Final Report for Publication

Public

BERTRANC PROJECT

Technical Secretariat

Contract N^{o} : WA-96-CA.191

Project Co-ordinator: **MaTSU (UK)**

Partners: **TRUTh (GR)**
RINAVE (P)

Project Duration:
1 July 1996 to 30 June 1999

Date: **4/04/2000**

PROJECT FUNDED BY THE EUROPEAN COMMISSION UNDER THE TRANSPORT RTD PROGRAMME OF THE 4th FRAMEWORK PROGRAMME

Contents

Partnership

The “BERTRANC” Concerted Action Committee was composed of two parts:

- A committee of experts nominated by the government of member states, and;
- A Technical Secretariat to administer the day to day running of the project.

Table 1
BERTRANC Partnership

Name	Organisation	Country	Status
MEMBER STATE NOMINATED EXPERT			
Mr John Koch Nielsen	Danish Maritime Institute	Denmark	Expert
Mr Niels Mogensen	Danish Maritime Authority	Denmark	Expert
Mr Martti Heikkila	Accident Investigation Board	Finland	Expert
Mr Juhani Sukselainen	VTT Manufacturing Technology	Finland	Expert
Capt Jan Erhardt	Bundesministerium fur Verkehr	Germany	Expert
Dr Rolf Schulte-Strathaus	Germanischer Lloyd	Germany	Expert
Prof Piero A. Caridis	National Technical University of Athens	Greece	Expert
Mr George Panagakos	DAS - International Development Consultants Ltd.	Greece	Expert
Mr Eamonn Doyle	Cork Institute of Technology	Ireland	Expert
Mr Vivion Gough	Cork Institute of Technology	Ireland	Expert
Ing Franco Zuccarelli	D’Appolonia S.p.A.	Italy	Expert
Mr Salvatore Furnari	Registro Italiano Navale	Italy	Expert
Mr Willem de Vries	Directorate General for Freight Transport	Netherlands	Expert
Mr Willem Vlakveld	Directorate General for Freight Transport	Netherlands	Expert
Mr Martin Olofsson	Det Norske Veritas AS	Norway	Expert
Prof Svein Kristiansen	Norwegian University of Science and Technology	Norway	Expert
Prof Carlos Guedes-Soares	Instituto Superior Tecnico	Portugal	Expert
Eng Antonio Moutinho	Bonanca	Portugal	Expert
Mr Jesus Carbajosa	Cetemar	Spain	Expert
Mr Ricard Mari-Sagarra	Universitat Politecnica de Catalunya	Spain	Expert
Mr Bengt-Erik Stenmark	Swedish Maritime Administration	Sweden	Expert
Prof Torbjorn Thedeen	Center for Safety Research	Sweden	Expert
Mr Roger Brydges	Marine Accident Investigation Branch	United Kingdom	Expert
Capt Simon Harwood	Marine Accident Investigation Branch	United Kingdom	Expert
TECHNICAL SECRETARIAT			
Mr Ken Robson	MaTSU	United Kingdom	Co-ordinator
Miss Alexandra Kalapoutis	TRUTh	Greece	Partner
Mr Rodrigo Araujo	RINAVE	Portugal	Partner

Executive Summary

Although maritime transport plays a key role in the efficient movement of goods throughout Europe, its recent history has been plagued with mishaps and accidents which have had an adverse effect both in terms of public perception of the industry and also on the lives and well-being of those who are employed within it. A number of high profile and serious accidents have occurred over the last 15 years which have caused, at best, pollution of the maritime environment with hydrocarbon or chemical products, or at worst, massive loss of life.

Through the Directorate General for Transport (DG VII), the Commission of the European Communities (CEC) identified that an improvement of maritime safety was a priority requirement both to enhance the public's confidence in the transport mode as well as improving its efficiency through minimising losses. To meet this objective, DG VII established the "BERTRANC" Concerted Action Committee (CAC) of experts, nominated by the government of member states, to bring advice and opinion into the forum.

Through the specific remit to examine the "Methodology of Safety in Maritime Operations", and the "Impact of the Human Element on Global Maritime Safety", the project's broad aims were to:

- To facilitate the development of a common methodology for the investigation of maritime accidents and the reporting of hazardous incidents;
- To improve the understanding of human factors as related to accidents and to account for these factors in the common methodology.

