.3.87 As. Bosun relieved - to cabin & lies down
1805 6.3.87 HFE sails ro-ro berth
1810-20 6.3.87 HFE turns in outer harbour
1824 6.3.87 Passed outer mole. Combinator to 6
1825 6.3.87 100 tonnes ballast ex 14 & 3 tanks
1826½ 6.3.87 Spd 17 knots, heels to port, rapid sheer to st'bd
1828 6.3.1987 HFE capsizes and sinks with loss of 193 lives
Bow door open
As bosun asleep
Procedures cannot be followed
Procedures violated
No backup
Bow doors not visible from Bridge
Normal sailing routine
Trimmed 2m by head
Pumping ballast to restore trim
Gentle breeze
Wave height >1mm
Free surface water on car deck
Water unable to drain


Decision Makers
(Organisational Influences)
Regulatory standards
Influence Diagram or Accimap
Change of route
Manning levels
Ship design decisions
Ramp incompatible
Scheduling
Line Management
Roster management
On time running
Inadequate procedures
ballast arrangements
Lack of door alarms
Preconditions
Inadequate /conflicting procedures
Fatigue inducing conditions
Time pressures
Lack of door alarms
Ro-Ro design
HFE Trim
Design - Clam doors not vis frm Br
Productive Activities
(Unsafe acts)
Bosun makes assumption
As Bosun asleep
Mate does not check door
Free surface effect
Bow door not closed
Water on car deck
As Bosun sleeps through tannoy
Event
Capsize & Fatalities


189 lives lost drowning and Hypothermia
Ship sank after capsize
Loss of stability
Free surface effect
Sea on car deck
Bow doors open
Ship 2m by head
Ship above critical speed
Bow door not shut at sailing
Mate on bridge, procedural violation
Pressure to sail on time
Bridge team unaware door open
Assumption by Bosun that Ass Bosun on duty
Ass Bosun asleep
On time policy
Trimmed to fit upper ramp
Ass Bosun Fatigued
Incompatible procedures
Design, clam doors
No bridge indicator
Similar clothing worn by lorry driver
Ass Bosun permitted to rest
Dover timings critical
Port design incompatible with ship
Officer manning level
Management dismiss retro-fit
Excessive hrs work
Ship change of route
Design decision


Vessel design
Design Stability analysis
Accumulated weights
Impaired stability
Harbour design
Truck companies
Passenger excess
Berthing procedure
CAPSIZE
Cargo management
Berth design Calais
Operations, management & standing orders
Change in berthing procedure
Passenger management
Berth design Zeebrugge
Traffic scheduling
Operations, management-transfer
Unsafe heuristics
Crew working
Shipboard planning
Vessel operation
Operational management-schedule

Resolution A.884(210)

Amendments to the Code for the Investigation of Marine Casualties and Incidents (Resolution 849(20)

This session discusses the advice from IMO on the investigation of human factors.

Recalling resolution A. 849 (20)

Considering that practical advice for the systematic investigation of human factors in marine casualties and incidents will assist in the effective analysis and promote the identification and implementation of preventative action.

Invites Governments to implement the Guidelines as soon as practicable, as far as national law allows, with a view to improving the quality and completeness of casualty investigations and reports

Requests MSC & MEPC to keep the Guidelines under review and to amend them as necessary.

1. Introduction - Purpose of the guidelines

The purpose is to provide practical advice on investigating human factors.

Underlines that ships operate in a dynamic environment and the ship is a place of living as well as a place of work

Notes that the international community has always focused on technical and engineering solutions to address ship safety issues. "Despite these technical innovations, significant marine casualties and incidents continue to occur."

Acknowledges that human factors are present in all marine incidents and should be addressed at a wider level than training and competence.

Use of the guidelines should result in a greater understanding of the reasons for marine incidents and allow preventative measures to be introduced.

2. Investigation procedures and techniques

2.1 A systematic approach involves six steps:

1. collect occurrence data;
2. determine occurrence sequence;
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2.2.1 Timing of an investigation

"An investigation should be carried out as soon as possible after an occurrence. The quality of the evidence, particularly that relying on the accuracy of human recollection, can deteriorate rapidly with time, and delayed investigations are usually not as conclusive as those performed promptly. A prompt investigation is also a demonstration of commitment by all those concerned.

Resolution 884 (21)
Amendments to the Code for the Investigation of Marine Casualties and Incidents

2.2.2 The occurrence site.

- Where possible the site should be left unchanged
- If not possible, the scene should be documented as accurately as possible.
- Secure supervisory instructions, permits, recording charts, etc.
- Damage or failed components should be kept secure for scientific analysis.

Resolution 884 (21)
Amendments to the Code for the Investigation of Marine Casualties and Incidents

2.2.3 Witness information

Once the situation is stabilised and there is no threat to people, the ship, environment etc, everyone involved should commit their recollections to paper to assist in preserving their memory of events.

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Amendments to the Code for the Investigation of Marine Casualties and Incidents

2.2.4 Background information

As much information as possible should be obtained before visiting the site:

- procedures for the operation involved;
- instructions relating to the operation involved;
- location plans (charts etc.);
- command structure and persons involved;
- messages, directions that may have bearing on the occurrence;
- ship particulars and plans; and
- any other relevant information.

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Amendments to the Code for the Investigation of Marine Casualties and Incidents

2.2.5 The investigation sequence

Fact-finding includes:

- inspection of location;
- gathering or recording physical evidence;
- interview witnesses on site and external (bearing in mind cultural issues)
- reviewing documents, procedures and records;
- conducting specialist studies;
- identify conflicting evidence;
- identify missing information; and
- recording additional factors and possible underlying causes.

Resolution 884 (21)
Amendments to the Code for the Investigation of Marine Casualties and Incidents

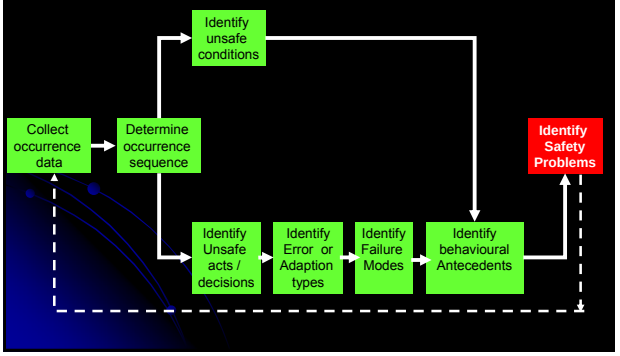
2.2.6 Fact-finding

Collect as many facts possible. The scope can be divided into five areas:

1. **environment;**
2. **equipment;**
3. **procedures; and**
4. **people;**
5. **organization.**

+ Review conditions, actions or omissions of each of the above.
+ Avoid premature conclusions, fact finding should be separate from analysis.
+ Check lists are an aid to investigation but have limitations.
+ Active failures are the initial focus, also investigate underlying, "latent" failures
+ Note recent changes in procedures or personnel, work and social issues
+ Test evidence by "who?, what?, when?, where?, how?, and why?

Human factors process from IMO



2.2.7 Conducting interviews

- subject to national law, spell out the intent of the interview;
- witnesses should be interviewed singly;
- interview style can have a great influence on outcome;
- interview team should be kept to minimum, two ideal, with "friend" observer;
- situation may result in reluctance by witness to be open;
- it is not the role of the investigator to apportion liability or blame;
- the role of the investigator is to establish facts and causes of the occurrence;
- at the end of the interview summarise to ensure no misunderstanding;
- a written record may be made, this should be provided to the interviewee.

2.2.8 Selection of interviewees

- first hand witnesses, regardless of rank or position
- those who witnessed or were involved in the immediate aftermath
- persons remote from the site but with relevant evidence
  - designated person under ISM
  - superintendents and shore operators
  - flag/coastal State surveyors or officials
  - specialists/consultants, class designers etc.

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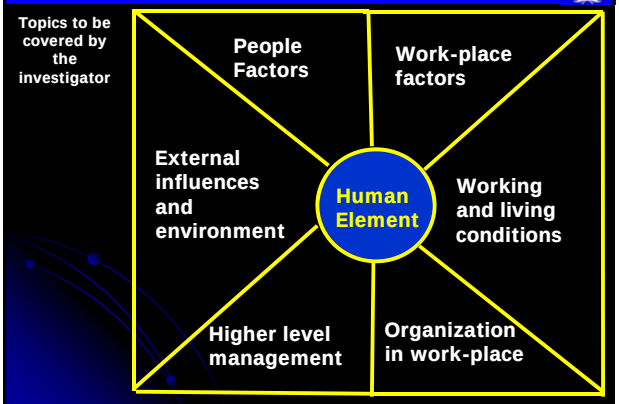
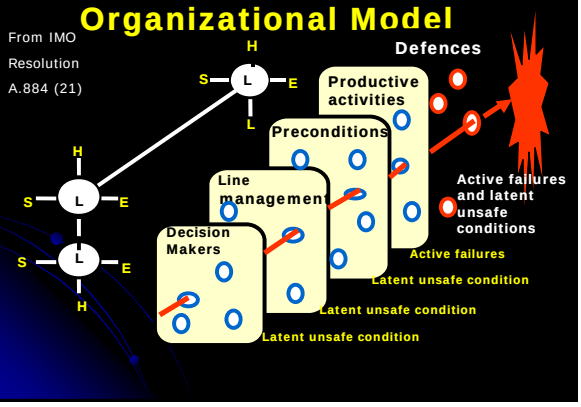


2.3.1 People factors

- **ability, skills, knowledge (outcome of training and experience**
- **personality (mental condition, emotional state)**
- **physical condition (medical fitness, drugs and alcohol, fatigue)**
- **activities prior to accident/occurrence**
- **assigned duties at time of accident/occurrence**
- **actual behaviour at time of accident/occurrence**
- **attitude**

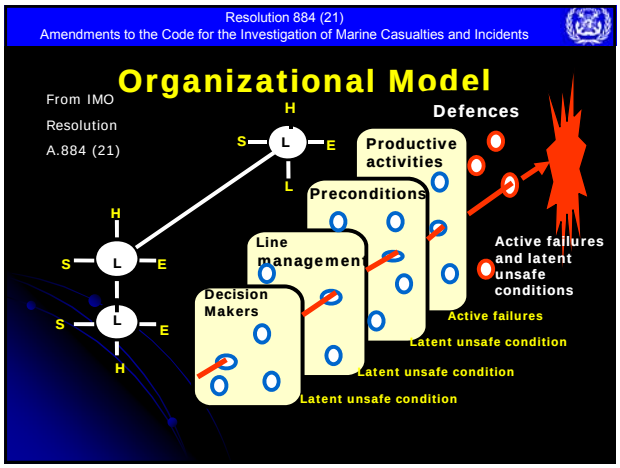
Organizational Model

From IMO Resolution A.884 (21)



2.3.2 Organization on board

- division of tasks and responsibilities
- composition of the crew (nationality/competence)
- manning level
- workload/complexity of tasks
- working hours/rest hours
- procedures and standing orders
- communication (internal and external)
- on-board management and supervision
- organization of on-board training drills
- teamwork, including resource management
- planning (voyages, cargo, maintenance)

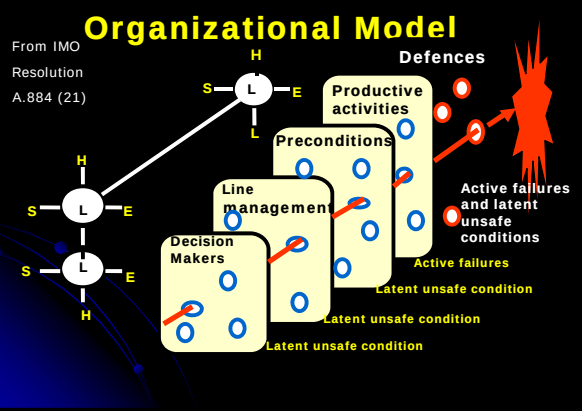


2.3.3 Working and living conditions

- level of automation
- ergonomic of working, living and recreation areas and equipment
- adequacy of living conditions
- opportunities for recreation
- adequacy of food
- level of ship motion, vibrations, heat and noise

2.3.4 Ship factors

- design
- state of maintenance
- equipment (availability, reliability)
- cargo characteristics, including securing, handling and care
- certificates



2.3.5 Shore-side management

- policy on recruitment
- safety policy and philosophy (culture, attitude and trust)
- management commitment to safety
- scheduling of leave periods
- general management policy
- port scheduling
- contractual and/or industrial arrangements and agreements
- assignment of duties
- ship-shore communication

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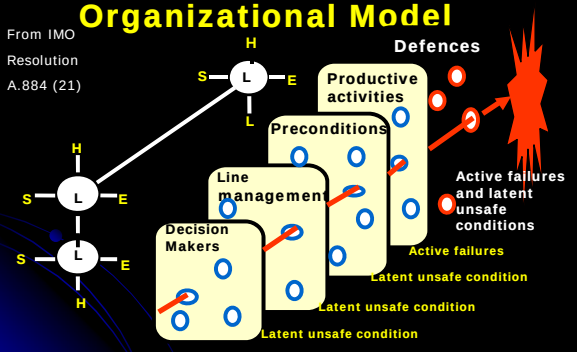

2.3.6 External influences and environment

- weather and sea conditions
- port and transit conditions (VTS, pilots, etc)
- traffic density
- ice conditions
- organizations representing shipowners and seafarers
- regulations, surveys and inspections (international, national, port, classification societies, etc.)

Resolution 884 (21)
Amendments to the Code for the Investigation of Marine Casualties and Incidents

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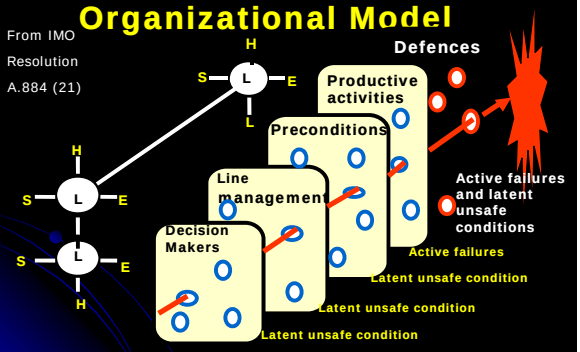

Resolution 884 (21)
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2.4 Analysis

Once facts are collected, they need to be analysed to help establish the sequence of events in the occurrence and to draw conclusions about safety deficiencies uncovered by investigations. Analysis is a disciplined activity that employs logic and reasoning to build a bridge between the factual information and the conclusions.

Resolution 884 (21)
Amendments to the Code for the Investigation of Marine Casualties and Incidents

2.4.1 Fact finding and analysis

After fact-finding and analysis it should be possible to give a description of the occurrence, its background, the time it tool place, and the events leading to it.

The Description should include such factual items as:

- the weather conditions;
- the operation(s) involved;
- the equipment in use, its capabilities, performance and any failures;
- the location of key personnel and their actions immediately before the incident;
- the pertinent regulations and instructions;

Resolution 884 (21)
Amendments to the Code for the Investigation of Marine Casualties and Incidents

2.4.1 cont

- uncontrolled hazards;
- changes of staff, procedures, equipment or processes that could have contributed to the occurrence;
- what safeguards were or were not in place to prevent the incident;
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- medical treatment actions taken to mitigate the effects of the occurrence and the condition of injured parties, particularly if disabling injuries or death ensued;
- damage control including salvage;
- inventory of all consequences of the occurrence (injury, loss, damage or environmental damage); and
- general ship's condition

2.4.1 cont

It should also be possible to identify active and underlying factors such as:

- operational deviations;
- design aspects of hull structural failure;
- defects in resources and equipment;
- inappropriate use of resources and equipment;
- relevant personnel skill levels and their application;
- physiological factors (fatigue, stress, alcohol, illegal drugs, prescription medicine);
- why safeguards in place were inadequate or failed;

2.4.1 cont

- role of safety programs;
- problems relating to the effectiveness of regulations and instructions;
- management issues; and
- communication issues.

2.5 Safety action

The ultimate goal of a marine safety investigation is to advance maritime safety and protection of the marine environment.

This is achieved by identifying safety deficiencies through a systematic investigation of marine casualties and incidents and then recommending or effecting change in the maritime system to correct these deficiencies.

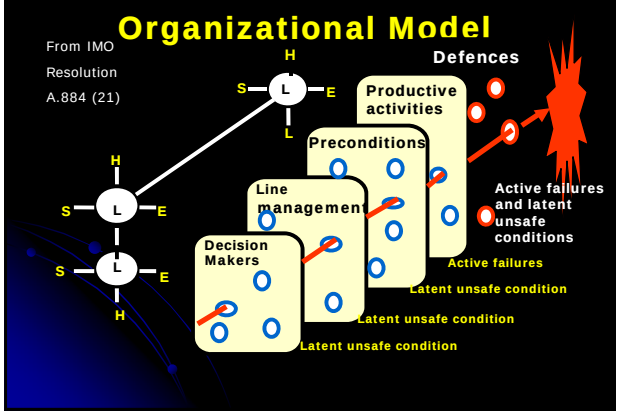
3 Reporting Procedures

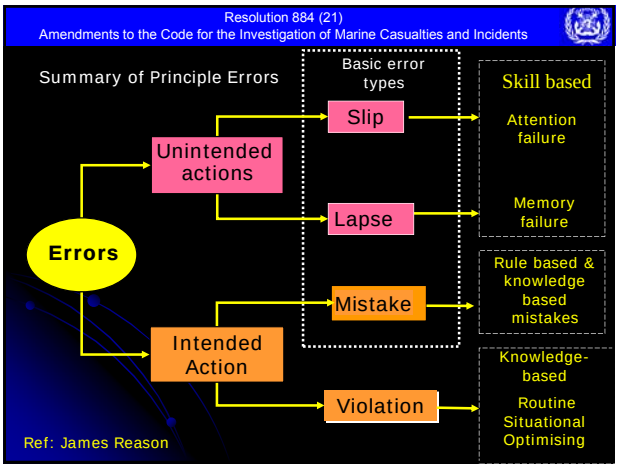
- To facilitate the flow of information from casualty investigations, each report should conform to a basic format.
- Reports should be made to IMO in accordance with established procedures.
- Persons/organisations with a vested interest in a report should be given the opportunity to comment on the report or relevant parts before it is finalised
- Final report should be distributed to relevant parties involved and should preferably be made public.

A variety of contributory factors can play a significant part in the events preceding a marine casualty or incident and responsibility for investigating and analysing human factors therefore becomes important.

The skilled marine casualty and incident investigator generally is the person best suited to conduct all but the most specialised aspects of human factor investigation.

An investigator should have appropriate experience and formal training in marine casualty investigation, which should include specific training in identification of human factors.




Resolution 884 (21)
Amendments to the Code for the Investigation of Marine Casualties and Incidents
Summary of Principle Errors
Basic error types
Errors
Unintended actions
Intended Action
Slip
Lapse
Mistake
Violation
Skill based
Attention failure
Memory failure
Rule based & knowledge based mistakes
Knowledge-based
Routine
Situational
Optimising
Ref: James Reason

Resolution A.884(210)

Amendments to the Code for the Investigation of Marine Casualties and Incidents (Resolution 849(20)

This session studies the advice from IMO on the investigation of human factors.

Resolution 884 (21)

Amendments to the Code for the Investigation of Marine Casualties and Incidents

Recalling resolution A. 849 (20)

Considering that practical advice for the systematic investigation of human factors in marine casualties and incidents will assist in the effective analysis and promote the identification and implementation of preventative action.

Invites Governments to implement the Guidelines as soon as practicable, as far as national law allows, with a view to improving the quality and completeness of casualty investigations and reports

Requests MSC & MEPC to keep the Guidelines under review and to amend them as necessary.

1. Introduction - Purpose of the guidelines

The purpose is to provide practical advice on investigating human factors.

Underlines that ships operate in a dynamic environment and the ship is a place of living as well as a place of work

Notes that the international community has always focused on technical and engineering solutions to address ship safety issues. "Despite these technical innovations, significant marine casualties and incidents continue to occur."

Acknowledges that human factors are present in all marine incidents and should be addressed at a wider level than training and competence.

Use of the guidelines should result in a greater understanding of the reasons for marine incidents and allow preventative measures to be introduced.

2. Investigation procedures and techniques

2.1 A systematic approach involves six steps:

1. **collect occurrence data;**
2. **determine occurrence sequence;**
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For each unsafe act or decision:

4. **identify the error type or violation;**
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Amendments to the Code for the Investigation of Marine Casualties and Incidents

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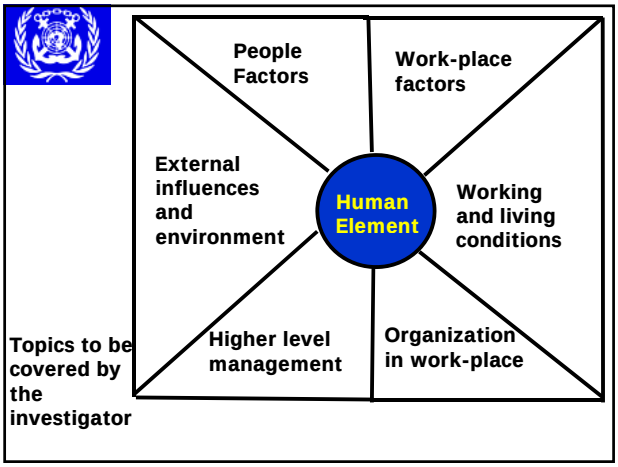

Resolution 884 (21)

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Resolution 884 (21)

Amendments to the Code for the Investigation of Marine Casualties and Incidents

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Resolution 884 (21)

Amendments to the Code for the Investigation of Marine Casualties and Incidents

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2.4.1 cont

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An investigator should have appropriate experience and formal training in marine casualty investigation, which should include specific training in identification of human factors.

Recognition Of Potentially Dangerous Attitudes

Hazardous thoughts

"Don't tell me what to do . . . I know best!"

Some people feel threatened if anyone offers a suggestion – rules/procedures are for others.

Antidote – obey the rules. They are usually the product of bitter experience.

Or convince the peer group that you are right.

Assumptions

"I assume that . . .!"

On the basis experience assumptions may be made that do not fit the current situation..

Antidote – Check the facts!

Assumptions are more prevalent when:

◇In unmonitored automatic mode

◇When anticipating a certain thing to happen

◇After a busy period when stress has reduced

◇When seeking reassurance

Hazardous thoughts

"I can do it!"

A particular male/macho trait of displaying skill or verve ahead of safety.

Antidote – Be responsible. You are responsible for the conduct of a high priced asset and the lives of those aboard. The consequences of an adverse outcome are not worth it.

The superior seafarer is one who uses his/her superior seamanship to avoid getting into situations where superior skill will have to be shown.

Hazardous thoughts

"It won't happen to me . . . other people have accidents!"

Invulnerability and overconfidence until it is too late.

Antidote – Protect your self, your ship and the lives of all aboard. Properly assess the consequences and the real likelyhood.

It can happen to you unless you asess the situation properly and act sensibly.

Hazardous thoughts

"Do something - anything!"

Mariners may feel that any action is better than no action. Emergencies need to be thought through and prompt rather than immediate action is more effective..

Antidote – Think first – have plans.

Don't rush into decisions without considering the implications and alternatives.

Hazardous thoughts

"What's the use . . . There is no point in trying!"

People may feel they are losing control. The situation is allowed to deteriorate further – a fatalistic attitude.

Antidote – Act!

Act decisively, rather than letting things go from bad to worse. Action may mitigate an adverse outcome.

Hazardous thoughts

"It's not my job !"

Some people avoid responsibility and involvement. They work within their own sphere.

Antidote – We are all in this together!

Team work makes life easier and safer. We cannot avoid responsibility for things within our competence.

Hazardous thoughts

"We have always done it this way! – Why? Because this is the way it has always been done!"

Some people will reject new ways of doing things because it is outside their comfort zone.

Antidote –Review!

Procedures are living documents, well thought out change leads to safer practices and overcomes redundant thinking.

Hazardous attitudes were identified by Barry Turner as one of the factors present during stage 2 'the Incubation Period' in the 84 investigations he analysed in the 1980s.

They can also be seen as potential 'pathogens' as described by James Reason.

They are Latent Factors which are difficult to establish, though investigators may have suspicions.

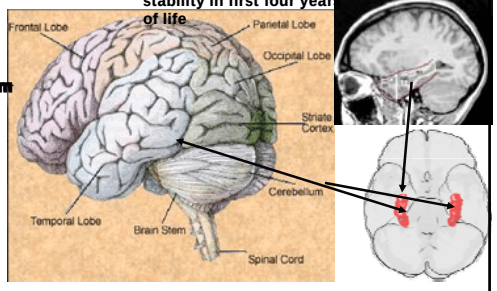
Memory

This session will examine some concepts of memory including:

- sensory store
- short term memory
- long term memory

Self-awareness
Language
Social interaction
Abstract problem solving
Sense of time

Right hemisphere provides emotional stability in first four years of life



Hippocanthus

Flight
Fright
Freeze

There are several different types of memory, each adapted to a different purpose:

- ※ **sensory store**
- ※ **short term memory**
- ※ **long term memory**

Sensory store

Incoming information is initially held in the sensory store.

There are two forms of sensory store:

↑ Echoic for information we hear

↑ iconic for information we see.

Iconic memory

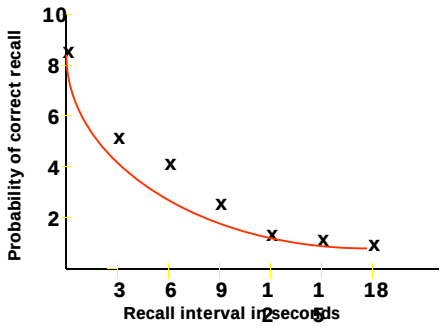
Visual information is held for about 0.5 to 1 second

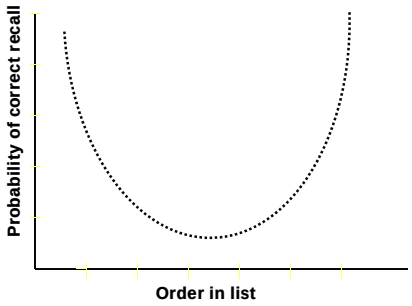
For normal sighted person 80 per cent of memory stems from iconic memory.

Echoic memory

Aural information is held for about 2 to 8 seconds

Short term memory without recall





Short term memory

Short term memory, also called working memory, enables us to store several pieces of information in memory at once.

Properties of short term memory:

- information is forgotten in seconds without rehearsal
- extremely limited capacity

Long term memory

Procedural

Episodic

Semantic

Long term memory is associative

Aspects of associative memory:

- recall by association
- graceful degradation

Long term memory

Properties of long term memory:

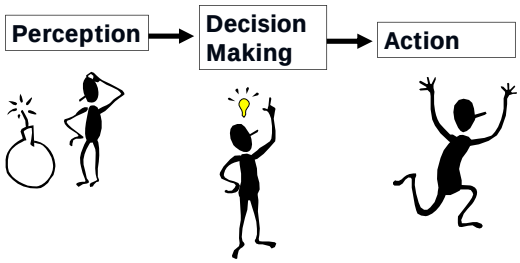
- capacity is for all intents limitless
- information can potentially be stored forever
- disturbed and associative by nature.

Memory is actively reconstructed

Eye witness testimony:

Even relatively subtle changes in questions can influence answers.

Information processing



Information processing is an active process.

Humans actively process information, they don't just passively receive, store and retrieve information

Memory runs like unconnected frames on a film and we fill in the missing frames from our experience. Unless we have learned something by rote we remember complex information by shaping it to fit what we deduce from our experience store.

We construct what we see
We construct what we remember
We interpret

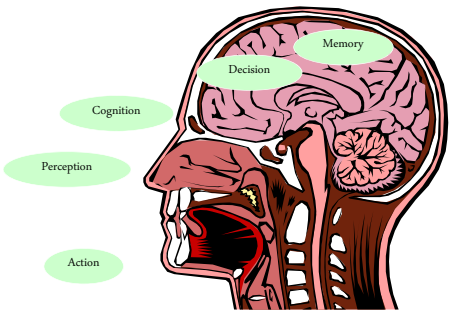
Information Processing, Decision Making & Response

Decision Making and Situational Awareness

Scope of this Session

- Human Information Processing System (HIPS)
- Decision making
- Situational Awareness
- Basic Ergonomic Concept

Human Information Processing



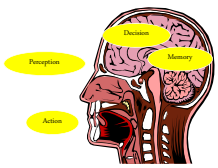
Information Processing, Decision Making & Response

Five Steps of Information Processing:

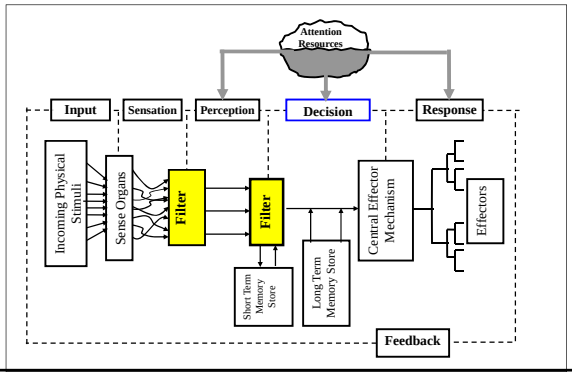
- Input (Physical stimuli)
- Sensation
- Perception
- Decision Making
- Response

Sensation – Limitation of Senses

- Any problem in sight, hearing, touch, taste, or smell will affect perception.
- Persons with weak eyes or defective hearing will have trouble recording accurately what they see or hear and as such their perception may therefore be inaccurate.



Human Information Processing, Decision Making & Response



Perception

- When someone senses something, the brain acts in three stages:
  - It select the information
  - It organizes the information, and
  - It interprets the information
- The result is “perception”.

About Filters

Sensation – Filter – Perception – Filter - Decision

- Filter is a step in HIPS that occurs between sensation, perception, and decision.
- Filter Effect is a manner in which HIPS determines the amount of information allowed to pass.
- It is a function of the attention required from and individual
- Thus if the crew/master’s workload is high, the filter may be closed, admitting nothing but the most urgent messages

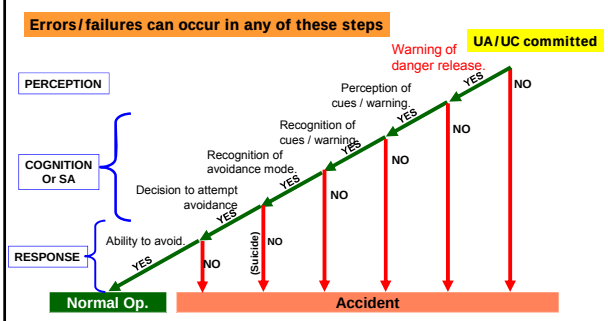
Decision Making Step

- Once the information is perceived, the individual will decide what to do with it.
- Sometimes the decision may be instantaneous
- other times it is a careful and thoughtful one the perceived information may be stored before taking an action to respond to the situation.

Response Action

- If a decision is made to generate a response, a series of steps is made by the central nervous system to call up the necessary muscle commands to carry out the action.

Errors in Human Information Processing



More on HIPS

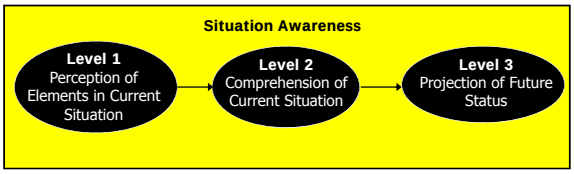
Situational Awareness (SA)

Situational Awareness	Being aware of what is happening around you and understanding what the information means to you now and in the future so that you can make the right decision.

Three Levels of SA

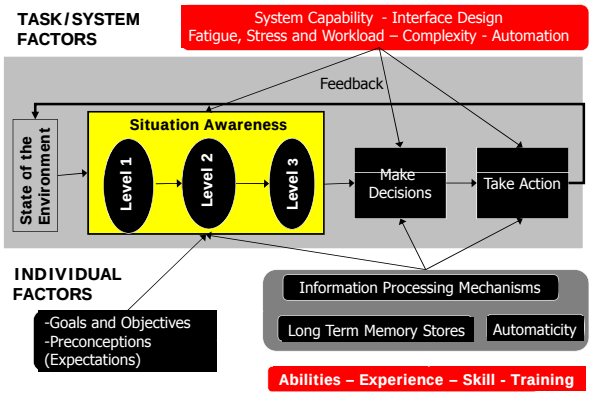
1. Must be able to take in information.
2. Understand what it means, and
3. Identify the implications for the future

Three Levels of SA



Endsley (2000)

So what are the underlying factors?



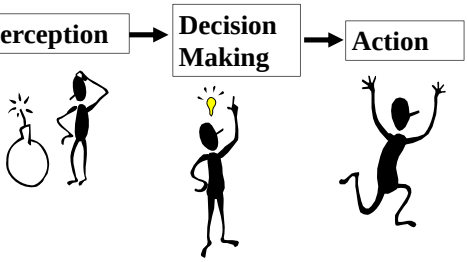
What's in it for Investigation?

- In investigations
  - As a cause or contributing factor?
  - As a starting point to begin explaining behaviour!!!
- As a concept presented in operator training.
  - What it is, how you know you are losing it and how to get it back…
- By uncovering how people think and work, SA–oriented design and training creates efficient user–centred systems to:
  - increase interface usability
  - reduce human errors and system failures===>ERGONOMICS

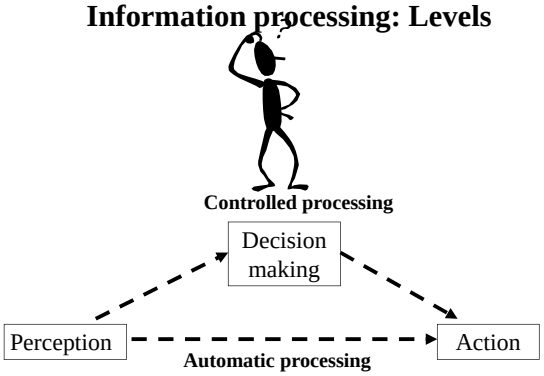
To Ergonomics

Decisions

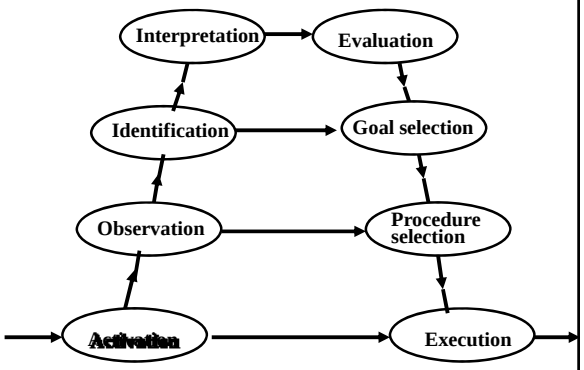
Information processing



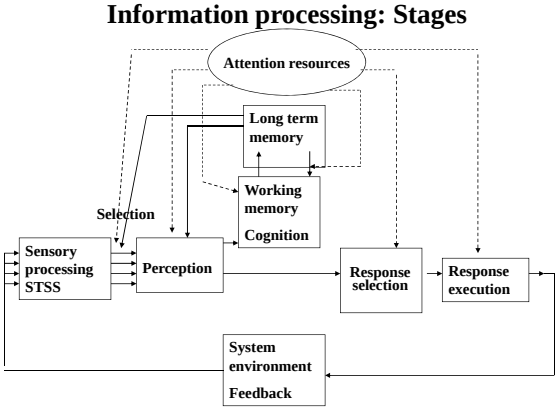
Information processing: Levels



Simplified 'Ladder' Model after Rasmussen



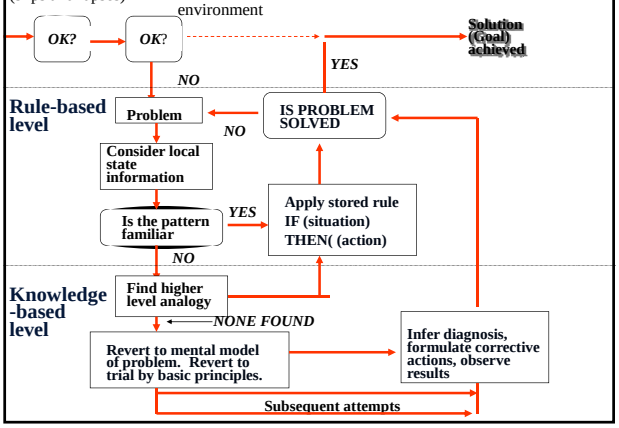
Information processing: Stages

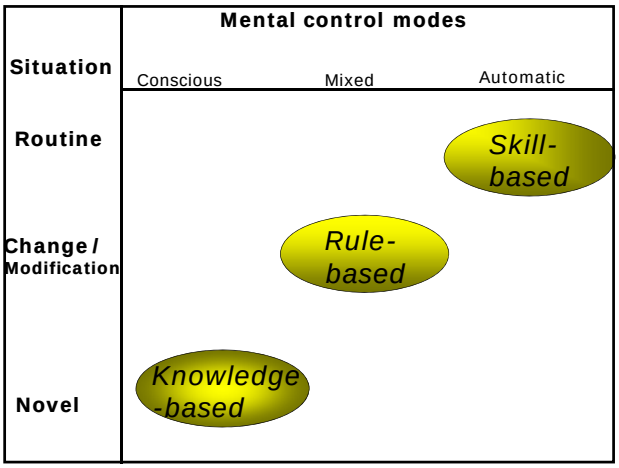


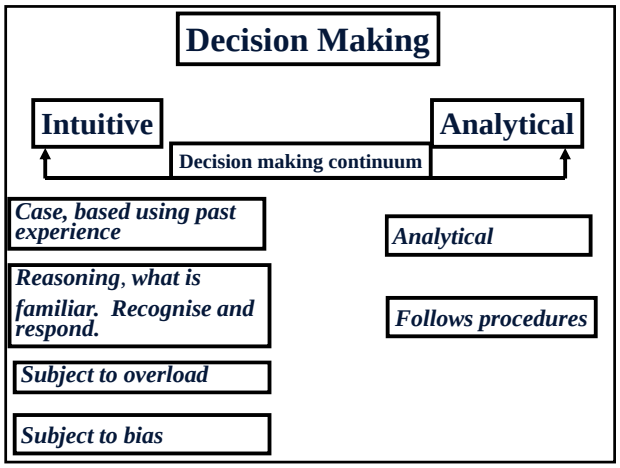
Skill based Level (slips and lapses)

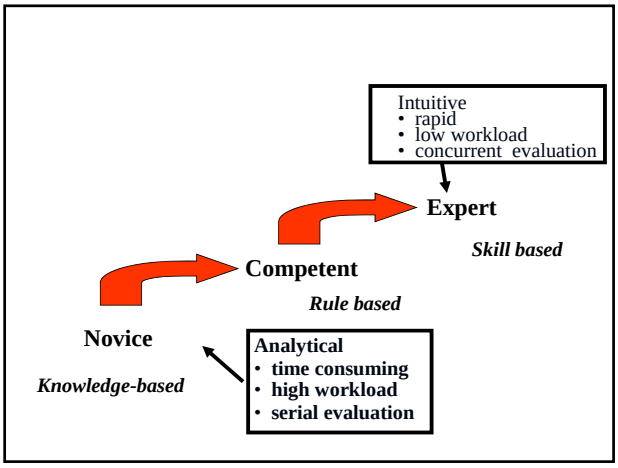
Routine actions in a familiar environment

GEMS









Situational Awareness

The awareness that people possess of themselves, others, the environment and the objects with which they interact.

What is happening now, what has happened previously, what is expected to occur in the future.

Situational Awareness

A timely and accurate understanding of all the factors in a situation

Using that information to determine what may happen to the ship in the future.

Bringing together all the information into a mental model.

Factors that lead to poor situational awareness

- **A 'macho' attitude**
- **Task under load**
- **Task overload**
- **Uncertainty**
- **Frustration and anger**
- **Fatigue and stress**

Symptoms of poor Situational Awareness

- **Fixation or attention tunnelling**
- **Ambiguities**
- **An empty feeling**
- **Improper or inappropriate procedures**
- **Failure to meet operational targets**

Problems with situational awareness

- **Subjective assessment**
- **Lack of empirical data**

Situational awareness errors

Level 1	**Failure to understand what is happening in the operational environment**	
……..		**Design/attention**
Level 2	**Failure to use understood data**	
……..		**Misreading cues**
Level 3	**Failure to plan ahead**	
……..		**Poor mental model**

Isn't she lovely 'the mistress'?
With her wide-apart grey-green eyes,
The droop of her lips and, when she smiles,
Her glance of amused surprise?

How nonchalantly she wears her clothes,
How expensive they are as well!
And the sound of her voice is soft and deep
As the Christ Church tenor bell.

Her joints ached with rheumatism and her knuckles were gnarled with arthritis.

She reached for the worn woollen sheet that passed as a shawl.

She knew they would becoming for her soon and she could here the murmur of the mob.

Her last chill minutes before the agony of the flame.

Helen is very shy and withdrawn, always helpful, but not interested in people, or in the realities of day to day life. A meek soul she has a passion for order, tidiness, structure, certainty and a passion for detail. She is good at what she does.

What is her most likely occupation?

A nurse

A farmer

A hairdresser

A librarian

A veterinary surgeon.

A bit more information

15 % of nurses fit this description	**(T 25 000)**
10 % of farmers fit this description	**(T 125 000)**
5 % hair dressers	**(T 300 000)**
40 % of librarians fit the description	**(T 20 000)**
20 % of vets fit the description	**(T 10 000)**

Nurses	**3750 meet that description**
Farmers	**12 500 meet that description**
Hairdresser	**15 000 meet that description**
A librarian	**8000 meet that description**
A vet	**5000 meet that description**

Helen is likely to be a hairdresser.

Decision/ Representativeness Bias

BIAS

What is bias?

A predisposition or prejudice

'It is a capital mistake to theorize before you have all the evidence. It biases the judgement.'

Sir Srthur Conan Doyle, A Study in Scarlet (1888) Ch.3

What is the effect of bias?

It can colour your judgement and opinion and the judgement and opinions of others.

It can influence decision making.

Attribution bias

- **People tend to attribute their own mistakes/errors to the environment or the situation, but tend to attribute the misfortune of others to personal or internal inadequacies, traits, qualities and characteristics.**

- **In general, the more similar another person is to us, the more we will be prepared to consider the situation which provoked the error.**

What are the consequences of attribution bias?

- **Managers and supervisors removed from the 'sharp end' may be more inclined to make internal applications of blame and be less aware of environmental factors.**

Confirmation Bias

Take account of only that evidence/information that fits the preconception of the decision maker, while dismissing or ignoring information that gives a contrary view.

Availability Bias

The ease with which information can be drawn from memory is presumed to be the best and most accurate solution.

What are the risks with availability bias?

Investigators are satisfied with the most easily obtained information.

Anchoring Bias

Opinion gained from initial observations

What are the risk associated with anchoring bias?

Two people tossing a coin record the following sequence:

T H T T H ?

H H H H H ?

Which person is most likely to toss Tails on the next throw?

Misconception of chance

Confirmation Bias

Take account of only that evidence/information that fits the preconception of the decision maker, while dismissing or ignoring information that gives a contrary view.

Group think

Collective decision making can lead to an illusion of invulnerability

Risky shift

Group interaction leads to individuals shifting their position to achieve a consensus. Often the shift is towards the more risky (exciting?) options. This leads to greater acceptance of danger.

Closely allied with Group Think and invulnerability

Cultural influences affecting safe operation

Individual attitudes are shaped by the customs, civilisation, and achievements of our particular people, nation or region.

Shaped by cultural beliefs, based on environment, and/or religion and/or political, and/or traditional social value systems.
e.g - Muslim, Buddhism, Christianity, Hinduism,

- democracy, communism, dictatorships

Broad groups, subdivide

Muslims - Shiite, Sunni

Buddhism - Theravada, Mahayana

Christianity - Roman Catholic, Orthodox, Protestantism

Cultural Dimensions

Geert Hofstede – Emeritus Professor, Maastricht University

"Culture is more often a source of conflict than of synergy. Cultural differences are a nuisance at best and often a disaster . . ."

Cultural Dimensions

Hofstede identified five 'cultural dimensions' that are present in societies but that vary between societies:

- Power distance Index (PDI)
- Individualism (IDV)
- Masculinity (MAS)
- Uncertainty Avoidance Index (UAI)
- Long Term Orientation (LTO)

Cultural Dimensions

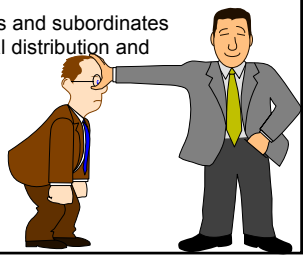
Hofstede's theories based on national characteristics is much debated and disputed. People within any particular ethnic or national group will vary in their character and cultural outlook.

However, it is useful for investigators to be aware that a close nit group, such as a ship's crew, cultural issues may exist because of individual or national attitudes towards other crew members. Negative attitudes effect safe operation of ships.

Power distance

Power distance - *the extent to which the less powerful members of an institutions and organizations within a country expect and accept that power is distributed unequally.*

The manner in which superiors and subordinates expect and accept the unequal distribution and exercise of power.



Power Distance

From fifty three Countries or regions with IBM employees

Country/ region	Ranking	Index score
Malaysia	1	104
Philippines	4	95
Indonesia	78	8/9
Singapore	74	13
France	68	15/16
HongKong	68	15/16
Thailand	64	21/23
Pakistan	55	32
Australia	36	41
Sweden	31	31
Austria	11	53

Individualism

The cultural emphasis given to individual ideas as distinct from collective decision making.

Individualistic cultures - expect individual initiative and achievement.

Collectivist cultures - tight social framework, social obligations, blood ties, moral and personal commitment to the group.

Individualism

From fifty three Countries or regions with IBM employees

Country/ region	Index score
Australia	90
Malaysia	26
Philippines	32
Indonesia	14
Singapore	20
France	71
HongKong	25
Thailand	20
Pakistan	14
Sweden	71
Austria	55
Guatemala	6

Masculinity

High masculinity - Ambition and performance as measured by material and monetary success.

Low masculinity (femininity) - values interaction between people, public service, quality of life

Masculinity

From fifty three Countries or regions with IBM employees

Country/ region	Index score
Japan	95
Malaysia	50
Philippines	64
Indonesia	46
Singapore	48
France	43
HongKong	57
Thailand	34
Pakistan	50
Australia	61
Austria	79
Jamaica	68
Sweden	5

Uncertainty Avoidance

How cultures cope with novelty, ambiguity and uncertainty.

Clarity and order in social relationships *versus* unstructured and uncertain social structure.

Strict adherence to rules and procedures *versus* minimal rules, using procedures as guidelines.

Uncertainty avoidance

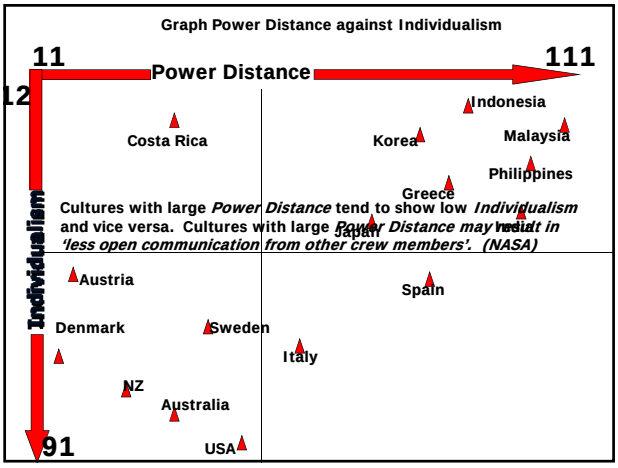
From fifty three Countries or regions with IBM employees

Country/ region	Index score
Greece	112
Malaysia	36
Philippines	44
Indonesia	48
Singapore	74
France	86
HongKong	29
Thailand	64
Pakistan	70
Australia	51
Sweden	29
Austria	70
Jamaica	19

Long-Term Orientation

Long-term orientation – a vision or plan projected against long-term future perceptions. e.g. the need to save for the future

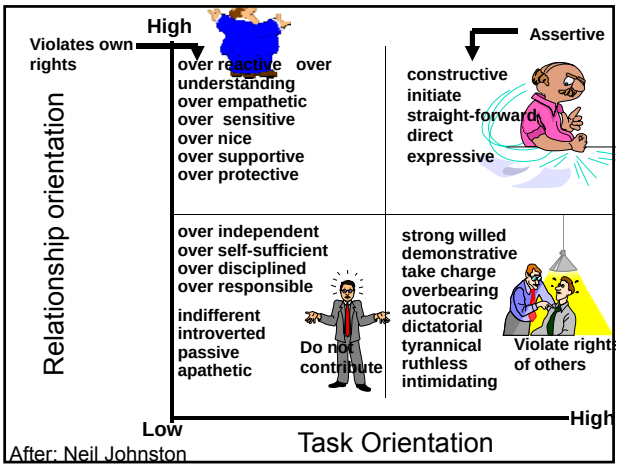
Short-term orientation – concerned with the 'now'. e.g. Following current practices, concern with status



Bridge Resource Management

BRM training seeks to assure the effective functioning of the bridge team through timely and proficient use of all available resources.

After: Neil Johnson, Aerospace Psychology Research Group, Trinity College, Dublin



After: Neil Johnston

Bridge Resource Management

BRM includes training in::

- **effective communications**
- **superior leadership**
- **effective formation of work groups**
- **willingness of subordinates to speak out**
- **adherence to rules and procedures**
- **building a shared mental model**
- **coping with novel decision-making situations**

After: Neil Johnson, Aerospace Psychology Research Group, Trinity College, Dublin

Bridge Resource Management Training

Requires management commitment

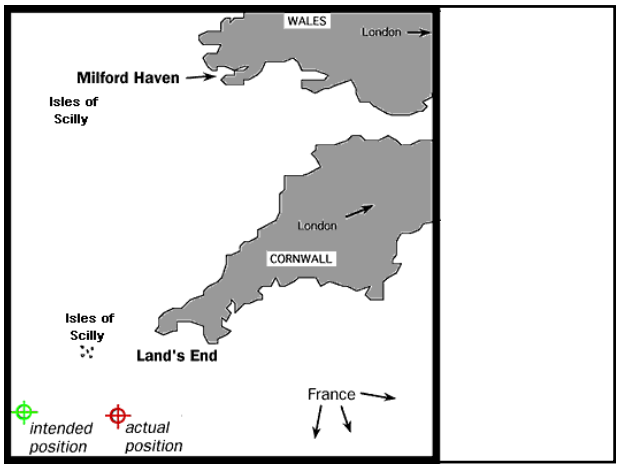
Adequate development time

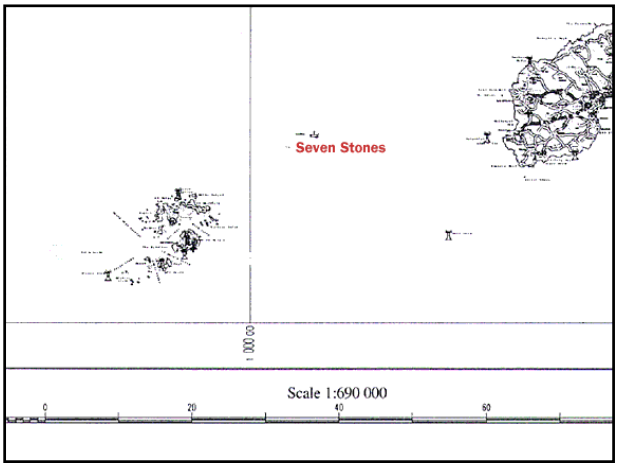
Understanding of the cultural imperatives

Build on and adapt to cultural strengths

Bridge Resource Management

BRM is one measure to reduce risk.