The CAC decided that these aims could be fulfilled by undertaking a programme of work encompassing the following elements:

- Work Package 2.1 - Current practices and procedures in accident investigation;
- Work Package 2.2 - Training best practice for accident investigators;
- Work Package 2.3 - Competencies of investigation personnel;
- Work Package 2.4 - Best practice in methodologies for accident investigation;
- Work Package 2.5 - CHIRP best practice;
- Work Package 2.6 - Accident data;
- Work Package 2.7 - Population statistics;
- Work Package 2.8 - Common accident methodology;
- Work Package 2.9 - Specification of a proposed common methodology;
- Work Package 2.10 - Acquisition of data and collation of an appropriate database;
- Work Package 2.11 - Human element/remedial tools.

To further this programme, the CAC held a series of meetings during the life of the project to provide a suitable forum for the discussion of these important matters and to ensure that all understood the precise requirements of the project, including any changes that were made to the initial approach. Overall, a total of 10 meetings were held in Brussels as well as in some of the major maritime centres of Europe. These latter meetings were held at the invitation of, and were hosted by, the CAC members from Greece, Portugal, Sweden and Spain.

Initially, the format of the meetings was a single day meeting with a plenary session in the morning and afternoon. It soon became apparent however, that far greater progress could be made if the meeting was split into a series of plenary and working group sessions over 2 days. The advantage of this approach was that it enabled smaller groups to progress and for them to be able to report back to the large plenary session on their progress.

In all the meetings the Technical Secretariat played an active role and assisted the members' deliberations and submissions by producing a series of guideline documents for the Work Packages. This was done at the members request with the aim of ensuring that each member state would be making their submission based on a similar series of questions and hence starting point. The output of each Work Package could then be readily correlated.

There were a number of different types of deliverables from the project. From the earliest days, a series of 'state of the art' studies were undertaken to assess the current maritime accident investigation methodologies and philosophies in use in the various member states. These first steps, though elementary, were necessary to enable the starting point for the study to be ascertained. Although the 'state of the art' studies were initially seen as a 'building block' for future activities, they produced valuable and important documents in themselves. A number of members have expressed the opinion that they see the documents as a useful source of reference for the mechanism and philosophy being adopted in other member states for accident investigation and its related activities.

Later, building on the 'state of the art' studies and through an immense amount of debate and consensus, came the definition of what should be done in the future to improve maritime safety through the development of a common methodology for accident investigation and the reporting of hazardous incidents.

Three proposals were made to the Commission for further studies under the auspices of the 5th Framework Programme. In the first of these, delivered during March 1998, members put forward a suggestion for a pilot scheme to test out the concept of a Confidential Hazardous Incident Reporting Programme (CHIRP). This scheme is based on the assumption that considerably more 'incidents' than 'accidents' occur and that for each 'incident' or 'near miss', there are important lessons to be learned. The proposal outlined the requirements of the whole system for collation, confidentiality, analysis and dissemination of information on 'near misses' to persons involved in the industry. The concept has been successfully used in the aviation industry for a number of years and has proved itself to be extremely valuable. This issue is dealt with in detail in Section 3.6.

A further proposal was made to the Commission in March 1999, when members put forward a suggestion for a pilot scheme to train Maritime Accident Investigators via an Open Flexible Learning (OFL) approach. The proposal identified what can be considered a ‘base’ level and style of training for what may become a pan-European corps of maritime accident investigators. This issue is dealt with in detail in Section 3.3.

The final proposal to the Commission dealt with the human element and the part it plays in not just maritime accidents, but in all accidents. The project identified that there will still be significant scope for increasing maritime safety by making a study, and learning from, an assessment of the human element and how it impacts on maritime accidents. To properly exploit this opportunity, the specification for a database was defined. The specification, if implemented will allow a maritime accident investigator to ask a number of questions to those involved to provide an insight into the human element and how it may have played a part in the accident. Although defining the questions that a maritime accident investigator should ask is an important part, the specification has also been formulated so as to make it suitable for use as an analysis tool, with the intention that accident trends can be assessed. This issue is dealt with in detail in Section 3.12.

Overall, it is considered that the BERTRANC Project has met its objectives. This has been achieved through the efforts and dedication of the members of the CAC throughout the life of the project and under the overall guidance of DGVII.

1 Project Objectives

Maritime transport plays a key role in the efficient movement of goods throughout Europe. Through the Directorate General for Transport (DG VII), the Commission of the European Communities (CEC) identified the improvement of maritime safety as priority requirement. To meet this objective, DG VII established the "BERTRANC" Concerted Action Committee (CAC) of experts, nominated by the government of member states, to bring advice and opinion.

The committee had the specific remit to examine the "Methodology of Safety in Maritime Operations", and the "Impact of the Human Element on Global Maritime Safety", with the following broad aims:

- To facilitate the development of a common methodology for the investigation of maritime accidents and the reporting of hazardous incidents;
- To improve the understanding of human factors as related to accidents and to account for these factors in the common methodology.