WALES
London
Milford Haven
Isles of Scilly
London
CORNWALL
Isles of Scilly
Land's End
France
intended position
actual position


Seven Stones
Scale 1:690 000
0
20
40
60

Ergonomics

Ergonomics

Primarily deals with the physical aspects of matching people with their work tasks, workstations and the tools and equipment with which they work.

('Ergon' – work 'nomos' – natural law)

Ergonomics

Horace L Hunley considered the human factor in the design and operation of the submarine.

Crew of 8, operating 8 hand cranks on an offset cam to turn a propeller.

Crew specified to be shorter than average with superior upper body strength.

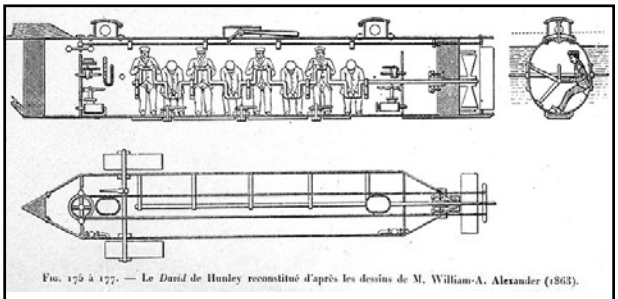


Fig. 175 à 177. — Le *David* de Hunley reconstitué d'après les dessins de M. William-A. Alexander (1863).

Candle used for illumination and oxygen gauge.

Ergonomics – the Investigator's interests

Check lists

Instruments/display design

Controls

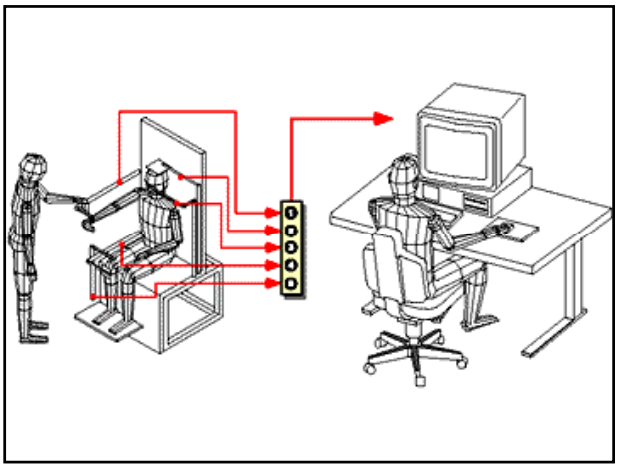
Warnings

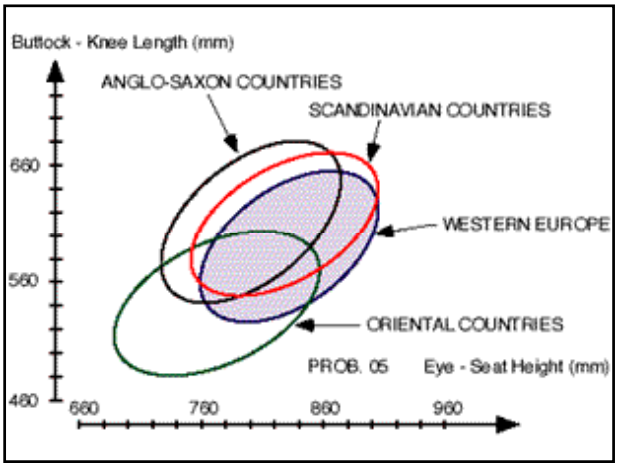
Signs

Ergonomics

Associated disciplines of Anthropometry – ***the measurement and shape of people***

Biomechanics – ***strength, power and mechanics of the body***



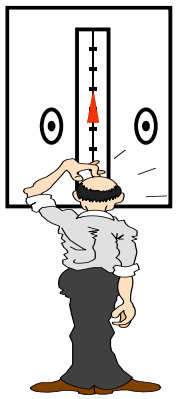


Anthropometric Data

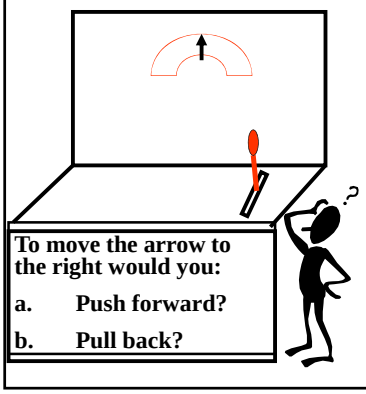
UK Subjects 1994

	Men			Women		
	5th	50th	95th	5th	50th	95th
Body Mass (kg)	55	75	94	44	63	81
Stature (mm)	1625	1740	1855	1505	1610	1710
Eye height	1515	1630	1745	1405	1505	1610
Sitting height	850	910	965	795	850	910
Horizontal reach	835	890	945	760	810	860

Which way are the nobs turned to raise the arrow?



Ergonomics



To move the arrow to the right would you:

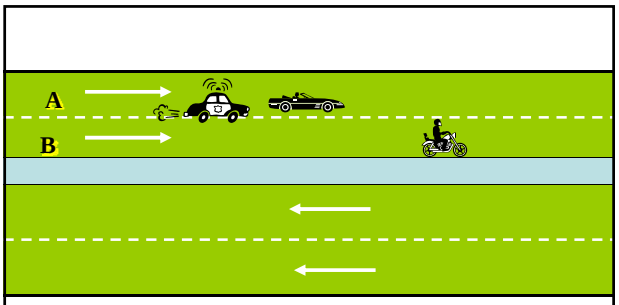
a. Push forward?

b. Pull back?

Is the shrine on the:

a. left bank

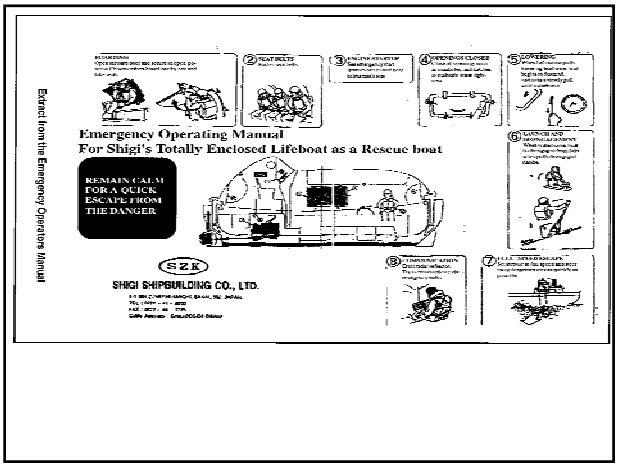
b. right bank



The highway has two lanes in each direction. Which is the 'outside' lane

a. A

b. B



Environmental factors influencing human performance

Environmental factors

1. To identify some of the environmental factors that influence the way people perform.
2. Develop an understanding of the marine and shipboard environment on seafarers.

Environmental factors

What environmental factors affect performance?

- Temperature (Too hot – Too cold)
- Humidity
- Noise
- Vibration
- Ambient light
- Ship movement
- Smell

Environmental factors

Temperature – Too hot

- Discomfort
- Sweating (excessively)
- Dry mouth, lips etc
- Irritability and headaches
- Reduced vigilance
- reduced performance
- Mood swings
- Increased fatigue
- skin discomfort

Environmental factors

Temperature – Too cold

- Poor decision making
- Apathy and lethargy (can't be bothered)
- Affected speech (slurred indistinct)
- Shivering
- Loss of motor skills
- Muscle stiffness

Environmental factors

Temperature – Sources of heat

- Equipment – electrical/electronic equipment
- Machinery (engines, boilers, steam pipes, etc)
- Physical exertion
- Sun's radiation
- Construction material
- Environmental heating

Environmental factors

Workplace management

- Air conditioning/control?
- Insulation
- Air movement (fans)
- Appropriate clothing
- Fluid intake/availability
- Exposure to heat source
- Work/rest cycles
- Monitoring

Environmental factors

Humidity

- Optimal range 40% to 70%
- Excessively high – reduces the efficiency of sweating and affects body's ability to control temperature
- Excessively low – increases fluid loss and possibility of dehydration

Environmental factors

Noise – Excessive Noise

- Significance performance decrement
- May lead to irritability
- Disrupts concentration
- Can destroy rest and sleep
- Accelerates fatigue
- Interferes with spoken communication/hearing
- Lead to hearing impairment or hearing loss

Environmental factors

Vibration

- Increase in discomfort
- Accelerates fatigue
- Distorts vision
- Interferes with speech communications
- May lead to irritability
- Disrupts concentration
- Can destroy rest and sleep
- May affect writing and record keeping

Environmental factors

Ambient light

Sources of illumination

- Natural light
- Artificial light
- Other sources of illumination

Environmental factors

Ambient light

- Natural light

- Sunlight
- Cloudy conditions
- Reflection from water
- Snow/ice reflection
- Reflections from shinny surfaces
- Amplitude and angle of sun
- Moonlight
- Night vision

Environmental factors

Ambient light

- Artificial light

- Incandescent bulbs (maximum performance at about 500 lx)
- Fluorescent strips/bulbs
- 'Red lighting'
- Blue lighting

Environmental factors

Ambient light

- Other sources of illumination

- Light from electrical storms
- Light from fires

Environmental factors

Ship movement - excessive

- Significance performance decrement
- May lead to irritability
- Disrupts concentration
- Can interfere with rest and sleep
- Accelerates fatigue
- Physical discomfort
- Seasickness
- Food intake

Environmental factors

Smell

- Induce hunger or revulsion
- Affect performance
- Bad smells may lead to irritability
- Disrupts concentration
- Can interfere with rest and sleep
- Physical discomfort
- Seasickness

The Nine Switches of Human Alertness

H I L

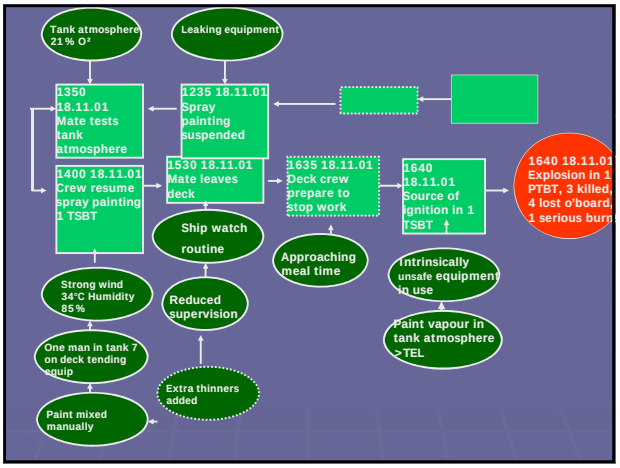
Interest, opportunity, or sense of danger	Muscular activity	Time of day on circadian clock
Environmental temperature	Environmental sound	Environmental aroma
Sleep bank balance	Ingested nutrients and chemicals	Environmental light

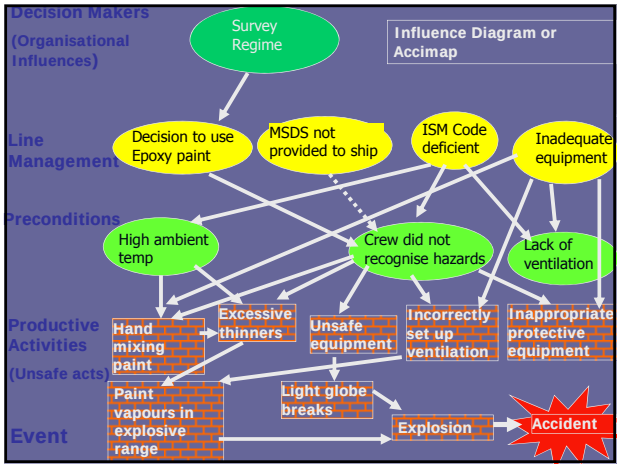
Areas of Investigation of Explosion

- Overview of Evidence
- Previous painting activity
- The Explosion
  - The fuel source
  - Tank ventilation
  - Source of ignition
- Material Safety Data Sheet
- Crew exposure to fumes
- The International Safety Management Code
  - The On-board ship management
  - The Ship management Company
  - The ship management remedial action
- Port Comms. Response to emergency, SAR

Paint constituents

Compound	Flammability Limit % by volume in air	Flash Point (°C)	Vapour Density (Air = 1)	Auto-ignition temperature (°C)
Toluene	1.1 – 7.1	4	3.14	480
Xylene	1.1 – 7.0	27	3.7	527
N-butanol	1.7 – 9.8	29	2.6	345
Isobutanol	1.7 – 10.9	28	2.6	415





Risk

&

Management of Risk

This session examines:

- Risk and perception of risk
- The risk management process
- Safety management
- The ISM Coode

Causes of sudden death Australia

Fatality	Av 97-00		2000
Motor vehicle	1752.75		1776
Pedestrian	372.25		359
Accidental drowning	250.75		229
Exposure to fire or flames	97		95
Water transport	44.75		51
Snake/lizard	3.75		1
Wasps/hornet/bees	1.5		4
Dog	1.25		3
Spider	0.75		0
Crocodile/alligator	0.25		0

Source, Australian Bureau of Statistics

What affects your perception of risk?

- **Familiarity**
- **Control over exposure**
- **Control over risk**
- **Potential for catastrophe (multiple fatalities)**
- **Dread**
- **How well known to science**
- **Exposure of family or close associates**

What is risk?

Risk - - a chance or possibility of danger, loss or injury or other adverse consequences

Some basic definitions.

Safety: **State in which the risk of harm (to persons) or damage is limited to an acceptable level.**

Risk: **The chance of something happening that will impact upon an objective. It is measured in terms of consequence and outcomes. (The degree of harm that could be associated with a hazard.**

Hazard: **A source of potential harm or a situation with a potential to cause loss.**

Cause: **That which produces an effect, or give rise to an action. (Anything we can say 'but for . . ."**

Risk can be measured .

Quantified or compared against a standard.

What standards exist that an investigator can use?

How do we assess or measure risk?

Risk = consequence x *probability*

or

Risk = frequency x *consequence*

Sea Empress

15 February 1996

Risk Management

The ALARP principle As Low as Reasonably Practicable (and stay in business)

Comparative risk – risk is determined on the basis of alternatives (eg, flying as compared to driving)

***De minimis* – trivial risk**

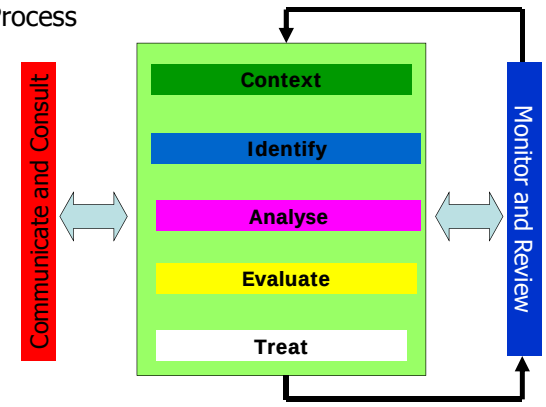
Zero Risk – no risk of harmful accident

Reason, J. *Managing the Risk of Organizational Accidents.* Pg 175

Irrespective of the concept invoked to define what safety is at a particular point in time, as society progresses, it demands a higher degree of safety. Thus safety is a target moving continuously towards zero risk, . . .

Michael Baram

Risk Management Process



Hierarchy of controls

1. Eliminate hazard
2. Substitute Hazard
3. Isolate hazard
4. Engineering controls
5. Administrative controls
6. Personal protective equipment

Safety factor

- Safety factor which has an influence on ongoing operations, and for which an organisation has control and responsibility
- Previously termed 'safety deficiency'
- Importance in terms of level of risk, not degree of contribution
- Three /four/ five levels:

• Significant	• Minimal	• Slight
• Minor	• Moderate	• Minor
• Critical	• Major	• Medium
	• Catastrophic	• Major
		• Extreme

Likelihood	*Consequence*			
	Minimal	Moderate	Major	Catastrophi
Likely	Significant	Significant	Critical	Critical
Possible	Minor	Significant	Significant	Critical
Unlikely	Minor	Minor	Significant	Critical
Extremely unlikely	Minor	Minor	Minor	Significant

Likelihood	Consequences
Frequent	Likely to occur **regularly**
Probable	Will occur **several times** in the life of the operation/item
Occasional	Unlikely but can be **reasonably expected** to occur in the life of the operation/item
Remote	**Unlikely** but possible to occur in the life of the operation/item
Improbable	So unlikely it **may not be experienced**

Likelihood	*Consequence*			
	Catastrophic	Critical	Major	Minor
Frequent	1	3	7	13
Probable	2	5	9	16
Occasional	4	6	11	18
Remote	8	10	14	19
Improbable	12	15	17	20

Acceptability of risk

Index Score	Level	Risk
1-5	EXTREME	Intolerable, immediately discontinued except in extreme circumstance and, close monitoring by senior staff.
6-9	HIGH	Tolerable with continuous review. Discontinued as soon as reasonably practicable
10-17	MEDIUM	Tolerable with periodic review to ensure risk does not increase. Risk ALARP.
18-20	LOW	Acceptable with periodic review to ensure risk does not increase

Level	Severity		
	Safety/ Health	Environmental impact	Operation
5 Extreme	Multiple fatalities	Long-term. Lasting impairment Widespread Severe on sensitive area	Very serious damage to v/l or equip or v. serious ops failure requiring urgent corrective action. Criminal proceeding. Loss of 1 > customers.
4 Major	Single fatality. Severe, permanent partial disability	Medium/long-term. Some impairment of eco-system. Large areas affected	Major damage to v/l or equip or major opsl failure requiring significant corrective action. Major process loss. Detention. Major complaint. Threat or temporary loss of customer
3 Medium	LTI, moderate permanent partial disability	Short-medium term. Local area. No eco-system	Moderate damage to v/l or equip. Moderate ops failure. Serious vetting findings. Significant process loss. Serious complaint. Service restriction for one v/l or class of v/ls
2 Minor	Restricted work case	Temporary. Minor affect, small area	Minor damage to v/l or equip. Minor ops failure. Minor vetting findings. Minor process loss. Minor complaint. Conditional acceptanc of service (specific v/l)
1 Slight	First aid/ medical treatment	Low, with no lasting affect. Minimal area	Insignificant or no damage to v/l or equip. Insignificant or no ops failure. Insignificant process loss. Request for process change. Observation.

Level	. . .rity / Operation	Potential degree of public attention	Probability of Occurrence	Countermeasures
5 Extreme		International coverage	Occurs several times per year at each location.	Non-existent - no countermeasures have been developed or implemented.
4 Major		National coverage	Occurs several times a year in the company.	Poor - less than generally accepted standards in the industry, or does not meet regulations.
3 Medium		Regional coverage	Has occurred in the company within the last year.	Adequate - meets generally accepted standards in the industry. Meets regulations.
2 Minor		Local coverage	Has occurred within the company within the last 3 years or greater.	Good - better than generally accepted standard in the industry and exceeds regulations.
1 Slight		No coverage	Has not occurred in the company.	Excellent - best available practice in the industry.

Humans are error prone – account for the active element in many accidents.

Defences (operational risk controls) exist in any organisation to reduce the chances of human error occurring, and if human error does occur to mitigate the results.

The operational risk controls may be influenced by legislation, company policy and particular (local) conditions under which people work.

International Safety Management Code for the Safe Operation of Ships and for Pollution Prevention

(ISM Code)

As a safety management system the ISM Code should identify all risks that threatens health and safety of crew or the integrity of the ship, its equipment or the environment .

Error Management (EM)

'Errors fall into recurrent patterns: the same situation keeps on producing the same error in different people'

James Reason

Shipping Industry - Legal

- In spite of the ISM Code's statement about the company's ultimate responsibility, when things go wrong responsibility too often still falls upon the Master (Erika)
- This also legally convenient. Shipping laws have been designed to place responsibility on the master (*in personam)*
- Result:
  - Very difficult to implement proper reporting system for both legal and cultural reasons
  - Lack of clarity and proper guidance on safety

Food for thought

The late great US Coast Guard Captain Dominic Callichio, who reformed American maritime law…, **theorised that so many maritime rules were created so that no rules were clear. This led to confusion in operation and policy but complete clarity in hindsight and prosecution.**

SOLAS Chapter IX

Management for the Safe Operation of Ships

1. Definitions
2. Application
3. Safety Management Requirements
4. Certification
5. Maintenance of Condition
6. Verification and Control

- The ISM Code is based on a Quality Assurance (QA) approach and hastily adopted by the shipping industry after the high profile ***'Herald of Free Enterprise'*** and ***Scandinavian Star*** incidents

  - ISM Code has focus on '**Safety**' and '**Environment**'

ISM Code

Adopted by Assembly Resolution 741 (18)

Became mandatory by virtue of the entry into force of SOLAS chapter IX on 1 July 1998

Further amended at the Maritime Safety Committee session of by resolution MSC 99(73), resolution MSC.104(73) of December 2000 and resolution MSC.273(85) of December 2008

General Principles of Safety at Work

Employers have an obligation to protect workers from risks in the tasks that they carry out or from plant, equipment and machinery used to carry out the task.

Employers must provide a safe working environment.

Companies providing equipment must provide 'equipment fit for purpose.

Employees must work safely in accordance with safe practice and procedures (and ensure other employees also work in accordance with safety procedures..

General Principles of Safety at Work

Employees must work safely in accordance with safe practice and procedures (and ensure other employees also work in accordance with safety procedures..

Safe work procedures:

- ensure that employees/workers are aware of the risks ;
- outlines how to avoid injury or illness
- documents risks
- describes appropriate risk controls.

Managing Risk

All foreseeable hazards must be identified:

- unacceptable risks must be eliminated entirely;
- acceptable risks reduced to as low as reasonably practicable by:
  - ✓ substitution – replace hazard with safe alternative
  - ✓ isolate – remove people from immediate contact
  - ✓ engineering – modify equipment or develop equipment to protect workers
  - ✓ administration – develop and maintain safe work procedures, train workers in hazard control
  - ✓ Personal protective equipment – safety clothing and equipment to protect body and senses.

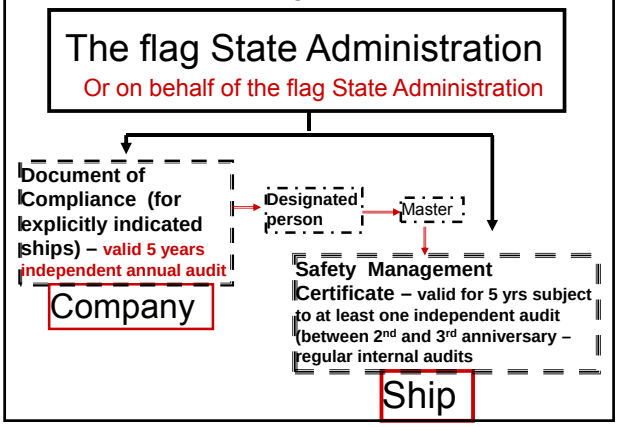
ISM Code

The objectives of the Code are to ensure safety at sea, prevention of human injury and loss of life, and avoidance of damage to the environment, in particular to the marine environment and to property.

ISM – In other words

- To provide an international standard for the safe management and operation of ships and for pollution prevention
- To minimize the scope for poor **human decisions** that contribute directly or indirectly to a casualty or pollution incident through the application of better management

ISM



ISM –Code Headings

1. General
2. Safety & environmental policy
3. Company responsibilities & authority
4. Designated Person (s)
5. Master's responsibility and authority
6. Resources & personnel
7. Development of plan for shipboard Operations
8. Emergency preparedness
9. Reports & Analysis of non-conformities, accidents & hazardous occurrences
10. Maintenance of ship & equipment
11. Documentation
12. Company Verification, review & analysis
13. Certification, verification and Control (Res. A741(18))

ISM Code

Safety-management objectives of the Company (ship owner or any other organization or person such as the manage or the bareboat charterer who has assumed responsibility for operation of the ship).

1. Provide for safe practices in ship operation and a safe working environment;
2. Establish safeguards against all identified risks; and
3. Continuously improve safety-management skills of personnel ashore and aboard ships, including preparing for emergencies related both to0 safety and environmental protection.

ISM Code

The safety management system is a structured and documented system enabling Company personnel to implement effectively the Company safety and environmental safety policy.

1. Compliance with mandatory rules and regulations;
2. That applicable codes, guidelines and standards recommended by the Organization, Administrations, classification societies and maritime industry organizations are taken into account.

Elements of ISM Code

- **Safety & environmental policy**
- **Documented instructions & procedures**
- **Defined authority & lines of communication**
- **Reporting of accidents & non-conformities**
- **Identification of training needs**
- **Emergency response**
- **Internal/External audits & reviews**
- **Company and shipboard management recognized as an integral part of safety**

ISM Code

Therefore, any accident involving a ship is a potential failure in the ship's ISM Code regime.

ISM – Designated Person (s)

- A person or persons ashore who provide a link between the ship and the company
  - **having access to the highest levels of shore management**
  - **having the responsibility and authority to monitor safety and pollution prevention of each ship**
  - **ensures that adequate resources and shore based support**

Usually the face of company management at a casualty investigation.

ISM Code
A safety management system

Six reasons why a safety management system fails:

1. **Management support is irregular, or inconsistent, or uncommitted.**
2. **System treated as 'paper warfare' work force not committed**
3. **System established in response to external demands – not 'owned' or understood by the workforce.**
4. **System imposed without effective participation of those that use it.**
5. **System not specific to ship – an 'off-the-shelf' product**
6. **Auditing ineffective.**

ISM – Audits – Some questions

Who does the audit?

Is there a potential conflict of interest in audit process?

Does the auditor have a particular technical skill?

(Auditors are usually good at picking up non-conformities and making observations in their own field of expertise.)

Marine Accident Investigators and ISM

1. **Review audit reports.**
2. **Check non-conformities.**
3. **Review accident reports.**
4. **Check audit reports (internal and external).**
5. **Check the audit reports/observations are consistent with what you see.**
6. **Apply the first test of the six tests of safe operation model to your review.**

Six tests of Safe Operation

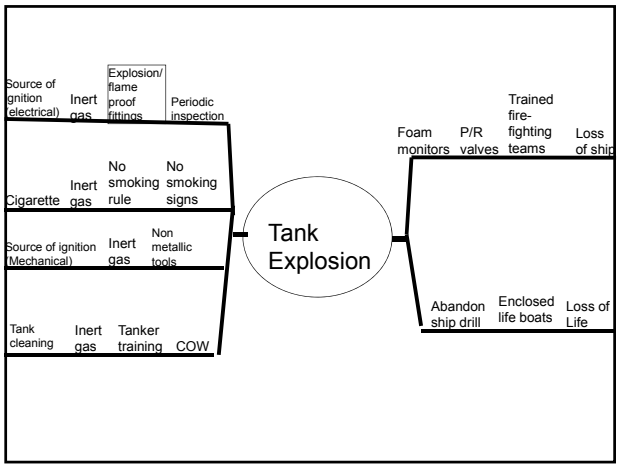
1. Were the risk factors identified or identifiable?

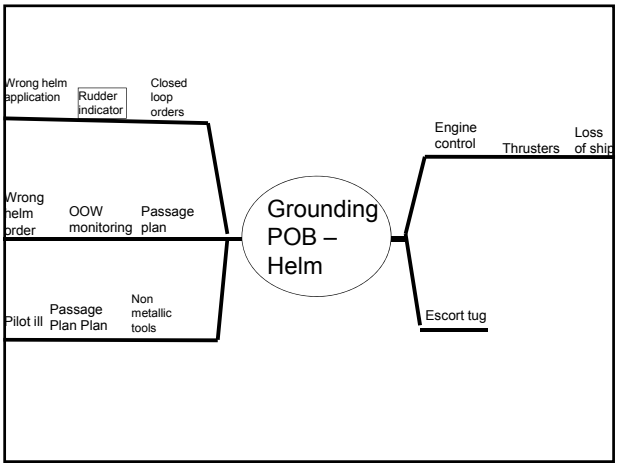
Could the event be classed as a 'major accident event'?

Was the accident event identified in the ISM documentation?

Had the company identified the threats and their preventative controls?

Had the company identified the potential consequences and the mitigating controls?





Shipping Industry Culture

- Very Strong `**Culture of Blame**´ based on tradition of **'Absolute Responsibility'**
  - **'Absolute Responsibility'** – some person always held directly responsible in case of an accident regardless of situational and organizational factors
  - **'Absolute Responsibility**' has fostered a **'Highly Individualistic Culture'**
- **'Highly Individualistic Culture'**
  - Each person tends to perform a task in different manner
  - Very difficult to get agreement on **'good practice'**
  - Without consensus on **'good practice'** very difficult to develop proper and effective training system
  - Not conducive to the implementation of a **'Safety Management System'**

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*** Recommended**

Electronic Evidence

Electronic evidence

- Voyage Data Recorders
- Electronic Chart Plotters
- Machinery Diagnostics
- Mobile Telephones

Electronic Data

- Ship Systems
  - Navigational Electronic Chart System
  - Voyage Data Recorder (VDR)
  - Automatic Identification System (AIS)
  - Global Positioning System (GPS)
- Shore Based recording
- Data Recovery and Shipping
- Solid State Memory
- Acoustic Beacon
- Electrostatic Discharge (ESD)

Computers

- An increasingly useful source of information
- On board computers store much of what goes on at sea.
- The investigator who understands how to access information is well placed
- Do not destroy computer data
- Seek assistance of manufacturer to access memory

Resolutions

Res. A. 861 (20)

Performance Standards for Shipborne Voyage Data Recorders (VDRs)

Circulars

MSC/Circ. 1024

Guidelines on Voyage Data Recorder (VDR) Ownership and Recovery

Voyage Data Recorder

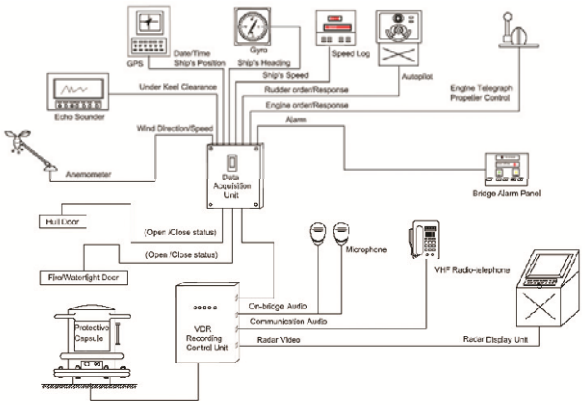
- Voyage Data Recorder (VDR) or Simplified Data Recorder (S-VDR) means a complete system, including any items required to interface with the sources of input data, for processing and encoding the data, the recording medium, the power supply and dedicated reserve power source
- Protective Capsule means the recording medium enclosure

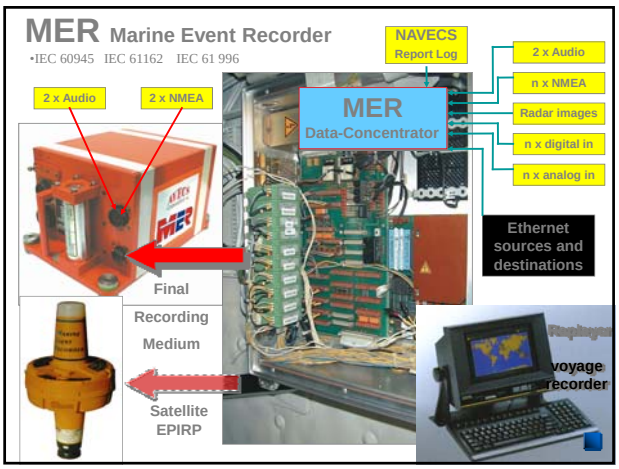
Definitions

- Recording Medium means the item of hardware on which the data is recorded such that access to it would enable the data to be recovered and played back by use of suitable equipment. Examples are a hard drive, memory chip, etc.
- Playback Equipment means the equipment, compatible with the recording medium and the format used during recording, employed for recovering the data. It includes the display or presentation hardware and software that is appropriate to the original data source equipment

Input Data Items to be Recorded	VDR	S-VDR
Date and Time (referenced to UTC)	X	X
Ship's Position (latitude and longitude derived from an electronic position-fixing system)	X	X
Speed (speed through water or speed over the ground)	X	X
Heading (as indicated by the ship's compass)	X	X
Bridge Audio (one or more microphones)	X	X
Communications Audio (VHF communications relating to ship operation)	X	X
Radar Data (one of the ship's radar installations)	X	1
Automatic Identification System (AIS) Data		2
Echo Sounder (depth under keel)	X	3
Main alarm (status of all mandatory alarms on the bridge)	X	3
Rudder Order and Response (also status and setting of auto-pilot if fitted)	X	3
Engine Order and Response (also status of bow thrusters if fitted)	X	3
Hull Opening Status (information required to be displayed on the bridge)	X	3
Watertight and Fire Door Status (information required to be displayed on the bridge)	X	3
Accelerations and Hull Stresses (hull stress and response monitoring equipment when fitted)	X	3
Wind Speed and Direction (relative or true when fitted)	X	3
1 – If radar interface available 2 – If no radar interface available or an additional data source		3

Typical Block Diagram





Audio / Ship Parameters

- Audio provides the investigator with the environment (quiet, noisy, etc), conversation (..what alarm is sounding?..) and the command being issue (..engines stop..)
- Ship parameters provides the investigator with information on what the ship was doing at the time of the incident
- Both sources of information compliment each other, need both to fully understand what was occurring at the time of the incident

ECDIS/ECS Data

- Stored data may include:
  - Time (UTC)
  - Date
  - Position
  - Speed over ground (SOG)
  - Course over ground (COG)
  - Planned route
  - Documentary data (man over board, etc)

Navigational Electronic Chart System

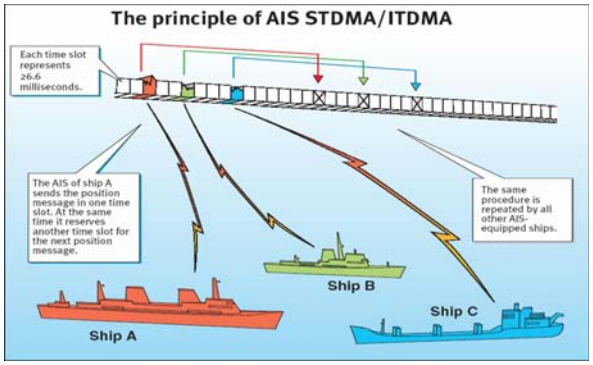
- *A navigational electronic chart system* is a general term for all electronic equipment that is capable of displaying a vessel's position on a chart image on a screen.
- There are two classes of navigational electronic chart systems.
  - Electronic Chart Display and Information System (ECDIS), which meets IMO/SOLAS chart carriage requirements.
  - Electronic Chart System (ECS), which does not meet IMO/SOLAS chart carriage requirements.
- An ECS may be able to use either official navigational charts or other charts produced privately and can have functionality similar to ECDIS.

ECDIS/ECS Data Recovery

- ECDIS/ECS are typically computer based with a Microsoft Windows operating system
- Typically can extract data to floppy drive, CD, DVD or USB drive
- If ECDIS/ECS has been damaged may be able to recover data by removing hard drive.

Automatic Identification System (AIS)

- AIS is a shipboard broadcast transponder system in which ships continually broadcast their identity, position, course, speed and other data to all other nearby ships and shore-side authorities on a common VHF radio channel.



AIS messages

- **Static Data**
  - Maritime Mobile Service Identity (MMSI)
  - IMO number
  - Length and beam
  - Type of ship
  - Location of position fixing antenna on ship (aft of bow, port or starboard of centre line)

Static information is programmed at time of commissioning

AIS messages

- **Dynamic Data**
  - Ship's position with accuracy indication and integrity status
  - Time in UTC
  - Course over ground (COG)
  - Speed over ground (SOG)
  - Heading
  - Navigational status (e.g., at anchor, etc, manually entered)
  - Rate of turn (Where available)

Dynamic information is derived from interfaces with the ship's GPS and other sensors

AIS messages

- **Voyage related data**
  - Ship's draft
  - Hazardous cargo
  - Destination and ETA (at master's discretion)

Voyage related data is entered manually by the master

- **Safety related messages**
  - As needed

Safety messages can be inserted by the ship or shore station

Global Positioning System (GPS)

- The Global Positioning System (GPS) is a satellite navigation system. A constellation of more than two dozen GPS satellites broadcasts precise timing signals by radio, allowing a GPS receiver to accurately determine its location (longitude, latitude, and altitude) in any weather, day or night, anywhere on Earth.
- Speed over ground and course over ground is calculated by the GPS receiver
- Differential GPS (DGPS) is a method of improving the accuracy of your receiver by adding a local reference station to augment the information available from the satellites.

GPS Data

- Stored data may include:
  - Time (UTC)
  - Date
  - Position
  - Speed over ground (SOG)
  - Course over ground (COG)
  - Planned route
  - Events (man over board, etc)

Shore Bases Recording

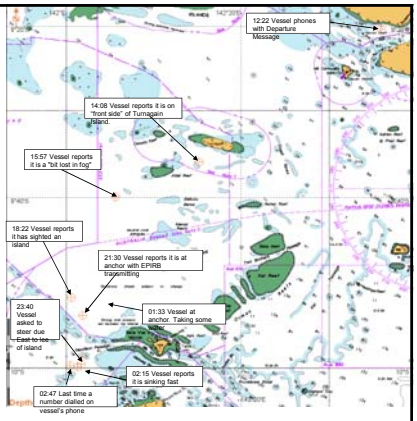
- AIS
- Closed Circuit Television (CCTV)
- Radar
- Audio Communications

Mobile Telephones – Satellite Telephones

Mobile Phones – Approximate location through mobile telephone towers.

Satellite Phones – Position from satellite constellation. Accuracy from tens of metres to kilometres, depending on number and altitude of satellites.

Plotting a vessel's position by satellite phone



No 1 Rule Of Electronic Data

- All electronic data should be treated as perishable evidence. The electronic data should be replayed and/or downloaded as soon as possible after the event.

Data Recovery Guidelines

Note: These are general guideline. As every situation will likely be different the recovery guidelines may need to be altered

- Unit Operational
  - Replay and/or download data using unit
- Unit Damaged
  - Remove unit
  - Sent unit to specialist facility
  - Remove recording medium from unit
  - Evaluate recording medium for damage

Data Recovery Guidelines

- No Damage to Recording Medium
  - Install recording medium into operational unit
  - Replay and/or download data
- Recording Medium damaged
  - Remove memory component (memory chips, etc) from recording medium. Install memory component into new recording medium. Install recording medium into operational unit
  - Replay and/or download data

Damaged Unit Recovery

- Prior to recovering the unit, photograph and or video the location and condition of the unit
- Record the following unit information:
  - Type of unit (GPS, AIS, etc.)
  - Unit manufacturer/model (Broadgate, L-3 Communications, etc)
  - Unit Part Number
  - Unit Serial Number
  - Unit damage (dents, scratches, etc)
- The unit should not be tampered with or opened, and the recording medium shall not be removed (i.e., memory module) until it reaches a specialist facility
- The unit should not be read out, downloaded or replayed on-site

Unit Shipment - Dry

- If the unit is recovered dry use a shipping container obtained from the equipment manufacturer, if possible. Otherwise package the unit in a manner that protects it from damage (i.e., inside a cardboard or wooden box, wrapped in either foam or bubble-wrap or in a container filled with foam peanuts)
- If the case is broken, **DO NOT** remove the recording medium from the device. Wrap the entire unit and its contents in polyethylene, similar material or heavy paper before packaging for shipment
- If the solid state memory board separates from the unit, wrap them in polyethylene or similar material or heavy paper before applying sealing tape. **NEVER** apply sealing tape directly to the recording medium. **DO NOT** remove the recording medium from the enclosure

Underwater Recovery

- The difficult part of lifting is the last few metres when the object breaks the surface
- Lift the object slowly allowing water to drain from the object

Unit Shipment - Wet

1. If the unit is recovered from fresh water, rinse the unit in clean fresh water (distilled, if possible), then immediately re-immerse the unit in a container of clean fresh water.
2. If the unit is recovered from salt water, rinse the unit in clean fresh water (distilled, if possible), then immediately re-immerse the unit in a container of fresh water. Where clean fresh water is not immediately available at the recovery site, the unit should be rinsed and then kept in salt water rather than exposed to air. If available, several change of clean fresh water, prior to packaging for shipping, should be made to dilute the salt

Unit Shipment - Wet

3. Arrange to ship the unit **IMMERSED IN WATER** (distilled, if possible). Make sure the unit stays immersed in water and not allowed to dry out. **DO NOT** attempt to dry it. Packaging may be accomplished by sealing the unit (in water) inside a plastic beverage container with silicon adhesive or a similar sealant. Ship by fastest means available.
4. If the unit is recovered from polluted/chemically contaminated water (either fresh or salt), rinse the unit in clean fresh water (distilled, if possible), then immediately re-immerse the unit in a container of fresh water. Where clean fresh water is not immediately available at the recovery site, the unit should be kept in clean salt water rather than exposed to air. If available, several change of clean water, prior to packaging for shipping, should be made to dilute the pollution/chemical contaminates.

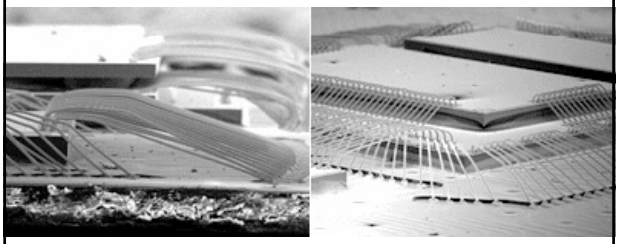
Unit Shipment - Wet

- Do not allow water to freeze during shipping. If freezing may occur, ship unit in dry condition but place in water on arrival at destination.
- Airlines may not allow container filled with water on an aircraft. If the airline does not allow shipment, ship unit in dry condition but place in water on arrival at destination.

Unit Shipment – Fire

- If the unit is recovered after being exposed to a heat source (fire, etc.) allow the unit to cool in ambient air. Do **not** rapidly cool the unit (placing the unit in a freezer, etc.).
- Do **not** package the unit if the surface of the unit is warm

Solid State Memory



Solid State Memory

- Two Types of Solid State Memory:
  - Volatile: memory that **loses** their contents when the power is removed
  - Non-volatile: memory that **retain** their contents when power is removed
- Some recording medium have an internal battery or capacitor to maintain memory contents when external power is removed

Memory Content Recovery

- **No Physical Damage**
  - Data recovery from non-volatile memory is likely if there is no physical damage.
  - If the data is corrupt, been deleted or reformatted the services of specialise in this type of data recovery ,companies such as Flash Media 911 in the USA may be required.
  - There is also software available that will read memory on a bit for bit basis to recover lost data. Typical program is Flash File Recovery from Panterasoft in the USA

Memory Content Recovery

- **Physical Damage** (includes electrical damage)
  - If the package has been physically damaged (ie broken or burnt) then this situation has a very low probability of recovery.
  - If the package is damaged and the internal die is intact then the package can be removed and the internal die then accessed.

Fire

- As temperature to circuit card increase:
  - Solder which secures components to circuit card melts (components may move or fall off circuit card)
  - Circuit board burns/melts
  - Damage to components

Sea Immersion

- Shallow water
  - Corrosion is major cause of damage
  - Pressure damage is minimal
- Deep Water
  - Corrosion damage is minimal due to low oxygen content
  - Pressure is major cause of damage

Acoustic Beacon

- Also know as a pinger
- Acoustic beacon
  - Actuation Fresh or salt water
  - Size – typical (less mount) 9.95 cm long by 3.30 cm diameter

Acoustic Beacon

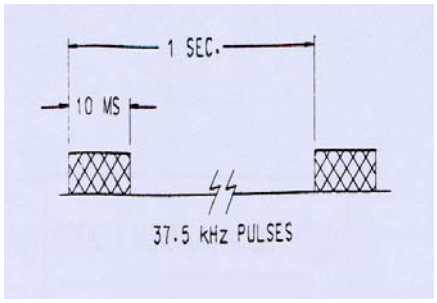
- Acoustic beacon
  - Theory of Operation

    A water switch is part of a triggering circuit, which when actuated will initiate normal pulsing of the beacon circuit. The signal is typically coupled to a transducer ring. This results in mechanical motion that is transmitted to the metal case of the beacon, which in turn, radiates acoustic energy into the surrounding water.

Acoustic Beacon

- Acoustic beacon - continued
  - Operating Frequency 25 kHz to 50 kHz (Typically 37.5 kHz ± 1 kHz)
  - Operating Depth Surface to 6096 metres (20,000 feet)
  - Operating Life 30 days (minimum)
  - Acoustic Output 700 dynes/cm^2 rms pressure at 1 metre (157.0 dB) (after 30 days)

    Note: Acoustic transmission does not immediately cease at 30 days but gradually reduces in amplitude (intensity) as the battery discharges
  - Pulse Length 10 milliseconds ± 10%
  - Pulse Repetition Rate Not less than 0.9 pulses/second

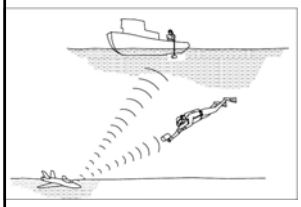


Acoustic Beacon

Acoustic beacon - continued

Beacon can typically be detected at a range of 1,800 to 3,600 metres (2,000 to 3,000 yards).

The sea state, nearby boats, marine animals, gas and oil lines, and other factors contributing to the ambient noise level will affect the range at which the beacon can be detected.



Electrostatic Discharge (ESD)

- Electrostatic discharge is the sudden transfer (discharge) of electricity from one object to another
- An example is the spark you sometimes feel when you walk across a carpet and touch a doorknob
- A tiny transfer of electrical charge - even one that you can't see, hear or feel – is as damaging as a bolt of lightning to some electronic components and assemblies

ESD Protection Methods

- ESD Strap 
- ESD Kit 
- ESD Bench 
- ESD Bags 

VGA / DVI Video Capture

- 'DVI2USB' allows capture of DVI or VGA video source to USB port on computer

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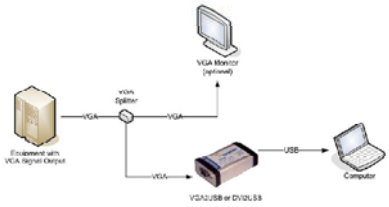
www

VGA / DVI Video Capture



Before an Incident/Accident Occurs

- Determine what units are installed on the ship and/or shore that store data
- Determine procedures and equipment required to download and/or replay data from an operational unit
- Determine procedure to remove recording medium from a damaged unit
- Determine where the recording medium will be evaluated
- Determine where the recording medium will be downloaded and/or replayed
- Determine procedure and equipment required to download and/or replay data

Remember

Evidence must be: -

- ❑ identified;
- ❑ collected;
- ❑ preserved;
- ❑ recorded; and
- ❑ able to be produced.

Where ever possible use an electronics expert, equipment installer or supplier.

If in doubt seek expert advice from supplier or trusted source.

o Michael Hill
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Evidence
and its Collection

A General Introduction

Preface

- This session covers some general points of evidence
- Later on there will be more detailed, and separate, cover of:
  - Witnesses and their limitations
  - How to interview
  - Fire Investigations
  - Handling Voyage Data Recorders

The aim is to……..

- introduce you to the collection of evidence
- identify certain features that may not immediately occur to you
- generate interest in this basic skill of accident investigation
- Deter you from the trap of "only collecting information that the investigator considers relevant."

Remember

Evidence must be: -

- ❑ identified;
- ❑ collected;
- ❑ preserved;
- ❑ recorded; and
- ❑ able to be produced.

Identification - Collection - Preservation

- Use a note book
- Camera
- Collect physical evidence in appropriate container
  - ✓ suitable plastic bags for documents and equipment
  - ✓ sterile glass jars and secure tops for oil/liquids
  - ✓ sterile tins with airtight lids for suspected samples of hydrocarbon residue
  - ✓ clean plastic wrap for larger equipment
- Label – identify, date, describe and sign
- Record
- Receipt
- Secure

Record and Produce

- Use a note book
- Camera
- Start a file
- Keep a record of evidence acquired

Maintain good office management of records

Evidence – An Introduction

- "Evidence can be defined as something that furnishes proof."
- Much of it is perishable. Its quality degrades with the passage of time.
- It will usually be found to be incomplete, inconclusive, conflicting and thoroughly confusing. Don't worry at this stage.
- It is very difficult for a single investigator to collect it all.

Resist Temptation!

- No matter how tempting, never assume you know what happened.
- Resist the temptation to look for evidence that supports a particular theory.

And get started as soon as possible

- The sooner you can start collecting evidence the better. Best within 24 hours.
- Human evidence deteriorates even faster!

The Burden of Proof

In marine accident investigation, the burden of proof is generally accepted as being "on the balance of probability" rather than "beyond reasonable doubt."

Types of Evidence

- Different types of Accident involve different types of evidence.
  - Physical. Material/debris/metal fatigue
  - Personal or human. Witness accounts
  - Electronic including Voyage Data Recorders
  - Photographic. Still and video.
  - Documentary. Charts/logbooks/orders/letters
  - Environmental. Weather/sea state
  - Historical. Refits or maintenance
  - Underwater. Wrecks on seabed.

Why collect it?

- **To establish the sequence of events**
- **To determine what happened and why.**

Physical Evidence

- Once removed it can never be replaced precisely
- All physical evidence should be catalogued, documented or photographed
- Damaged or fractured items of evidence should, so far as possible be protected against further damage

Evidence Examination

- Do not touch anything to start with
- Photograph in situ without removing any grease, dirt or soot
- Keep a careful record of what was found (a tape recorder can be useful)
- Check direction of any compression or telescoping
- Do not clean items in situ unless essential

Some additional advice

- If looking at damaged equipment, try and look at something similar that is undamaged for comparison purposes
- Use system diagrams to aid an understanding of what it should have been
- If possible use external laboratories for detailed examination of machinery and component parts.

Evidence may indicate:

- Corrosion (Steel thickness measurements)
- Metal fatigue
- Counterfeit components
- Poor quality maintenance or repairs
- Excess loading
- Incorrect labelling
- Inadequate protection to moving parts

Electronic evidence (to be covered separately)

- Voyage Data Recorders Electronic Chart Plotters
- Machinery Diagnostics
- Mobile Telephones

Photographic Evidence (to be covered separately)

Photographic evidence comes under four headings

1. Historical (Archive pictures)
2. Real time (pictures or video of the accident). Include pictures taken by others including third party observers
3. On site or investigator's photographic record - includes underwater pictures
4. Reconstruction or model photography

Environmental Evidence

- Can be a crucial element
- Relevant in collisions, groundings, founderings, cargo shifts, personal injury and any evacuation
- The evidence comes under three headings
  - The forecast weather
  - The weather as reported by witnesses
  - The actual weather

Environmental Evidence

- Do not assume that the conditions reported by the vessel are necessarily accurate
- Visibility and wave height assessments may be in error. Check the sources and establish how the assessment was made
- Water temperature is needed when assessing survival factors
- Prepare weather directory as a useful source of information

Environmental Evidence

- Where weather is a factor
  - e.g. in collisions, groundings, founderings, personal injury or ship/cargo damage obtain meteorological weather reports.
  - Photographic evidence from both video and still photographs
  - Contemporaneous entries in ship's log

Bodies

- Dead bodies can reveal important evidence
- **Never** make an assumption about how someone died. Establish precise cause of death
- Insist on a post mortem
- Toxicological testing is increasingly relevant – drugs, alcohol and toxic gasses

Checking the evidence

- The cross checking of evidence is imperative
- Do documents from different sources contain the same information
- Do witness statements corroborate physical and electronic evidence.
- As the investigation progresses, irrelevant information can be removed (but not destroyed)

Checking the evidence

Checking certificates of competence:

- which administration issued the certificate?
- was the certificate issued in recognition of another State's STCW certificate?
- do you go to the original issuing administration?

Once you think you have collected all the evidence, how do you know you haven't missed anything?

The Answer is you don't

Peer Group Review

- Once the bulk of evidence has been collected, consider having a peer group review.
- Enables others to offer an opinion on what needs to be done, especially in difficult areas.
- Allows colleagues to share their experiences

Works wonders to help identify "missing links" at an early stage

Transition to Analysis

- The analysis of evidence gets underway at the very beginning of any investigation but it is only when most of the evidence has been collected that a true picture of what happened and why emerges.

Analysing the evidence will be covered separately.

Time?

Real time events

Relative time

Establishing a time base line

Checking times - (GPS clock, ship's clocks bridge clocks, course recorder, VDR, engine room clocks, data loggers, wrist watches, VTS times, etc.)

Limitations of charted positions

Limitation of 'bell-book' times

Photography as Evidence

A General Introduction

Preface

- This session briefly outlines some of the issues in taking photographs to use as evidence in an investigation.

Physical Evidence

- Once removed it can never be replaced precisely
- All physical evidence should be catalogued, documented or photographed

Photographic Evidence

Photographic evidence comes under four headings

1. Historical (Archive pictures)
2. Real time (pictures or video of the accident). Include pictures taken by others including third party observers
3. On site or investigator's photographic record - includes underwater pictures
4. Reconstruction or model photography

Photographic Evidence

- **Provides a permanent visual record of the incident scene**
- **Shows what was seen by the investigator**
- **Shows what was collected by the investigator in its original position**
- **Essential part of follow up investigations**
- **Often critical in providing proof or verification.**

Photographic Evidence

- **Photograph the scene before anything else is done**
  + touched
  + moved
- **Use camera with electronic flash**
- **Digital camera should have at least 6 megapixel resolution**
- **Camera should have macro/close-up capability.**

Photographic Evidence
Miscellaneous equipment

- **Tripod**
- **Scale or rulers**
- **Camera with 'hot shoe'**
- **Extension flashes**
- **Note book to sketch scene, and**
- **Log photographs taken .**

Photographic Evidence
Sequence of photographs

Sequence should follow a progression from general to specific

- **Overview**
- **Mid range (3-6 m) from point of interest**
- **Close –up (1.5 m or <)**
- **Macro (with and without scale)**

Photographic Evidence
Down-loading images

- **Ensure that an original (un-enhanced) disc is burnt and kept in a safe location**
- **Use a separate file for enhancing photographs as a working copy.**

Historical Photography

- Photographs of the vessel taken before the event can be invaluable
- Will often reveal "as fitted" modifications rather than "what should have been fitted."
- A picture of a vessel sailing on her last voyage may provide details about draft, or deck cargo
- Passenger videos of past lifeboat drills might be revealing of standards being set

Real Time Photography

- A surprising number of accidents, or the recovery, are filmed at the time they occurred. They record events such as the actual weather and the state of the vessel
- Examples include on board or port harbour security CCTV, SAR pictures, aerial pictures and hand held video by those on board or close by
- Very often such pictures have a time reference
- Find out who might have such pictures

Investigators' Photography

- The camera is a valuable analytical tool
- But it cannot think for itself!
- Every picture should have a purpose
- They record details such the condition and positions of equipment and instruments
- They orientate the scene and relative positions of material
- They record witness lines of sight

Photographic Subject Matter

- Details of injury or damage
- Evidence of improper use of equipment
- Indicator, switch or valve positions
- Items out of place
- Anything of interest that cannot be removed
- Pictures of inaccessible parts

Reconstruction Photography

- Some investigations lead to computer modelling, simulator reconstruction or tank testing
- Photographs of the tests can provide analysts with a record of what was observed
- Enables analysts to share experiences
- Can be invaluable when presenting the findings

Cameras

- Still or video?
- Digital or film?
- Instant or SLR?
- Flash or natural light?
- Close up?

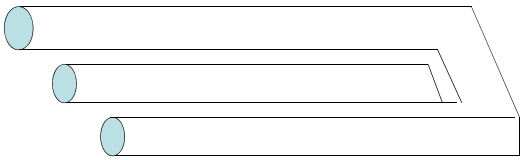
Know your camera

Digital Cameras

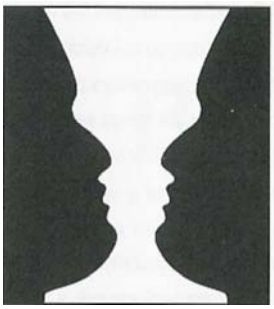
- Are an invaluable aid to casualty investigation
- Beware flash when taking close ups, it can blank out what you are trying to record.
- Take spare batteries AND recharging means
- Consider a back-up camera.

Witnesses

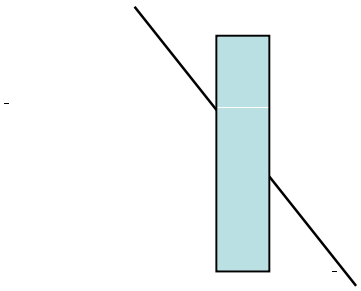
- Does the right side relate to the left?



Experiment No.4
What do you see?

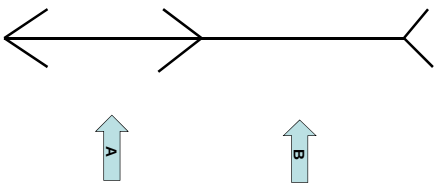


Experiment No. 6



Experiment No.7

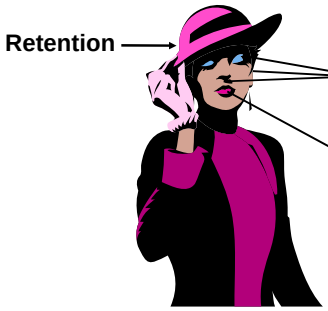
- Look carefully at this line



Witness Limitations

- **extensive research (Loftus & others)**
- **many limitations/biases have been demonstrated**
- **good interviewing techniques will minimise influence of limitations**
- **acquisition, retention, retrieval**

What senses do we use to record events?



Interviewing

Retention

Fragments stored at the time of the post event information

Interpretation at time of the post event information

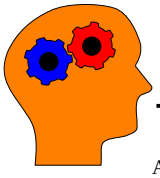
Acquisition

Fragments stored in memory

Interpretation at the time of the event (based on existing knowledge and inference

Retrieval

Reconstruction of interpretation



Response

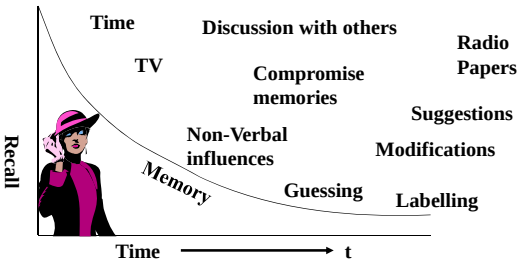
After EF Loftus

What Factors will influence recall?

Event factors	Witness factors
Exposure time	Degree of impact*
Light/visibility	
Detail salience	Speed
Complexity	
Type of fact	
Temporary biases	Stress
Involvement	
Age?	Expectations
Alcohol/drugs/ medicine	Perceptual activity
Gender	Cultural expectations
Prior knowledge	Prejudices

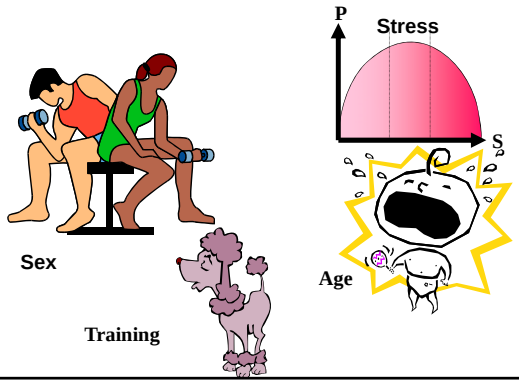
*Loftus uses word Violence

Retention



Marine Casualty Investigators' Course

Interviewing



Age

Children are relatively good witnesses but suggestible, and influenced by the wording of questions.

Very individualistic.

In general, no overall decline with advancing age.

Performance on some tasks may decline.

Memory for logical relationships and ability to make complex inferences, will not.

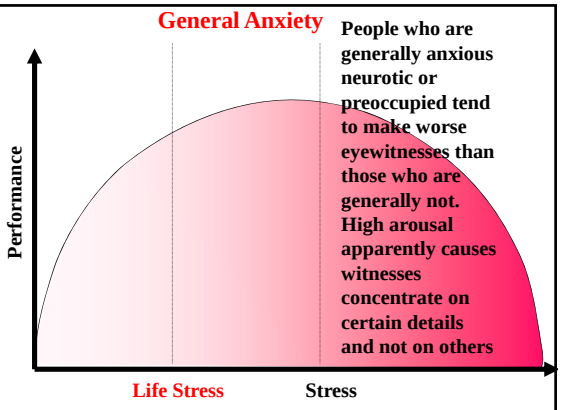
Which is the better sex as a witness?

Men tend to be more accurate and less suggestible on male orientated items

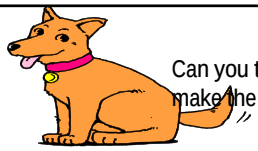
Women tend to be more accurate and less suggestible on female orientated items

Males and females tend to be accurate on different types of items, perhaps indicating a difference in their interests……

Elizabeth F Loftus, Eyewitness Testimony



People who are generally anxious neurotic or preoccupied tend to make worse eyewitnesses than those who are generally not. High arousal apparently causes witnesses concentrate on certain details and not on others



Can you think of any people who might make the best witnesses?

There is little evidence that a "trained observes" (eg. A policeman are more accurate witnesses.)

A person with expert knowledge may notice things "that aren't quite right". But may also be subject to bias, projection and assumption

Influence of language on recall

- **subjects shown films of car accident**
- **some were asked: "about how fast were the cars going when they smashed into each other?"**
- **others asked "hit", "contacted", etc.**
- **estimates 10 mph higher for "smashed" versus "contacted"**

Influence of language on recall

- **collided at 40 mph: average estimate was 38 mph**
- **collided at 20 mph: average estimate was 38 mph**
- **subjects asked one week later if saw broken glass (there was none)**
- **32% of "smashed" and 14% of "hit" said yes**

Body Language

Shifting in seat (swivel chairs)

Touching face, hair, or body

Use of hands

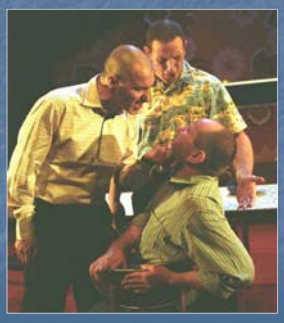
Scratching

Facial expressions

Feet

Leg movement

Witness Interviews
Cognitive Interviewing



This session examines

- types of interviewees/witnesses
- witness limitations
- stages of an interview
- general guidelines
- detailed principles for each stage

Type of Witnesses

- **Reluctant Witness**
- **Un-cooperative Witness**
- **Emotional Witness**
- **Hostile Witness**

Reluctant Witness

When witnesses refuse to be interviewed:

- Try to determine why, then try to fix problem.
- Appeal to their concern for marine safety.
- Explain that witnesses may have a representative at the interview (union/lawyer/family).
- Should all else fail, explain that the CTAISB Act empowers you to subpoena a witness to attend before you and give evidence under oath or solemn affirmation.

Un-cooperative Witness

During interviews, if witnesses do not cooperate, refuse to answer or give deliberately evasive answers:

- Be sure they understand the purpose of the interview.
- Appeal to their concern for marine safety.
- Explain that their evidence may contribute to preventing a reoccurrence.
- Concentrate on the positive, preventative side of the investigation.
- Determine if they would be more cooperative if they had representatives present.
- Should all else fail, explain that the CTAISB Act empowers you to subpoena a witness to attend before you and give evidence under oath or solemn affirmation.

Emotional Witness

When witnesses are emotionally upset or grieving:

- Be sympathetic and offer your condolences.
- Maintain your stature of a professional TSB investigator with a job to do.
- Explain that your job is to try to prevent a reoccurrence.
- Be patient.
- Anticipate that the individual will want to talk about the deceased.
- Avoid saying anything which may be interpreted as a negative reflection on the deceased.
- For the more sensitive questions, a subtle technique which often works is to imply that you are following standard procedures when you ask such questions, and that you are protecting the witness as best you can.

Hostile Witness

When witnesses are extremely hostile:

- Use appropriate body language to establish a rapport with the witness.
- Do not continue the interview in an atmosphere of active hostility.
- Try to discover the underlying reason.
- Spontaneous hostility may pass with a "cooling-off period"; postpone the interview a day or two.
- If the hostility is directed at the government, or authority, show your "nice side" with marine safety as your only objective.
- Be deliberately calm, speak slowly, softly, and in general terms. Allow plenty of time to answer.
- Suggest a written report, if it meets your needs.
- Should all else fail, explain that the CTAISB Act empowers you to subpoena a witness to attend before you and give evidence under oath or solemn affirmation

Introduction

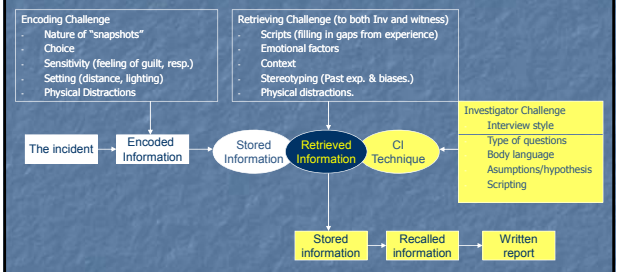
- **critically important task**
- **good techniques are not commonly used**
- **good techniques based on research in cognitive and social psychology**
- **aim is to provide you with an understanding of:**
  - **potential limitations of interviewees;**
  - **the nature of good interviewing principles**

Interviewing

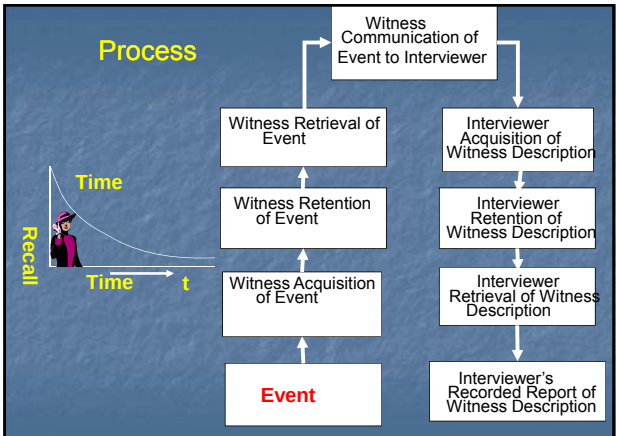
The process of collecting critical, perishable information from a person.

- The Witness is the central character in the interview, because she has event-related information.
- The opportunity to The witness should play an active role in the interview.
- Relies on what a person wants to tell you
- Relies a person's memory of events.

Cognitive Interview Process



Process



'Cognitive interviewing techniques enhances the reporting of correct detail and produces greater differences between the contents of true and false accounts.'

As reported by Milne and Bull 1999 (University of Portsmouth) commenting on a 1995 Spanish study by Hernandez-Fernaud, E. & Alonso-Quecuty,M

Phases of the Cognitive Interview

1) Introduction to develop rapport
   a) Greet and personalize the interview
   b) Explain the purpose, shared goal of safety and truth
   c) Explain the "ground rules" (logistics, social dynamics)
2) Free Recall
   a) Ask open-ended questions
   b) Do not interrupt or fill in blanks or pauses
   c) Allow for pauses
   d) Nonverbal
3) Follow-Up Questioning & Probing
   a) Questions from Free Recall
   b) Clarify earlier ambiguities, contradictions and gaps
   c) Concentrate
   d) OK to say "I Don't know" or "I Don't understand"
   e) Open and closed questions

Phases of the Cognitive Interview

4) Varied/Extensive Retrieval
   a) Facilitate recognition,
   b) Focus on all senses
   c) Mental imagery
   d) Change sequence (temporal order)
   e) Change perspectives
5) Review & Summary
   a) Check accuracy of notes
   b) Request additional information
6) Closure
   a) Collect background information
   b) Maintain rapport

Retrieval Processes

Two primary mechanisms by which we remember through:

1. **Recall of information**: involves an active, complex mental search process. It is the process by which you would answer an essay or fill-in-the-blank question on an exam.
2. **Recognition**: occurs when remembering takes place as a result of triggering or cueing by a like stimulus (e.g fragments of material, chart, instrument, etc.) to which he has previously been exposed, or sensed and felt.

Stages of Interviewing

A. **Preparation**
B. Introduction
C. General account
D. Detailed account
E. Background issues (participants)
F. Review
G. Evaluation and follow-up

Stage A: Preparation

- Obtain background information
- Determine aims
- Determine location
- Determine time
- Determine who will be involved
- Determine interview plan
- Obtain relevant materials and equipment

Setting up the interview venue.

- Free of interruptions
- Your office
- Hospital / ER
- Witness home
- Occurrence site, Ship
- Operator premises
- Face-to-face
- Telephone
- E-mail

Planning and preparation

- Analyse existing evidence
- Consider what other evidence you need and and who may have the answers
- Go through the factors and elements as they are understood
- Draw up a list of interviewee

Who should be involved in interviewing?

- Investigators
- One witness at a time
- Legal / union rep (with Witness's consent)
- Person in charge of operation
- People involved in the operation
- Anybody that can add to known facts
- Any person who can provide evidence or corroboration
- No observers
- Brief attendees on expected conduct

How many interviewers?

Seating set up

Working with an interpreter

Working from statements prepared by legal rep

Recording the interview

Notes

Electronic recording

Stenographer

Stages of Interviewing

A. Preparation
B. Introduction
C. General account
D. Detailed account
E. Background issues (participants)
F. Review
G. Evaluation and follow-up

Getting the Interview Started

- Introductions, business cards
- Ensure positive greeting
- Reason for interview
  - Emphasize not for regulatory / law enforcement
- Explain interview process
- Explain his/her rights & privileges
- Explain your powers & obligations
- Taping consent

General Principles

- develop good rapport
  - (put witness at ease, show them you are interested, empathise)
- maximise witness concentration
  - (minimise distractions; active listening; deal with one topic at a time)
- let the witness talk
  - (minimise interruptions; open questions; use pauses)
- recreate the event context
  - (appropriate use of instructions, cues)

General Principles

- encourage extensive, detailed responses
  - (appropriate use of instructions, logically ordered questions, multiple retrieval attempts)
- divide interview into a number of key topics
  - (during detailed account, background information stages)
- minimise your own workload
  - (team resource management, note-taking techniques, act natural where appropriate)
- maintain good rapport
  - (be patient, avoid arguments and criticism)

Stages of Interviewing

A. Preparation
B. Introduction
C. General account
D. Detailed account
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F. Review
G. Evaluation and follow-up

Step C: General Account

The investigator should endeavour to

- Recreate general context
- Request general description
- Active listening
- Modify witness's behaviour (if required)
- Identify items for further questioning

Recreate context/ event description

- ***Tell me everything you can remember, even the things you think are not important--even if you can not remember something completely. Everything which comes in to your mind, tell me at your own time and pace.***

Recreate context/ event description

- ***Put yourself back to the same place where you saw the incident. Create a picture in your mind of the scene.***
- ***Think of where you were, how you were feeling at the time, what you could hear. Think of what the weather was like, and who was present near you at the time.***
- ***Get a really good picture in your mind and then tell me everything you can remember without leaving anything out. All that comes in to your mind, please tell me.***

TEN COMMANDMENTS OF INTERVIEWING

1. **Stop talking –** *(you cannot listen if you are talking)*
2. **Put witness at ease –** *(let him/her feel free to talk – often called as "permissive environment.")*
3. **Show that you want to listen –** *(look, act and be interested. Don't check your email during the interview.)*
4. **Remove distractions –** *(silence phones, restrict views.)*
5. **Empathise –** *(put yourself in the witness's place – try to see their point of view.)*

TEN COMMANDMENTS OF INTERVIEWING

6. **Be patient** *(Allow plenty of time, Do not interrupt)*
7. **Hold your temper** *(Any hint of exasperation can lose you the initiative)*
8. **Avoid argument or criticism** *(Causes witnesses to become defensive – to clam up.)*
9. **Ask Questions; Make your questions flow in response to his/her response** *(Asking questions encourages the respondent and shows that you are listening.)*
10. **Stop talking.** *(This is first and last because all the other commandments depend on it. You just simply cannot do a good listening job while you are talking.)*

Stages of Interviewing

A. Preparation
B. Introduction
C. General account
D. Detailed account
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F. Review
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Step D: Detailed Account

- Recreate specific context
- Request item description
- Use special techniques where required
- Determine witness limitations
- Active listening
- Modify witness's behaviour (if required)
- Summarise at regular intervals
- Use appropriate types of questions

Behavioural Sequence Interview Technique

(Keating and Loftus – 1984)

Situation Cue *What happened*	Behavioural Response *What I did*	Reason why *Why I did that*
I heard an explosion	I looked out of the porthole	To see where the noise had come from
I could see a large flame forward	I ran to the control room	To help in an emergency response
The over-pressure alarm was sounding	I went to the bridge to call mayday on the VHF	To phone call the emergency services

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I felt a shudder	I went to the bridge front	To see what may have caused the vibration
I saw a buoy on my port side amidships	I went to the engine control	To stop the engine
The master came to the bridge	I told him that I had stopped the engine	So he could take the con

Questioning

Open-ended question

"broad, often specifying only a general topic [which] allows the respondent considerable freedom in determining the amount and kind of information to give."

'Tell me in your own words what happened from the time you assumed the conduct of the watch until the fire was extinguished.'

Questioning

Closed question

" . . . allows only a relatively narrow range of responses . . ."

'What colour was the ship's hull?'

'Who closed the fuel valve?

Questions to avoid

Forced-choice questions

"requiring a choice of options."

'Was the valve open or closed?'

Questions to avoid

Multiple questions

"Two or more possible questions at once."

'How many revs was the engine turning and what course was ordered?'

'Was the fuel valve open and was the cooling water circulating?'

Questions to avoid

Leading questions

"so worded that it suggests a particular answer to the witness."

'The O.O.W gave the order didn't he?'

'It was the Chief Petty Officer who closed the circulating valve wasn't it?'

Stages of Interviewing

A. Preparation
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Step E: Background Issues

- **Situational (task, environmental) conditions**
- **72-hour, 7-day history**
- **Medical/physiological**
- **Operational experience**
- **Organisational issues (?)**

Stages of Interviewing

A. Preparation
B. Introduction
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D. Detailed account
E. Background issues (participants)
F. Review
G. Evaluation and follow-up

Step F: Review

- Ensure all items covered
- Summarize info given by witness
- Clarify discrepancies (if required)
- Seek comment
- Ask witness if they want to add anything
- Ask if there's anything significant you did not ask about
- Ask if there's anything significant you did not ask about
- Obtain outstanding background information
- Ensure you have contact details
- Arrange follow-up interviews (if necessary)
- Leave your card – Encourage to contact you with more info.
- Thank witness

Stages of Interviewing

A. Preparation
B. Introduction
C. General account
D. Detailed account
E. Background issues (participants)
F. Review
G. Evaluation and follow-up

Step G: Evaluation and Follow-Up

- **write up notes**
- **evaluate information**
- **evaluate quality of interview**
- **contact witness again (if required)**

Assessing the witness

Truthful and untruthful witnesses

Points on self justification to remember

The higher the stakes: professional – financial – moral – the harder it is to admit to a mistake or bad judgement. Often leads to *self-justification*.

Self- justification is not the same as lying. Lying is a strategic decision to save own skin or gain a benefit.

***Cognitive Dissonance* – is the level of discomfort generated when we do something that is dramatically out of character or contrary to what we would normally do. *Self-justification* reduces the *cognitive dissonance* gap.**

If one tells the truth, one is sure, sooner or later to be found out.

Phrases and Philosophies for the Use of the Young', 1894

The best liar is he who makes the smallest amount of lying go the longest way.'

Samuel Butler 1835-1902

Truth and Convenience

Nine alleged ways to establish the truth of an account.

1. Inconsistencies
2. Ask the unexpected
3. Gauge against a baseline
4. Look for insincere emotions
5. Pay attention to gut reaction
6. Watch for micro expressions
7. Look for contradictions
8. A sense of unease
9. Too much detail – over elaborate description

TV and novels would have us believe that experienced police can tell when someone is lying to them.

Many police believe that 'They have the ability to detect changes in interviewees non-verbal behaviour across the interviewer which some believe to indicate evasion/deception.'

Milne & Bull (1999)

Non-verbal behaviour or '*Body Language'*, - usually unconscious, communication through the use of postures, gestures, and facial expressions.

Avoiding eye contact at critical times, licking lips, moving legs and knees etc.

'Research has consistently demonstrated that interviews cannot detect deception through non-verbal cues (see Memon, Vrij & and Bull, 1998) Indeed, those cues which interviewers "read" as indicators of lying often are the result of their (the interviewer's) own behaviour (e.g. being too close to the interviewer) and are instead signs of anxiety with the situation. Furthermore, more experienced police officers are more confident that they can spot deception but they are, in fact, no more confident.'

Milne & Bull (1999)

The investigator/interviewer needs to assess the accuracy of the information gained from an interview.

By:

Assessing what he/she was told against known facts.

Understanding the involvement of the interviewee.

Motivation for the account given

Taking into account outside influences.

Assessing the influences on 'retention'.

Ensuring that the interviewer has minimised any biases or preconceptions.

There may be reasons that a witness provides false or inaccurate information.

They may be lying, evading, or intentionally deceiving.

But more often inaccuracy or incorrect answers are the result of:

false memory,

misconception,

misperception,

misunderstanding

Do not forget that the investigator is human too.

You are subject to the same problems of acquisition, retention and recall!

There will be information that you forget to acquire!

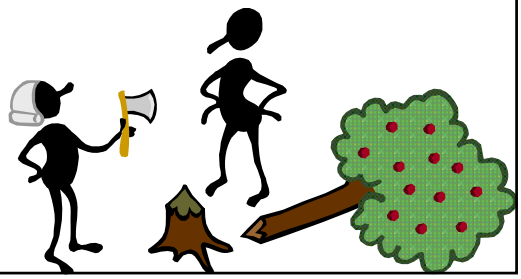
You can be distracted, bored, tired, thirsty, need a smoke!

You have prejudices and your own opinions!

You have to remain objective! You must prepare menta

Even the most truthful witness will tell you what they perceived, perception is not always reality or the truth of the matter!

Cognitive Interviewing



Introduction

- **critically important task**
- **good techniques are not commonly used**
- **good techniques based on research in cognitive and social psychology**
- **aim is to provide you with an understanding of:**
  - **potential limitations of interviewees;**
  - **the nature of good interviewing principles**

Overview

- **types of interviewees**
- **witness limitations**
- **stages of an interview**
- **general guidelines**
- **detailed principles for each stage**

Interviewing

The process of obtaining information from a persons. Relying on:

- what a person wants to tell you
- a person's memory of events.

Memory

The process of:

- **Encoding**
- **Storing**
- **Retrieving**

Forgetting

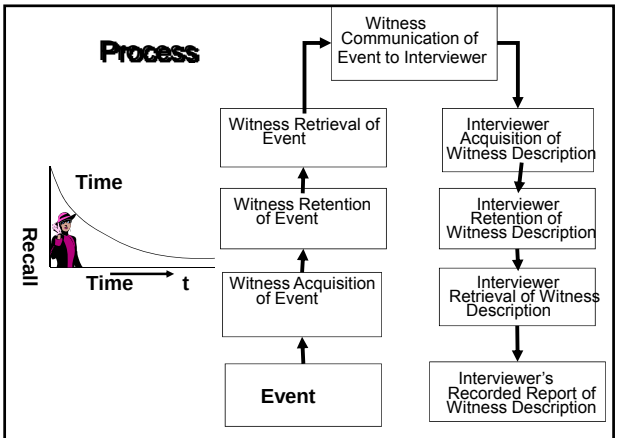
The failure to retrieve information?

Factors affecting the way people encode complex events

- State of the witness
- Stress level of witness
- The scale and impact of event
- Involvement
- Attention

Factors affecting peoples' retrieval of information

- Memory is constructive
- Inferences of language
- Stereotypes – association with past experience or existing biases
- Scripts – filling in gaps from experience
- Emotion -
- Context



'Cognitive interviewing techniques enhances the reporting of correct detail and produces greater differences between the contents of true and false accounts.'

As reported by Milne and Bull 1999 (University of Portsmouth) commenting on a 1995 Spanish study by Hernandez-Fernaud, E. & Alonso-Quecuty,M

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Planning and preparation

What is the aim?

•Establish or confirm events

•Understand involvement of interviewee

•Identify events and conditions

•To prevent similar casualty recurring

Stage A: Preparation

- obtain background information
- determine aims
- determine location
- determine time
- determine who will be involved
- determine interview plan
- obtain relevant materials and equipment

Interviewing

Setting up the interview

Venue?

Ship

Home

Office

Neutral ground

Planning and preparation

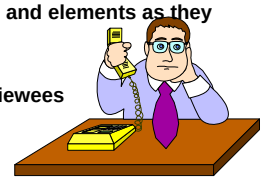
Planning

•Analyse existing evidence

•Consider what other evidence you need and who may have the answers

•Go through the factors and elements as they are understood

•Draw up a list of interviewees



Who should be involved in interviewing?

Legal representative

The interviewer (investigator)

or

"friend"

The witness

Interpreter

Stenographer?

Recording the interview

Notes

Electronic recording

Stenographer

Interviewing

•Person in charge of operation

•People involved in the operation

•Eye witness

•Anybody that can add to known facts

•Any person who can provide evidence or corroboration

How many interviewers?

Seating set up

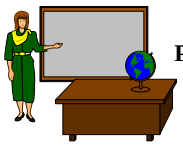
Working with an interpreter

Working from statements prepared by legal rep

Intimate < 450 mm

Personal 450 - 1200 mm

Social 1200 - 4000 mm



Public > 4000 mm

Ensure positive greeting

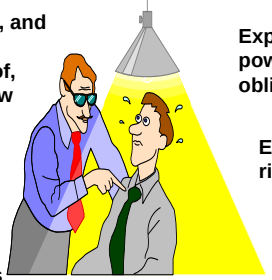
Explain the reasons for, and possible outcomes of, the interview

Explain your powers and obligations

Explain interview process

Explain his or her rights

Consider any needs the witness may have.



General Principles

- develop good rapport
  - (put witness at ease, show them you are interested, empathise)
- maximise witness concentration
  - (minimise distractions; active listening; deal with one topic at a time)
- let the witness talk
  - (minimise interruptions; open questions; use pauses)
- recreate the event context
  - (appropriate use of instructions, cues)

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- divide interview into a number of key topics
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  - (team resource management, note-taking techniques, act natural where appropriate)
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  - (be patient, avoid arguments and criticism)

Step C: General Account

The investigator should endeavour to

- recreate general context
- request general description
- active listening
- modify witness's behaviour (if required)
- identify items for further questioning

Recreate context/ event description

- ***Tell me everything you can remember, even the things you think are not important--even if you can not remember something completely. Everything which comes in to your mind, tell me at your own time and pace.***

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- ***Put yourself back to the same place where you saw the incident. Create a picture in your mind of the scene. Think of where you were, how you were feeling at the time, what you could hear. Think of what the weather was like, and who was present near you at the time. Get a really good picture in your mind and then tell me everything you can remember without leaving anything out. All that comes in to your mind, please tell me.***

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1. **Stop talking -** ***you cannot listen if you are talking***
2. **Put witness at ease -** ***let him/her feel free to talk***
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5. **Empathise -** ***put yourself in the witness's place***

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6. **Be patient** *Allow plenty of time,* ***Do not interrupt***
6. **Hold your temper** *Any hint of exasperation can lose you the initiative*
8. **Avoid argument or criticism** *Causes witnesses to become defensive – to clam up*
9. **Make your questions flow in response to his/her response**

Types of Questions

- **Free recall – what happened?**
- **Open Questions – describe the ship**
- **Closed questions – what colour was the hull?**
- **Leading question – was the hull black?**

Questioning

➢ Free recall – **the witness may be helped by neutral, logical prompts based on the sequence of what happened, response and reason.**

Behavioural Sequence Interview Technique
(Keating and Loftus – 1984)

Situation Cue ***What happened***	**Behavioural Response** ***What I did***	**Reason why** ***Why I did that***
I heard an explosion	I looked out of the porthole	To see where the noise had come from
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Questioning

Open-ended question

"*broad, often specifying only a general topic [which] allows the respondent considerable freedom in determining the amount and kind of information to give.*"

'Tell me in your own words what happened from the time you assumed the conduct of the watch until the fire was extinguished.'

'Describe for me the evolution you were undertaking that morning.'

Questioning

Closed question

"*. . . allows only a relatively narrow range of responses . . .*"

'What colour was the ship's hull?'

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Questions to avoid

Forced-choice questions

"*requiring a choice of options.*"

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Multiple questions

"*Two or more possible questions at once.*"

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Leading questions

"so worded that it suggests a particular answer to the witness."

'The o.o.w gave the order didn't he?'

'It was the Chief Petty Officer who closed the circulating valve wasn't it?'

Step E: Background Issues

- **situational (task, environmental) conditions**
- **72-hour, 7-day history**
- **medical/physiological**
- **operational experience**
- **organisational issues (?)**

Step F: Review

- **ensure all items covered**
- **conduct overall review**
- **clarify discrepancies (if required)**
- **Seek comment**
- **obtain outstanding background information**
- **finalise interview**
- **ensure you have contact details**

Step G: Evaluation and Follow-Up

- **write up notes**
- **evaluate information**
- **evaluate quality of interview**
- **contact witness again (if required)**

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Assessing the witness

Truthful and untruthful witnesses

Points on self justification to remember

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But more often inaccuracy or incorrect answers are the result of:

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I am told that experienced police are right 50 per cent of the time when they identify somebody deliberately lying.

Do not forget that the investigator is human too.

You are subject to the same problems of acquisition, retention and recall!

There will be information that you forget to acquire!

You can be distracted, bored, tired, thirsty, need a smoke!

You have prejudices and your own opinions!

You have to remain objective! You must prepare menta

Even the most truthful witness will tell you what they perceived, perception is not always reality or the truth of the matter!

FIRES & EXPLOSIONS

Ship fire investigation pose particular problems. This session examines some of the issues facing investigators when faced with a ship fire.

Defences

What defences worked ?

Did defences fail wholly or partially?

Defences

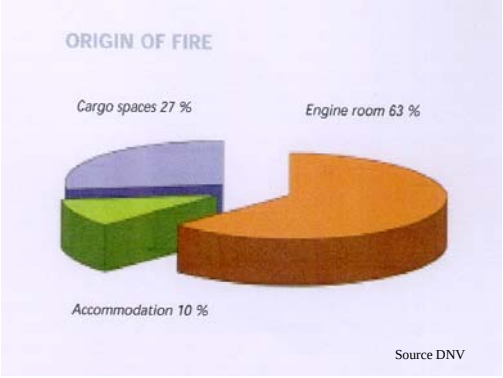
Alarms –
which alarms, where (heads), when? - VDR

Response –
emergency response, mustering and evacuation, specialist ships

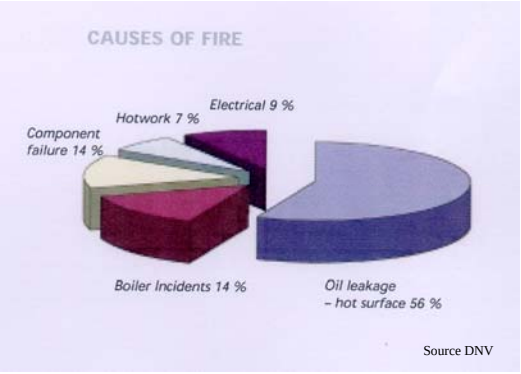
Extinguishing systems –
automatic, extinguishers (machinery space and cargo spaces), fire teams, equipment,

Containment systems –
fire protection zones, bulkhead ratings, fire doors (fuses and auto close)

Access and egress –
fire fighting and evacuation



Location of ship fires



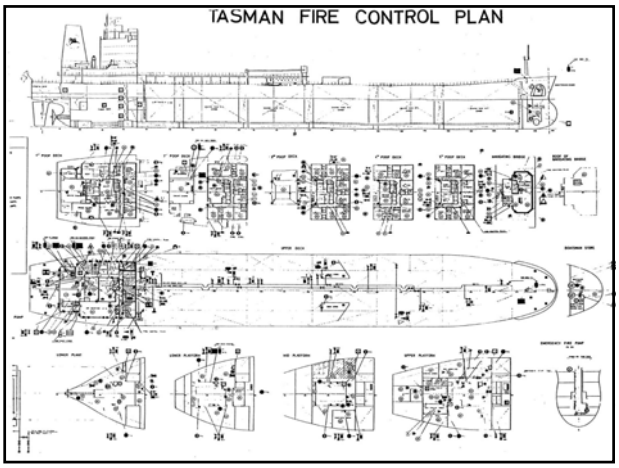
Causes of engine room fires

Approaching a fire scene

Work from the outside in -photograph

Look at all sides possible, top, sides and from below (if possible) –photograph – annotate a fire plan

Methodical – identify the elements of the fire triangle particularly the source of ignition (if possible)



Investigator Personal Protection Equipment Essential

Make safe – Dress Safe

- Natural fiber overalls
- Safety helmet
- safety boots
- Safety glasses/goggles
- Thick gloves
- Good torch

Reaching Large Numbers of Potential Witnesses

- Questionnaires

Questionnaires

➢ Structure of a questionnaire

1. **Personal Information**
2. **Pre-incident information**
3. **Information relating to incident**
4. **Post-incident information**
5. **Injury information**

Personal information

Question	Reason
Name	Correlate with other witnesses, passenger list and follow up
Address	As with Name
Gender	Relate gender issues including injuries
Age	Age-specific injuries and human factor criteria
Disabilities	To establish effectiveness of aural and visual information and mobility
Mobility	Problems with access to safety escapes etc, need for help
Have you been on other cruises	Establish familiarity with ships and emergency procedures

Pre-Incident information

Question	Reason
Were you travelling alone or with family or group?	To establish any mutual concern for any other passengers
In which cabin were you travelling?	To correlate injuries and experience with location on the ship
Where were you when the incident occurred?	To understand the spatial location and help assess the cause(s) of any injury
Are you familiar with the ship?	To establish general knowledge
Did you know what the emergency signals sounded like?	To establish their awareness of procedures
Do you know where the life saving equipment is kept?	To establish whether they were aware of any safety equipment
Did you attend any emergency briefings?	To establish whether passengers received safety briefings
Did you see any safety notices/pamphlet?	To establish the availability of safety information
Did you read any safety notices/pamphlet?	To establish whether passengers took any notice of such information

Information during incident

Question	Reason
How were you first alerted that something was wrong?	To establish at what point they thought something was wrong. Was there time to take preventative action?
Was there any smoke or fire?	To establish if fire was present. Smoke has a particular effect on the perceived urgency of egress.
Could you see to escape?	To establish light level and whether the train electrical supply and exit signs operated properly
Where were you when the emergency started	Will assist in comparing passenger flows to assigned muster points
What were your first thoughts?	To understand the level of anxiety
How did other passengers react?	To assess the level of behaviour of passengers, and establish whether there was good order or confusion, and panic etc

Incident information

Question	Reason
Did any of crew give you any instructions?	To establish any help or guidance given by the ship's crew.
Did you use any LSA or emergency equipment?	To establish whether life jackets and emergency equipment was used
What prompted you to use the emergency equipment?	To establish why and how emergency equipment was used- level of awareness
Was the emergency equipment easy to use?	To allow an assessment of effectiveness of equipment
How did you find your way to the muster point	To establish how people were guided and procedures followed by crew.
Did you open any doors or assist other passengers?	To establish the level of self-help and external help in escaping
Did you experience any difficulty in reaching the muster point?	To establish how easy it was to escape and identify any poor or dangerous design
Could you move without assistance?	To establish level of dependence
What did you do once at the muster point?	To establish what actions the crew took while marshalling passengers

Injury information

Question	Reason
Were you injured in the initial accident?	To establish the number of injuries
If yes, where and how seriously were you injured?	To establish where people suffered injury to collate this with position of travel
What caused the injury?	To establish whether design leads to injury
Were you injured escaping the carriage/coach?	To establish what injuries were caused by different escape methods/routes
If yes, describe how?	To establish the risks that exist in the escape
Did any injury affect your escape?	To understand how injury may have affected escape
Did you receive medical attention at the scene?	To understand assistance given and level of trauma
Did you attend a hospital?	Establishes whether hospital records exist
Did you seek any medical advice after the accident?	Establishes any delayed onset illness or injury.

Spirit of Tasmania - Questionnaire

123 responses were received

Question 1 – Age and gender of those covered by this response as at 23 February 2001

51 %	**46-60 years of age**
20 %	**31-45 years of age**
13 %	**61-75 years of age**
9.7 %	**19-30 years of age**
2.4 %	**>76 years of age**
1.6 %	**6-12 years of age**
0.8 %	**<6 years of age**

Gender **69 males (56 %)** **54 females (44 %)**

Any other passenger comments?

No comment	24	Crew efficient and helpful	20
Crew professional	19	Crew professional- no panic	19
Insufficient detail of emergency	19	Exposure to cold	8
Muffled PA	7	Safety announcement ex sailing muffled	7
Alarms not heard in hostel	6	Will travel on *Spirit again*	4
Passengers left in cabin	4	Compensation sought	4
Life jackets not distributed	4	Muster stations better organised	3
Felt anxious	3	Intoxicated passengers	3
Not frightened	2	Incident exaggerated by media	2
Did not hear alarm	2	Smoke at muster station	2
Staff poorly trained	2		
Frightening experience	1	Safety instruction unclear	1
Valium obtained too late	1	Passenger unaware of incident	1
Concerns over elderly	1	Debrief should have been offered	1
Improve crew ID	1	Reservation of travelling again	1
Discount trip sought	1	PA, Fire Alarm, Crew warnings overlap	1
Confused	1	Distressed woman in wheelchair	1
Not stay in hostel again	1	Insufficient lifeboats	1
Muster station confusion	1	Muster stations sited away from smoke	1
No oxygen available	1	Thermal blankets were required	1
Difficult passengers	1	Insufficient care of elderly & children	1
Warm clothing in car	1	Able passengers not asked to help	1
		Passengers slow in climbing stairs	1
Still enjoyed trip	1		

Reaching Large Numbers of Potential Witnesses

- Questionnaires

Questionnaires

➢ Structure of a questionnaire

1. **Personal Information**
2. **Pre-incident information**
3. **Information relating to incident**
4. **Post-incident information**
5. **Injury information**

Personal information

Question	Reason
Name	Correlate with other witnesses, passenger list and follow up
Address	As with Name
Gender	Relate gender issues including injuries
Age	Age-specific injuries and human factor criteria
Disabilities	To establish effectiveness of aural and visual information and mobility
Mobility	Problems with access to safety escapes etc, need for help
Have you been on other cruises	Establish familiarity with ships and emergency procedures

Pre-Incident information

Question	Reason
Were you travelling alone or with family or group?	To establish any mutual concern for any other passengers
In which cabin were you travelling?	To correlate injuries and experience with location on the ship
Where were you when the incident occurred?	To understand the spatial location and help assess the cause(s) of any injury
Are you familiar with the ship?	To establish general knowledge
Did you know what the emergency signals sounded like?	To establish their awareness of procedures
Do you know where the life saving equipment is kept?	To establish whether they were aware of any safety equipment
Did you attend any emergency briefings?	To establish whether passengers received safety briefings
Did you see any safety notices/pamphlet?	To establish the availability of safety information
Did you read any safety notices/pamphlet?	To establish whether passengers took any notice of such information

Information during incident

Question	Reason
How were you first alerted that something was wrong?	To establish at what point they thought something was wrong. Was there time to take preventative action?
Was there any smoke or fire?	To establish if fire was present. Smoke has a particular effect on the perceived urgency of egress.
Could you see to escape?	To establish light level and whether the train electrical supply and exit signs operated properly
Where were you when the emergency started	Will assist in comparing passenger flows to assigned muster points
What were your first thoughts?	To understand the level of anxiety
How did other passengers react?	To assess the level of behaviour of passengers, and establish whether there was good order or confusion, and panic etc

Incident information

Question	Reason
Did any of crew give you any instructions?	To establish any help or guidance given by the ship's crew.
Did you use any LSA or emergency equipment?	To establish whether life jackets and emergency equipment was used
What prompted you to use the emergency equipment?	To establish why and how emergency equipment was used- level of awareness
Was the emergency equipment easy to use?	To allow an assessment of effectiveness of equipment
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Confused	**1**	**Distressed woman in wheelchair**	**1**
Not stay in hostel again	**1**	**Insufficient lifeboats**	**1**
Muster station confusion	**1**	**Muster stations sited away from smoke**	**1**
No oxygen available	**1**	**Thermal blankets were required**	**1**
Difficult passengers	**1**	**Insufficient care of elderly & children**	**1**
Warm clothing in car	**1**	**Able passengers not asked to help**	**1**
		Passengers slow in climbing stairs	**1**
Still enjoyed trip	**1**		

IMO Regional Training Course on Marine Accident and Incident Investigation

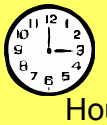
Investigating Fatigue

Definition

Ref:IMO MSC/Circular813/MEPC/Circ.330

Fatigue: A reduction in physical and/or mental capability as the result of physical, mental or emotional exertion.

The most common causes of fatigue known to seafarers are [redacted]



Fatigue in Accidents

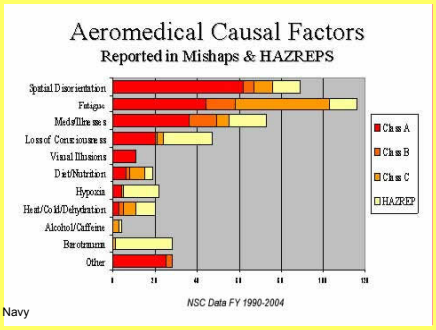
Hours of Work – True or False?

	TRUE	FALSE
• All hours are equal and interchangeable	☐	☐
• Fatigue is a function of consecutive hours worked	☐	☐
• Not working = Rest	☐	☐

Objective

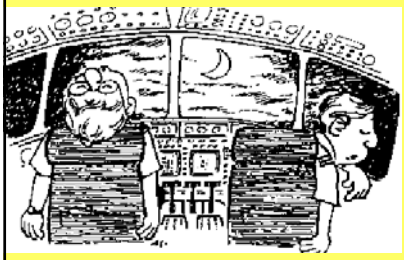
- Describe what is and what causes Fatigue
- Describe common fatigue-related performance effects; (What Fatigue can do to you?)
- Provide guidelines and tools for investigating fatigue.

Fatigue (from sleep deprivation, circadian desynchronosis) is the most frequently-cited aeromedical contributing factor in naval aviation mishaps. Fatigue is four times more likely to contribute to workplace impairment than drugs or alcohol.



Source: US Navy

Investigating for Fatigue



Constantly vigilant for any system malfunction, the Captain scans the overhead panel as the Co-pilot checks the window heat system with his forehead .... At 03:00 pilots can't be too careful

What Causes Fatigue?

Lack of sleep

- The major cause of fatigue
- Inadequate Sleep / disrupted sleep
- Time Since Last Consolidated Sleep
- Cumulative Sleep Deprivation

Work Rest Schedule

- Extended hours of physical or mental activity
- Inadequate breaks
- Not enough rest between work days/shifts
- Shift work (permanent or rotating)
- Irregular Work Hours
- Excessive Overtime

What make it worse?

What Causes Fatigue?

Circadian time of day

- internal biological clock sets daily rhythms (circadian rhythms) - allow for high activity during the day and low at night for sleep.

- Health Conditions
- diabetes, allergies, hypertension, or cold exacerbate fatigue.

Work Conditions

- Complex, mentally challenging tasks and workloads
- Travelling in multiple time zones
- Stress - Boring/Monotonous Tasks / Work Environment

Nature of Fatigue

- "Fatigue is neither caused nor prevented by:
  - personality,
  - education,
  - experience,
  - intelligence,
  - skill level,
  - physical size or strength
  - professionalism or training"
- "The effects of fatigue on performance are based in changes in brain function" (Dinges,1995)

Investigating for Fatigue

The investigator needs:

- background information on the physiological bases of alertness and fatigue;
- an understanding of how fatigue affects performance; and
- guidance on how to investigate for fatigue
  - **Step 1:** Determine whether the crew was in a fatigued state
  - **Step 2:** Determine if the unsafe act or decision is consistent with the type of behaviour expected of a fatigued person.

Step 1- Determine if the Crew was in Fatigue State?

TSB Checklist establishes the link between fatigue and the Unsafe Acts/Decisions:

- Quantity of Sleep?
- Quality of Sleep?
- Work History & Schedules – Impact on Quality and Quantity of sleep?
- Circadian Rhythm ?

Step 2: Determine if UA/UD are consistent with the type of behaviour expected of a fatigued person

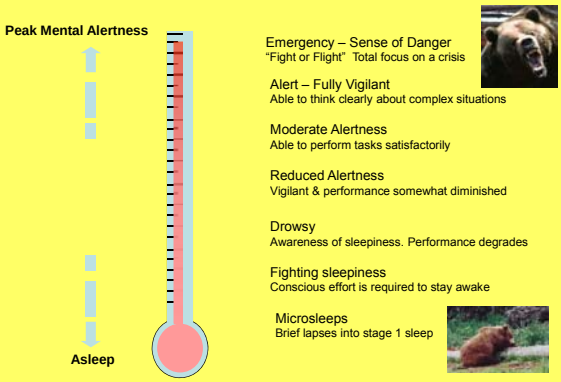
Behaviour expected of a fatigued person:

- Attention failure
- Memory failure
- Reduced alertness
- Reduced reaction time
- Inadequate problem Solving Ability
- Moody
- Attitudes
- Physiological Effects.

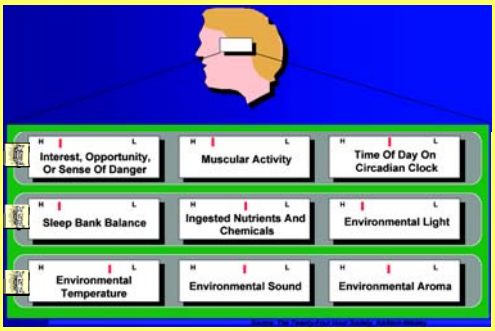
But the greatest single threat is being unaware that it is happening.

Fatigue and Alertness

- Fatigue and Alertness can be viewed as a continuum with peak mental alertness on one end sleep on the ther.
- Your level of alertness determines how well you perform your job – to remain attentive, vigilant and be able to think clearly.



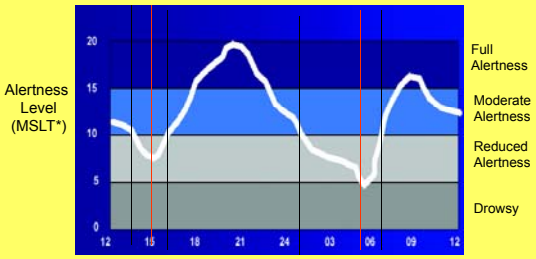
Nine Controls of Human Alertness



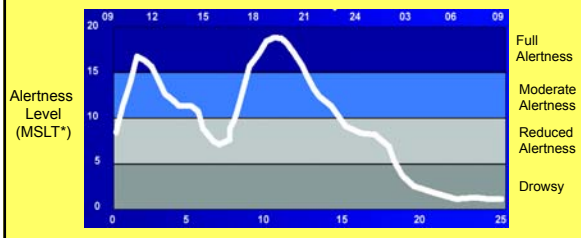
The Nine Controls of Human Alertness 1/2

- Interest, Opportunity or Sense of Danger
  - Nothing pulls us faster from a drowsy state than the imminent threat of danger. An interest or promising opportunity can also keep us awake.
- Muscular Activity
  - Any type of activity helps us to keep alert. Stretching or even chewing gum can stimulate your level of alertness
- Time of Day on Circadian Clock
  - Our biological (circadian) clock makes us sleepy or alert on a regular schedule.
- Sleep Bank Balance
  - Restful and sound sleep makes deposit in our "sleep bank" and sustained wakefulness makes "withdrawls". When the bank balance is too low, the pressure to sleep has a severe dampening effect on our alertness.
- Ingested Nutrients and Chemicals
  - Alertness may be enhanced by the chemicals and nutrients we ingest or inhale. E.g, caffeine is the most common stimulants.

Human Circadian Cycle



Determinants of Human Alertness: Extended Hours Without Sleep



Successive Hours of Sleep Deprivation

* Measurement of Sleep Latency

Design Specification for Human Body

Human are not designed for peak performance at nights.

- To be awake during the day and sleep at nights.
- The timing of sleep and wakefulness runs on a 24-hr cycle or rhythm, of about (circa) a day (dia) – hence circadian rhythm.
- Our body functions and energy levels are high after sunrise and low after sunset.

Impact of Fatigue on Human Performance

(What Fatigue can do to you?)

- You may not see properly.
- You may have slower reflexes and reactions.
- You may have microsleeps (up to 60 seconds where the brain goes to sleep and you black out no matter what you're doing).
- You may go on auto-pilot (automatic behaviour where you do routine tasks but aren't having any conscious thoughts).
- You may have poor judgement.
- You may not make good decisions.
- You may not be able to solve problems.

Impact of Fatigue on Human Performance

(What Fatigue can do to you?)

- You may not be able to concentrate or remember.
- You may not notice things you usually would.
- You may be less productive or efficient.
- You may make more mistakes than usual.
- You may take risks you usually wouldn't.
- You may not communicate well.
- You may not handle stress well.
- You may get moody.

Ultimate Consequences of Fatigue

Increased Human Error

Fatigue Index Score (FIS)

- Developed by consultants for US Coast Guard.
- This may be used to confirm or rule out the causal relationship of fatigue or other factors with the probability fo 80%.
- If the FIS is > 50 there is an 80 per cent likelihood that fatigue was a cause in the incident. For a score < 50, there is similarly an 80 per cent likelihood that fatigue was not a cause.
-

Fatigue Index Score

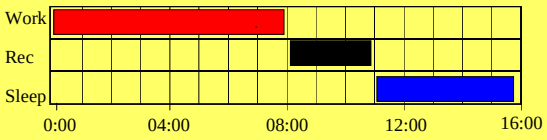
- FIS = (WH x 6.1) – (SH x4.5) + S x 21.4
  - WH = the number of hours WORKED in the 24 hours before the casualty;
  - SH = the number of hours SLEPT in the 24 hours before the casualty;
  - S = the number of fatigue SYMPTOMS experienced by the individual while on duty before the casualty.
- Symptoms:
  - Forgetfulness
  - Less motivated
  - Difficult to keep eyes open
  - Distracted
  - Sore muscles
  - Desire to sit or lie down
  - Difficulty operating equipment

Fatigue Index Score Exercise

- FIS = (WH x 6.1) – (SH x4.5) + S x 21.4
- Work out the FIS for a person who has worked 8 (12) hours in the previous 24, slept 6 (4) hours in the 24, and reported one of the seven symptoms.
- Answer - Group 1:
- [redacted]
- Answer - Group 2
- [redacted]

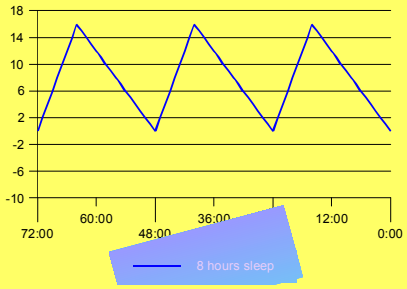
Microsoft Excel Worksheet

72 Hour Sleep History



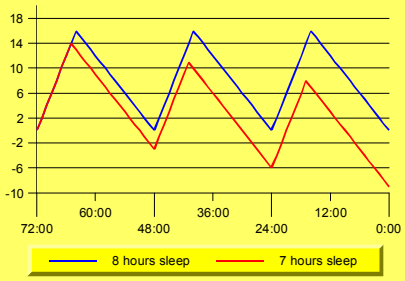
Sleep Credit/Deficit Diagram

8 hours of sleep per night

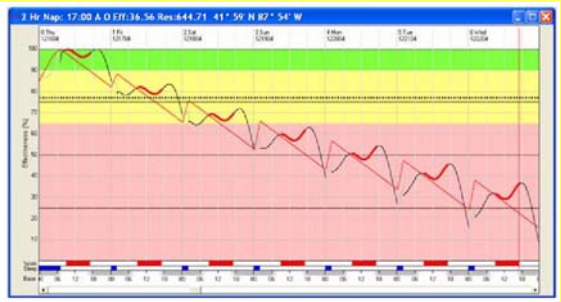


Sleep Deficit Diagram

7 vs 8 hours of sleep per night



Fatigue Avoidance Scheduling Tool (FAST)



Fatigue Investigation - TSB Investigator's Worksheet

- To establish fatigue as a contributing factor, it must be demonstrated that
  - ***First***: The person or crew was in a fatigued state; and
  - ***Second***: The unsafe act or decision is consistent with the type of behaviour expected of a fatigued person or crew.
- ***Checklist 1 - Establishing the fatigued state*** and
- ***Checklist 2 - Establishing the link between fatigue and the unsafe act/decision***, have been developed to aid investigators in the collection of fatigue-related evidence.

TSB

Checklist 1

Evaluate if the crew was in fatigue state.

Issue	Probes	Best-case Response	Notes
Quantity of Sleep Summary - establish whether or not there was a sleep debt	What was the length of last consolidated sleep period? Start time? Awake Time? Was your sleep interrupted (for how long)? Have you had any naps since your last consolidated sleep? Duration of naps? Describe your sleep patterns in the last 72 hours. (Apply sleep credit system)	7.5 to 8.5 hours Normal circadian rhythm, late evening Normal circadian rhythm, early morning No Yes Had opportunity for restorative (1.5-2 hrs) or strategic (20 min) nap prior to start of late shift 2 credits for each hour of sleep; loss of one credit for each hour awake - should be positive value	
Quality of Sleep Summary - establish whether or not the sleep was restorative	How did the sleep period relate to the individual normal sleep cycle i.e., start/finish time? (See "Quantity") Sleep disruptions? Sleep environment? Sleep pathologies?	Normal circadian rhythm, late evening/early morning No awakenings Proper environmental conditions (quiet, comfortable temperature, fresh air, own bed, dark room) None	

Checklist 1

Evaluate if the crew was in fatigue state.

Work History Summary - establish whether the hours worked and the type of duty or activities involved had an impact on the quantity and quality of sleep	Hours on duty and/or on call prior to the occurrence? Work history in preceding week?	Situation dependent - hours on duty and/or on call and type of duty that ensure appropriate level of alertness for the task Number of hours on duty and/or on call and type of duty that do not lead to a cumulative fatigue effect	
Irregular Schedules Summary - establish whether the scheduling was problematic with regards to its impact on quantity and quality of sleep	Was he/she a shiftworker? If yes, was it a permanent shift? If no, was it rotating (vs irregular) shiftwork? How are overtime or double shifts scheduled? Scheduling of critical safety tasks? Is there a fatigue counter-measure program in place?	No (Shiftworkers never fully adapt in terms of sleep quality) Yes - Days Yes - Rotating clockwise, rotation slow (1 day for each hour advanced), night shift shorter, and at the end of cycle. Scheduled when operators will be most alert in the context of their circadian rhythm. Scheduled when operators will be most alert in the context of their circadian rhythm. Yes	
Circadian Dysrhythmia (Jet Lag) Summary - establish the existence and impact of jet lag on quantity and quality of sleep	Number of time zones crossed? If more than one, at what rate were they crossed? In which direction was the travel?	One The slower the better East to West	

Checklist 2

Establishing the link between fatigue and the unsafe act/decision

Performance Impairment	Indicators	Notes
Attention	•Overlooked sequential task element •Incorrectly ordered sequential task element •Preoccupied with single tasks or elements •Exhibited lack of awareness of poor performance •Reverted to old habits •Focused on a minor problem despite risk of major one •Did not appreciate gravity of situation •Did not anticipate danger •Displayed decreased vigilance •Did not observe warning signs	
Memory	•Forgot a task or elements of a task •Forgot the sequence of task or task elements •Inaccurately recalled operational events	
Alertness	•Succumbed to uncontrollable sleep in form of microsleep, nap, or long sleep episode •Displayed automatic behaviour syndrome	
Reaction Time	•Responded slowly to normal, abnormal or emergency stimuli •Failed to respond altogether to normal, abnormal or emergency stimuli	
Problem-solving Ability	•Displayed flawed logic •Displayed problems with arithmetic, geometric or other cognitive processing tasks •Applied inappropriate corrective action •Did not accurately interpret situation •Displayed poor judgement of distance, speed, and/or time	

Checklist 2

Establishing the link between fatigue and the unsafe act/decision

Performance Impairment	Indicators	Notes
Mood	•Was less conversant than normal •Did not perform low-demand tasks •Was irritable •Distracted by discomfort	
Attitude	•Displayed a willingness to take risks •Ignored normal checks or procedures •Displayed a «don't care» attitude	
Physiological Effects	*Exhibited speech effects - slurred, rate, content *Exhibited reduced manual dexterity - key-punch entry errors, switch selection	

Hours of work

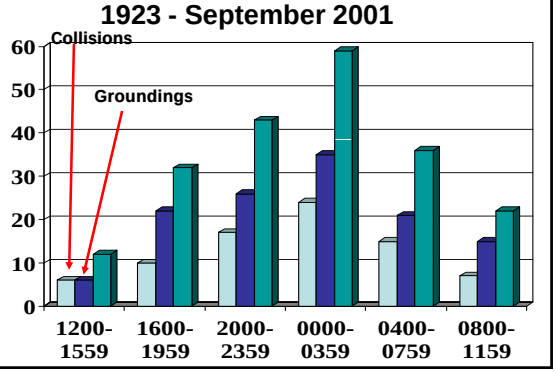
Resolution A. 947 (23)

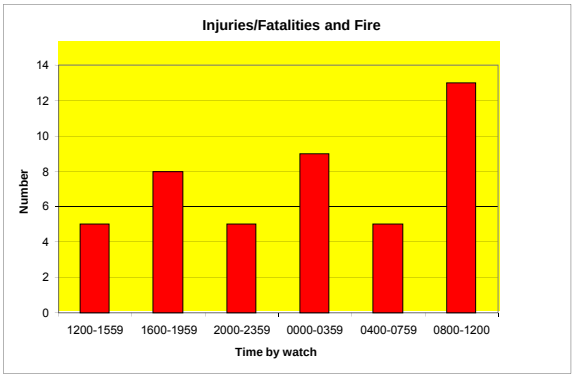
Human Element Vision, Principles and Goals for the Organization

Principles;

f) Crew endurance, defined as the ability to maintain performance within safety limits, is a function of many complex and interacting variables including individual capabilities, management policies, cultural factors, experience, training, job skills, and work environment.

Collisions and Groundings
Australian Commonwealth Investigations
1923 - September 2001





Fatigue

A reduction in physical and/or mental capability as a result of physical or emotional exertion which may impair nearly all physical abilities including:

strength	coordination
speed	decision making
reaction time	balance

Joint IMO/ILO Working Group on Human Factors

Fatigue

"acute or chronic, encompassing tiredness, depression, sleepiness, stress, sleep quality, disturbed circadian rhythms and boredom"

Seafarers International Research Centre(1996)

Fatigue

Acute fatigue can occur in a matter of hours and is usually the result of excessive mental or physical activity. Cure a period of rest or sleep.

Seafarers International Research Centre (1996)

Fatigue

Chronic fatigue is reached when the 'normal' period of sleep proves insufficient to restore the individual's working performance to its usual level. It is insidious and usually happens over a period of time. Persons suffering chronic fatigue always perform below their personal best.

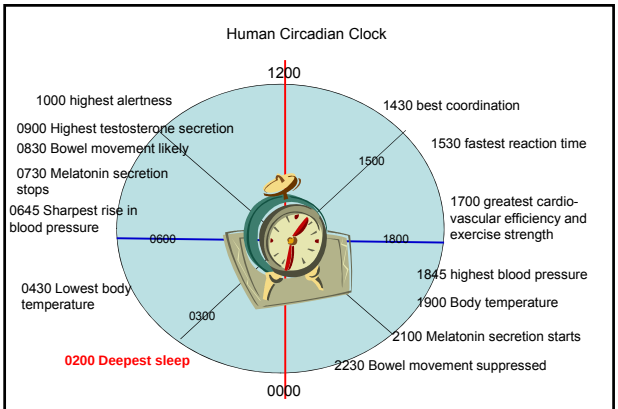
Seafarers International Research Centre (1996)

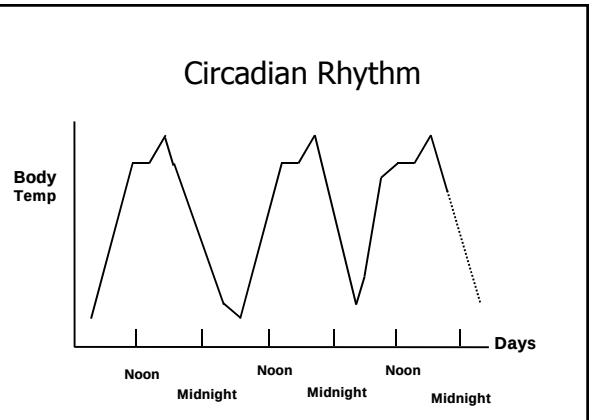
Risk factors that can lead to fatigue and a reduction in performance (from the US Coast Guard guide for crew endurance, 2001)

In 1910 average sleep length was 9-9.5h

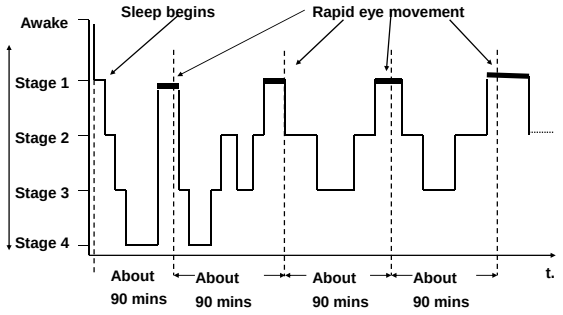
In 1913 tungsten-electric illumination introduced

In 1990 average sleep length was 7.5-8h





Sleep Cycles



This diagram shows about 5 hours of typical sleep

"We live in a world where commerce is conducted around the clock and by the click of a mouse. A world where goods and services are expected to be available when and where the customer wants.

Human ingenuity has created these expectations. And, for the most part, they are met.

But they come at a cost. One of those costs is human fatigue."

Paul Neville.
Chair, House of Representatives
Inquiry into Fatigue
in Transportation, 2000

Fatigue:Effects on Decision Making

- **activation problems**
- **perception and sensory input limitations**
- **information processing degraded**
- **aversion to effort**
- **differing effort**

Broad consequences of fatigue

- ä Hand-eye coord
- ä Communcation
- ä Mood
- ä Situational awareness
- ã Reaction times
- ã Error rates
- ã Lapses
- ã Microsleeps

What should procedures allow for?

♉ **Countermeasures:**
Preventative and Operational

♉ **Preventative - Used before work and during rest periods**

♉ **Operational - Provide temporary relief from symptoms of fatigue**

What should procedures allow for?

☺**Good sleep habits**
☺**Naps**
☺**Good sleep environment**

But beware of the following:-

Cautionary factors

Sleep inhibitors

- Food
- Alcohol
- Caffeine
- Nicotine
- Exercise

Operational countermeasures

- Napping where possible
- Social interaction and conversation
- Physical activity
- Strategic use of caffeine
- Bright Light

These do not combat the underlying factors of fatigue rather they temporarily enhance alertness to help maintain performance and efficiency

Factors which potentiate or predispose to fatigue

Watchkeepers at risk	*Temporal factors*	*Environment factors*	*Sleepiness factors*
Younger persons up to 25 years	Early morning duty	Open sea - featureless conditions	On duty with pre-existing sleep debt
Older persons over 50 years	More than 16 hours	Monotonous conditions	On duty with pre-disposing sleep condition (e.g. sleep apnoea)
Males	Pattern of irregular duty	Steady, low-level background noise	On duty in in normal sleep time
Persons with medical conditions (e.g. narcolepsy, obesity, on medication, et.)	Pattern of irregular sleep	Regular visual patterns (e.g. radar scans)	Person pre-disposed to sleepiness
After consuming alcohol	Early afternoon drowsiness	Gentle motion	On duty after poor quality sleep
Inadequate sleep or rest before duty		Ambient temperature and humidity level	

OH&S - Duty of Care

- **Imposes on employers a single over-riding managerial responsibility to safeguard employees from unreasonable risks in regards to the fundamental conditions of employment.**
- **Reasonably practical means that if it is within the employer's control to prevent a hazard, then he/she should do so.**

STCW for watchkeeper hours:

STCW Section A-VIII/1 and Section B-VIII/1- Fitness for duty :

- Watchkeepers minimum of 10 hrs rest in any 24 hrs
- Must be divided into 2 periods one of which at least 6 hrs
- Relaxed in case of emergency or drill or overriding operational conditions
- If relaxed the minimum period of ten hours may be reduced to not less than 6 consecutive hours provided that any such reduction shall not exceed beyond two days and not less than 70 hours of rest are provided each 7 day period.
- Administrations should consider requiring a record be kept of hours of work or rest – to be inspected by administration to ensure compliance.

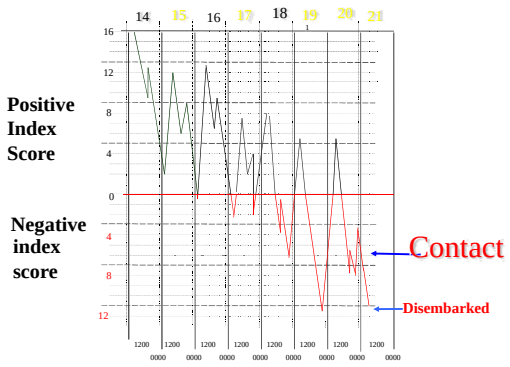
Does the ISM documentation cover hours of work and above requirements?

Quantifying Fatigue

Sleep Credit Deficit method.

- Gives a good indication of whether to probe deeper into the hours of work
- Credit two points for every hour slept to a maximum of 16 points;
  - the maximum sleep credit possible at any time is 16 points
- Deduct one point for every hour awake.

Pilot's sleep credit/deficit chart



USCG Fatigue Index Score

FIS = s(21.4) + wh(6.1) - sh(4.5)

s = total number of fatigue symptoms (0-7) experienced on duty before the casualty

wh = total number of hours worked in the last 24 hours to the nearest tenth

sh = total number of hours slept in the last 24 hours (to the nearest tenth)

USCG Fatigue index Score

Seven fatigue symptoms

- forgetful
- sore muscles
- desire to sit or lay down
- difficulty in keeping eyes open
- difficulty in operating equipment
- distracted
- less motivated

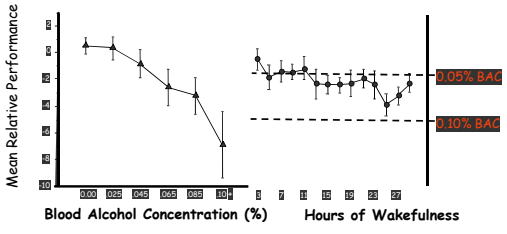
Can we objectively measure fatigue?

Solution – compare fatigue with some other measurable impairment

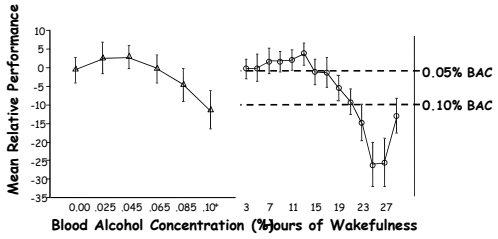
Subjects

- 22 male subjects [Av=25.6 y ± 4.6]
- 18 female subjects [Av=25.1 y ± 3.1]
- 14 Currently post-secondary students
- 14 Currently unemployed
- 12 Employed/Part-time/Casual
- 22 had experience of shiftwork

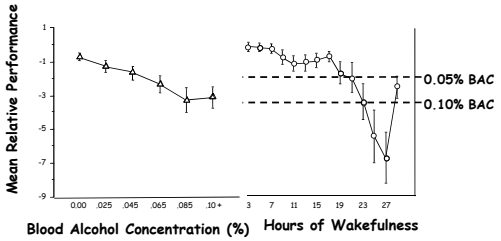
Logical Reasoning [accuracy]



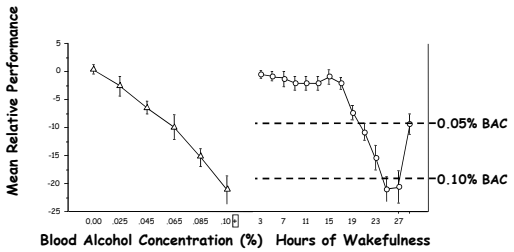
Logical Reasoning [response latency]



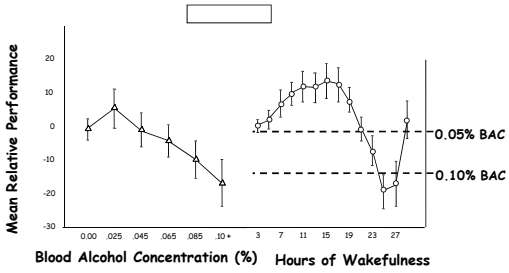
VIGILANCE [accuracy]



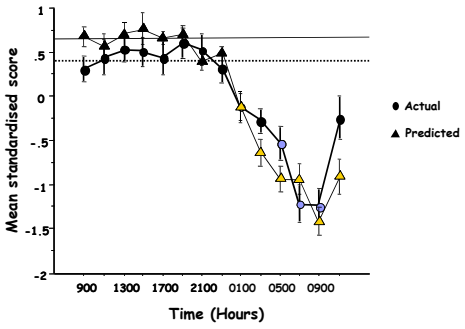
Vigilance [response latency]

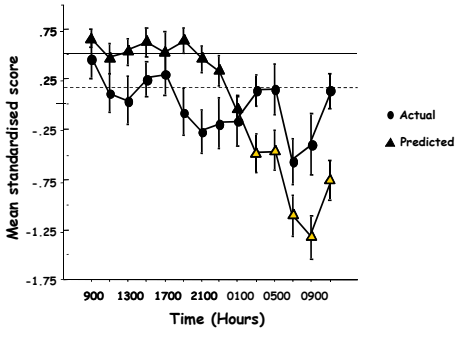


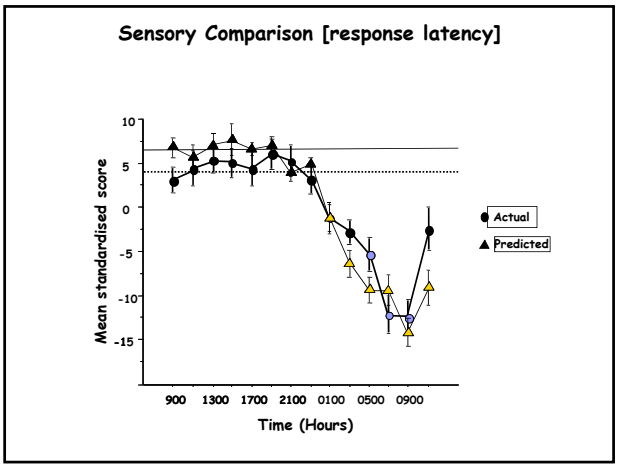
UNPREDICTABLE TRACKING



GRAMMATICAL REASONING [Response Latency]







Study conclusions

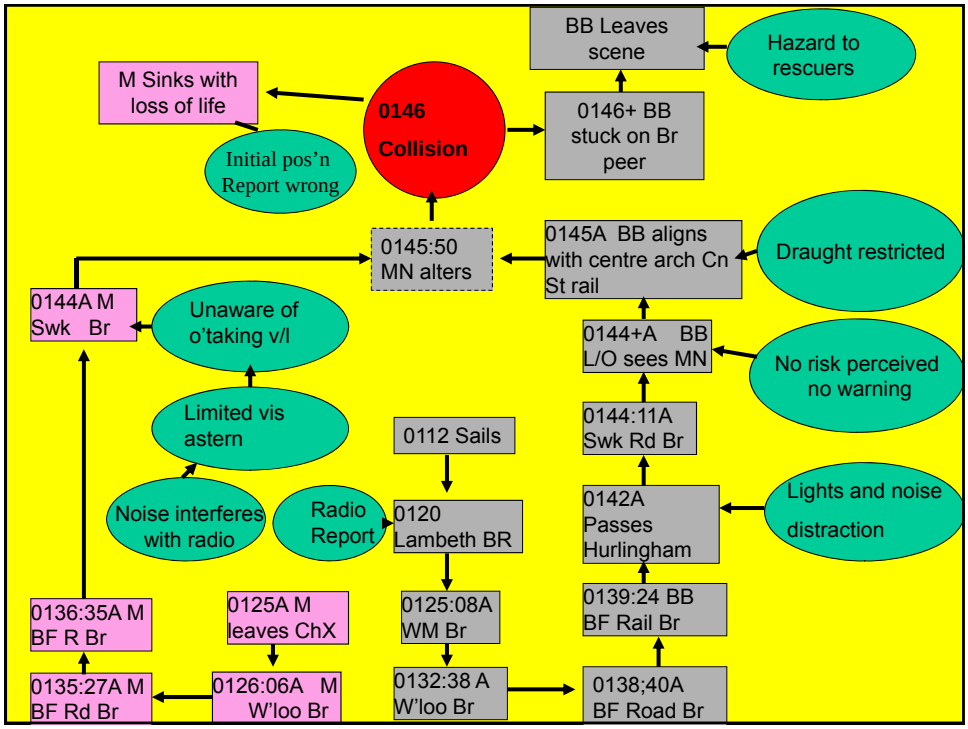
- Depending on the task measured, 17 to 24 hours of wakefulness produces performance decrements equivalent to a BAC of 0.05 - 0.10%

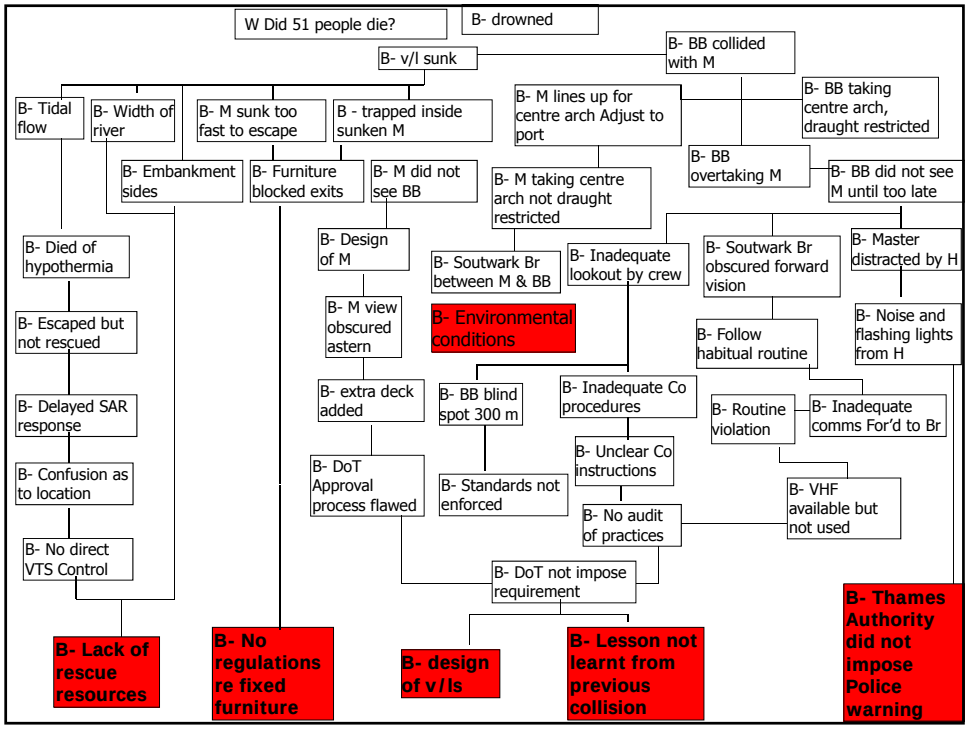
- Moderate levels of fatigue produce performance decrements equivalent to or greater than levels of alcohol intoxication deemed unacceptable when driving, working and/or operating dangerous equipment

FAID

Fatigue Analysis Program

www.interdynamics.com


BB Leaves scene
Hazard to rescuers
M Sinks with loss of life
0146 Collision
0146+ BB stuck on Br peer
Initial pos'n Report wrong
0145:50 MN alters
0145A BB aligns with centre arch Cn St rail
Draught restricted
0144A M Swk Br
Unaware of o'taking v/l
0144+A BB L/O sees MN
No risk perceived no warning
Limited vis astern
0112 Sails
0144:11A Swk Rd Br
Noise interferes with radio
Radio Report
0120 Lambeth BR
0142A Passes Hurlingham
Lights and noise distraction
0136:35A M BF R Br
0125A M leaves ChX
0125:08A WM Br
0139:24 BB BF Rail Br
0135:27A M BF Rd Br
0126:06A M W'loo Br
0132:38 A W'loo Br
0138;40A BF Road Br


W Did 51 people die?
B- drowned
B- v/l sunk
B- BB collided with M
B- Tidal flow
B- Width of river
B- M sunk too fast to escape
B - trapped inside sunken M
B- M lines up for centre arch Adjust to port
B- BB taking centre arch, draught restricted
B- Embankment sides
B- Furniture blocked exits
B- M did not see BB
B- M taking centre arch not draught restricted
B- BB overtaking M
B- BB did not see M until too late
B- Died of hypothermia
B- Design of M
B- Soutwark Br between M & BB
B- Inadequate lookout by crew
B- Soutwark Br obscured forward vision
B- Master distracted by H
B- Escaped but not rescued
B- M view obscured astern
B- Environmental conditions
B- Follow habitual routine
B- Noise and flashing lights from H
B- Delayed SAR response
B- extra deck added
B- BB blind spot 300 m
B- Inadequate Co procedures
B- Routine violation
B- Inadequate comms For'd to Br
B- Confusion as to location
B- DoT Approval process flawed
B- Standards not enforced
B- Unclear Co instructions
B- VHF available but not used
B- No direct VTS Control
B- No audit of practices
B- DoT not impose requirement
B- Lack of rescue resources
B- No regulations re fixed furniture
B- design of v/ls
B- Lesson not learnt from previous collision
B- Thames Authority did not impose Police warning

Pilotage and investigations into casualties in Pilotage Waters

This session deals with issues relating to accidents in pilotage waters:

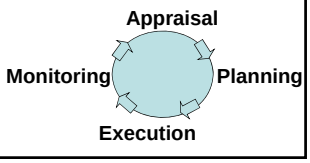
- Passage planning
- IMO and ICS guidelines
- Examination of safety management approach
- Pilotage ship interaction

IMO Resolution A. 893

1. Objectives

1.2 The need for a voyage and passage planning applies to all vessels. There are several factors that may impede the safe navigation of all vessels and additional factors that may impede the navigation of large vessels or vessels carrying hazardous cargoes. These factors will need to be taken into account in the preparation of the plan and in subsequent monitoring of the execution of the plan.

Four stages of planning:



Voyage Planning 'Berth to Berth'

Standards of Training, Certification and Watchkeeping Convention 1995

Safety of Life at Sea Convention, 1974

Chapter V. Reg 34. (2000)

IMO Resolution A.893 (21) Para 3.1

Bridge Procedures Guide 2007, 4th Edition
International Chamber of Shipping

UK Maritime Guidance Notice 72

IMO Resolution A.893

Guidelines for Voyage Planning

3. Planning

3.1 On the basis of the fullest possible appraisal, a detailed voyage or passage plan should be prepared which should cover the entire voyage or passage from berth to berth, including those areas where the services of a pilot will be used.

International Safety Management

Most ship board ISM documentation call up Section 3 of the Chamber of Shipping Bridge Procedures Guide, 1998

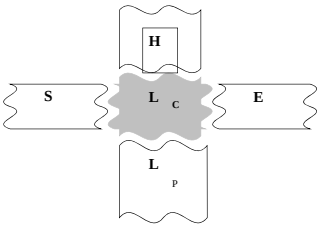
This document requires that all voyages should be planned on board 'berth to berth'.

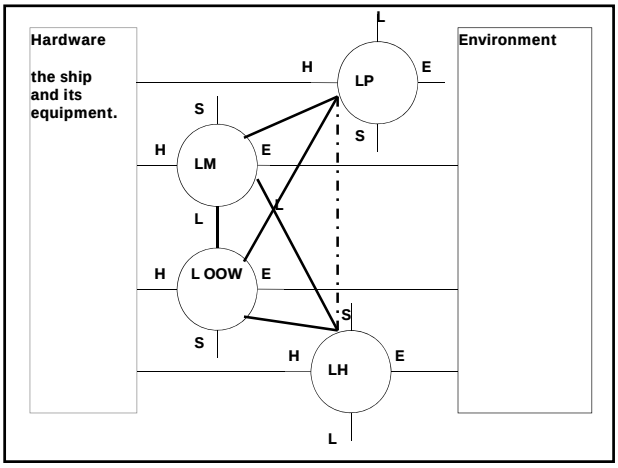
The preliminary pilotage passage plan prepared in advance by the ship should be immediately discussed and agreed with the pilot after boarding.

ISM Audits should pick up where such planning is not undertaken. Does it?

The control of ships poses a peculiar set of problems: The ship is part of a slow system in which inertia of the vessel and its general environment prevent direct and immediate feed-back; the navigator has to act in anticipation of what the situation will be at some time in the future; he has to think about and interpret what is going on and to work out what is to be done, rather than relying solely on what is obviously visible to him and reacting immediately.

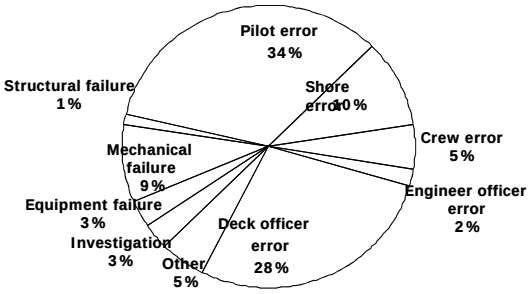
Don Bryant, Aline De Beievre, Martin Dyer-Smith: The Human Element in Shipping Casualties, 1991, for the UK Marine Directorate



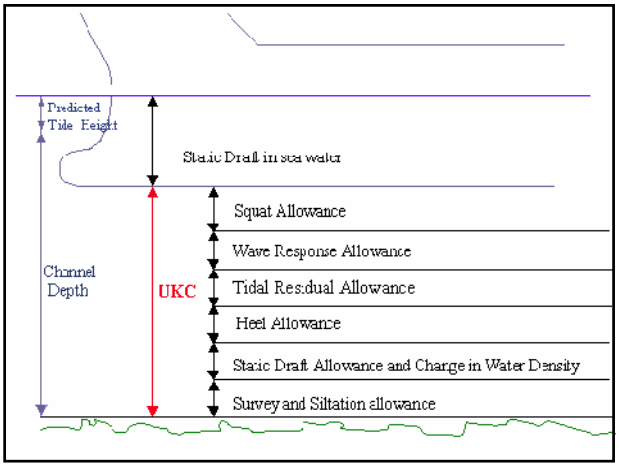


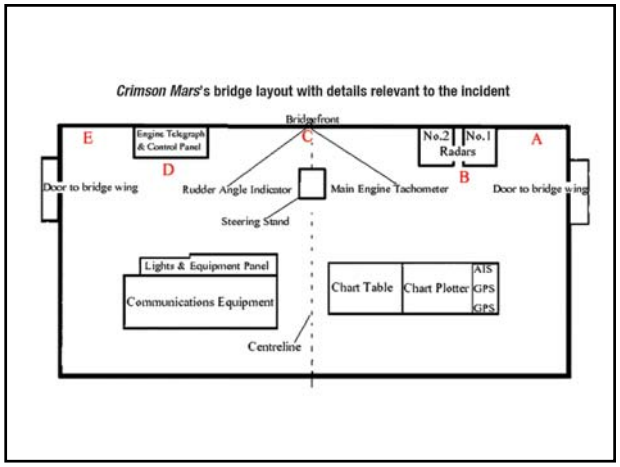
West of England P&I Club –

Pilot error was the largest single main cause of property damage, accounting for 34 per cent of claims of over $US1 600 000.



The United Kingdom Mutual Steamship Assurance Association (1993) *Analysis of Major Claims 1993,* London





BRM Issues

Definition

The use and coordination of all the skills and resources available to the bridge team to achieve the established goal of optimum safety and efficiency

The use and coordination of all the skills and resources (people, procedures and equipment) available to the bridge team to achieve the established goal of optimum safety and efficiency (New)

BRM Issues

AMSA Marine Notice 34/2002

Investigation and analysis of a series of collisions and groundings have shown that proper Watch keeping and Bridge Resource Management (BRM) techniques could have prevented some incidents. The human and organisational factors underlying these casualties arose from insufficient pre-passage planning and briefing of the bridge team, lack of sound BRM processes and poor navigational practice. Some of these were:

AMSA Marine Notice 34/2002

- Failure to delegate tasks and assign responsibilities
- Failure to set priorities
- Insufficient support to master and or pilot
- Inadequate monitoring
- Misuse of electronic navigation aids and:
- Failure to detect and/or challenge deviation from the passage plan and standard operating procedures

AMSA Marine Notice 34/2002

"*To varying degrees,…all the errors noted in the AMSA Marine Notice were identifiable in the events on the bridge of Crimson mars on 1 May*"

Page 17

BRM Issues

- **Passage Planning**

  The ship and pilot had different passage plans (No 'Shared Mental Model')
- **Briefing and Communication**

  Responsibilities undefined, no encouragement for 'challenge and response', no 'closed loop' in regard to helm orders, No use of hand signals and inconsistent use of 'midship' helm order

BRM Issues

- **State of the Bridge (situational awareness)**

  Critical part of the passage (turn off Garden Island) required optimal 'state of the bridge' and good situational awareness.

  The situational awareness during the turn was manifestly inadequate and the state of the bridge can only be described inattentive at this critical phase of the pilotage passage (page 22)

BRM Issues

- **Management of workload**
  - Insufficient crew members as per SMS (1 officer and 1 seaman short)
  - Ineffective preplanning, prioritising, delegation and defining of duties
- Improper monitoring of helm orders
- **Monitoring progress**
  - Equipment (Radar, GPS and Chart plotter) available for real time monitoring of progress but not used (inadequate monitoring by ship)
  - Improper workload management

BRM Issues

- 'Single person error' accident
  - No agreed to Passage Plan (Shared 'Mental Model') (Different Passage Plans)
  - What was the purpose of the ships Passage Plan?
  - Passage Plan by ship mostly for compliance with ISM Code (Plan required for all critical operations)
  - Passage Plan also recommended by *ICS Bridge Procedures Guide*
  - Pilot's Passage plan did not have the detail to allow the bridge team to monitor the passage and challenge if necessary
  - Lack of monitoring of helm orders

BRM Issues

- Use of mobile phones - distraction
- **Contingency planning**

  No contingency planning despite 6 previous groundings of large ships in the River Tamar since 1993. Deficiency on the part of TasPorts. Pilot left to deal with situation on his own

Speed Issues

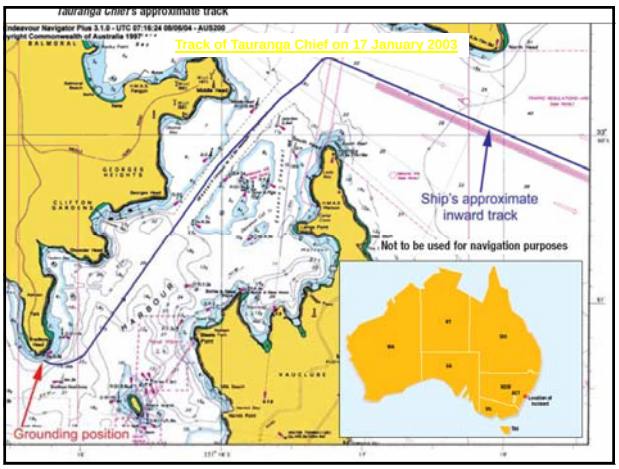
It is important that contingency planning for Bell Bay takes into account safe and appropriate speed for the pilotage. An increased speed can improve steering, increase control by reducing set and leeway, and decrease the time in a critical area. However, it reduces the time available to take corrective action to prevent grounding and increases the impact and damage from it. There are other advantages and disadvantages of a higher sped that may be relevant and need to be consider with the variables of each pilotage. However, in every case the need for effective planning, execution and monitoring is necessary.

Recurrent error in shipping - example

Helm Orders

'Tauranga Chief '– ATSB Marine Safety Investigation No 190

'Crimson Mars' – ATSB Marine Investigation No 227



Human Factors Issues

- Some persons are unable to distinguish left from right at all times, Such persons should never be allowed to be in-charge of any form of transport
- For a number of reasons a large proportion of the rest of the population can in situations involving high workload get right (starboard) and left (port) confused
- On a ship this source of error is compounded by the system whereby helm orders have to be conveyed from the person in charge of the con to the helmsman
- A rudder indicator situated behind the conning position (not unusual) further compounds the problem. The person conning the ship has to frequently adjust orientation
- Nearly all seafarers have personal experience of this phenomenon. There are not more accidents from this cause because most times the error is made when there is enough time or sea-room to recover or the error is detected by another person

MSC - MEPC. 3/Circ. 3

Casualty-Related Matters

Reports on Marine Casualties and Incidents

18 December 2008

MSC - MEPC. 3/Circ. 3

This session outlines IMO requirements for reporting of marine accidents.

Resolution A. 947 (23)

Human Element Vision, Principles and Goals for the Organization

Principles:

g) Dissemination of information through effective communication is essential to sound management and operational decisions.

ILO Recommendation 142

Prevention of Accidents (Seafarers) Recommendation, 1970

Considering that, although much is being done in a number of countries to reduce occupational accidents to seafarers, there is room for further study of such accidents and for further measures for their prevention, and that international standards embodying a relevant programme of action for the maritime sector are accordingly desirable, . . .

ILO Recommendation 142

Prevention of Accidents (Seafarers) Recommendation, 1970

1.(b) the term occupational accidents to seafarers arising out of or in the course of their employment.

ILO Recommendation 142

Prevention of Accidents (Seafarers) Recommendation, 1970

9 (2) Members should further have regard to the need for international co-operation in the continuous promotion of action for the prevention of occupational accidents; such co-operation might take the form of -

a) bilateral or multilateral arrangements for uniformity in accident prevention standards and safeguards;

b) exchange of information

c) . . .

MSC-MEPC.3/Circ.3.

18 December 2008

Casualty-Related Matters

Reports on Marine Casualties and Incidents

3. Under SOLAS regulation 1/21 and MARPOL articles 8 and 12, each Administration undertakes to conduct an investigation into any casualty occurring to ships under its flag subject to those conventions and to supply the Organization with pertinent information concerning the findings of such investigations.

MSC-MEPC.3/Circ.3.

18 December 2008

REPORTS ON MARINE CASUALTIES AND INCIDENTS

Harmonized reporting procedures - Reports required under SOLAS regulation I/21 and MARPOL 73/78 articles 8 and 12.

Vessel casualties are classified as:

Very serious casualties

Serious casualties

Less serious casualties

MSC-MEPC.3/Circ.3.

Very serious casualty

Very serious casualty are casualties to ships which involve total loss of the ship, loss of life, or severe pollution*.

[*"Severe pollution" is a case of pollution which, as evaluated by the coastal State(s) affected or the flag State, as appropriate, produces a major deleterious effect upon the environment, or which would have produced such an effect without preventative action.]

MSC-MEPC.3/Circ.3.

Serious Casualty

Serious casualties are casualties to ships which do not qualify as "very serious casualties" and which involve:

- a fire, explosion, collision, grounding, contact, heavy weather damage, ice damage, hull cracking, or suspect hull defect, etc., resulting in:

- structural damage rendering the ship unseaworthy such as penetration of the hull underwater, immobilization of main engines, extensive accommodation damage, etc.: or pollution (regardless of quantity); and/or
a breakdown necessitating towage or shore assistance

MSC-MEPC.3/Circ.3.

Less serious casualties

"less serious casualties" are casualties to ships which do not qualify as "very serious" or "serious casualties" and for the purpose of recording useful information also include "marine incidents".

MSC-MEPC.3/Circ.3.

Information to be sent in accordance with the type of casualty	*Very serious casualties*	*Serious casualties*	*Less serious casualties*	*Marine incidents*
Annex 1 of the attached reporting form	*To be provided within 6 months of the casualty in all cases*	*To be provided within 6 months of the casualty in all cases*	*May be provided if there are important lessons to be learned.*	*May be provided if there are important lessons to be learned.*
Annexes 2& 3 of the attached report format, as well as other relevant annexes	*To be provided at the end of the investigation in all cases*	*To be provided at the end of the investigation in all cases*	*May be provided if there are important lessons to be learned.*	*May be provided if there are important lessons to be learned.*
Full investigation report	*To be provided at the end of the investigation in all cases*	*May be provided if there are important lessons to be learned.*	*May be provided if there are important lessons to be learned.*	*May be provided if there are important lessons to be learned.*

MSC-MEPC.3/Circ.3.

ANNEX 1.

Ship identification and particulars

Indicates the information to be submitted in all casualty reports.

MSC-MEPC.3/Circ.3.

ANNEX 2

Data for “very serious” and “serious casualties”

Indicates information to be supplied on “very serious” and “serious casualties”.

MSC-MEPC.3/Circ.3.

ANNEX 3

Supplementary information on “very serious casualties” and “serious casualties”.

Additional information required for”very serious casualties” and “serious casualties”.

MSC-MEPC.3/Circ.3.

ANNEX 4

Information from casualties involving dangerous goods or marine pollutants in packaged form on board ships and in port areas.

This form may be applicable for marine casualties as defined as well as marine incidents.

MSC-MEPC.3/Circ.3.

ANNEX 5

Damage cards and intact stability casualty records

This form may apply to “very serious” and “serious” casualties.

MSC-MEPC.3/Circ.3.

ANNEX 6

Fire casualty record

This form may apply to “very serious” and “serious” casualties.

MSC-MEPC.3/Circ.3.

ANNEX 7

Questionnaire related to the maritime distress system.

This form may apply to "very serious" and "serious" casualties.

MSC-MEPC.3/Circ.3.

ANNEX 8

Fatigue as a contributory cause to maritime accidents - fatigue factors data compilation sheet.

This form will apply where fatigue is deemed to be a contributory factor in the casualty.

MSC-MEPC.3/Circ.3.

ANNEX 9

Incidental spillage of harmful substances of 50 tonnes or more.

This form relates to incidents involving harmful substances. The report is considered necessary when investigating a casualty or an incident (MARPOL 73/78, articles 8 and 12), however this does not replace the one-line entry report required by the annual mandatory report under MARPOL 73/78, article 11 (MEPC/Circ.318, Part 1)

International Maritime Organization

Global Integrated Shipping Information System

Maritime Security	Information communicated under the provisions of SOLAS regulation XI-2/13 (SOLAS Ch. XI-2 & ISPS Code
Condition Assessment Scheme	Electronic database for the implementation of the Condition Assessment Scheme – Res. MEPC.94 (46), as amended
Recognized Organizations	Information submitted by Member States under MSC/Circ.1010-MEPC/Cir.382
Maritime Casualties and Incidents	Data on Maritime Casualties and Incidents as defined by circulars MSC-MEPC.3/Circ.1.
Port Reception Facilities	Data on the available port reception facilities for the reception of ship-generated waste.