To achieve these aims, the following objectives were pursued:

- To gain a thorough of the existing safety procedures and methodologies currently employed by member states;
- To gain an appreciation of whether systems employed by other transport modes could be employed in the marine sector;
- To implement a common accident reporting methodology agreeable to all member states;
- To develop a marine version of the aviation industry's Confidential Hazardous Incident Reporting Programme (CHIRP);
- To identify remedial tools.

The objectives of the project were pursued through a series a meetings and by the background work and efforts of the members in the period between meetings. This methodology is presented in Section 2. The deliverables form the project broadly fell into three categories:

- Proposal to DGVII of the Commission for further research studies or demonstration projects to be carried out under the 5th FP.
- 'State of the Art' summary document.
- Communiqué from the CAC to the Commission

The deliverables from the project are discussed in general terms in Section 3 and are presented in detail in Appendices 1 to 9.

2 Method to Achieve Objectives

2.1 INTRODUCTION

In fulfilling the objectives laid out in Section 1, the CAC decided to hold a series of meetings during the life of the project. The aim of the meetings was to guide the CAC member's deliberations in the period between meetings and to ensure that all understood the precise requirements of the project, including any changes that were made to the initial approach.

1st CAC Meeting:	Brussels, 4 July 1995.
2nd CAC Meeting:	Brussels, 21st November 1995.
3rd CAC Meeting:	Brussels, 26th February 1996.
4th CAC Meeting:	Brussels, 28 October 1996.
5th CAC Meeting:	Piraeus, 17 February 1997.
6th CAC Meeting:	Lisbon, 16th and 17th June 1997.
7th CAC Meeting:	Stockholm, 13 and 14 October 1997.
8th CAC Meeting:	Barcelona, 30 and 31 March 1998.
9th CAC Meeting:	Brussels, 5 and 6 October 1998.
10th CAC Meeting:	Brussels, 11 and 12 March 1999.

At its 1st meeting the CAC agreed the Terms of Reference for the study. Briefly, these broke the overall objectives down into eleven work packages:

- Work Package 2.1 - Current practices and procedures in accident investigation;
- Work Package 2.2 - Training best practice for accident investigators;
- Work Package 2.3 - Competencies of investigation personnel;
- Work Package 2.4 - Best practice in methodologies for accident investigation;
- Work Package 2.5 - CHIRP best practice;
- Work Package 2.6 - Accident data;
- Work Package 2.7 - Population statistics;
- Work Package 2.8 - Common accident methodology;
- Work Package 2.9 - Specification of a proposed common methodology;
- Work Package 2.10 - Acquisition of data and collation of an appropriate database;

- Work Package 2.11 - Human element/remedial tools.

It was also agreed that the general approach to be adopted for the collation and interpretation of information of the various issues to be covered by the CAC would be as follows:

a) As the programme of work outlined in the Terms of Reference progressed, the Technical Secretariat or committee members would suggest papers needed to obtain information from each member country.

b) The committee would nominate a member to be the responsible expert for interpreting this information and reporting back to the committee. This would be the Technical Secretariat in some cases where the paper concerned is broad general information rather than specialist technical, operational, regulation or policy information.

c) The Technical Secretariat would (in collaboration with the nominated committee member as required) provide a guideline for each paper requested from the member countries. This guideline would provide some structure to the papers so they can be more readily compared. It would prompt authors for the information required but was not to be considered as definitive. In other words, authors were to add comments on any issues that they considered to be relevant, particularly if they were specific to their country.

d) The paper from each country would be supplied to the Secretariat who assessed the completeness of information and, if appropriate, checked whether further data could be supplied. The Technical Secretariat then supplied the set of papers to the nominated member for interpretation.

e) The nominated member was to summarise the set of papers and draw out any commonality which existed, areas where further information or research projects would be useful, issues where procedural differences between countries needed to be discussed further, etc. The summary was presented to the next CAC meeting and any further actions were agreed.

It was also agreed that the Technical Secretariat would produce a guidance document to assist CAC members in completing their submissions for “state of the art” papers for each of the Work Packages. This was to ensure that all members who be approaching their submission from a common stand-point and would be answering similar questions in a similar manner.

3 Scientific and Technical Description

3.1 INTRODUCTION

The nature of the CA, being a discussion forum rather than a mechanism for research and development, does not lend itself to the production of 'normal' deliverables in the usual sense of the term. Instead, most Work Packages have resulted in either a 'State of the Art' study, a proposal to the Commission for further work to be undertaken as a research study, or a statement indicating the CAC's view on a particular issue.

The approach adopted and work undertaken in each Work Package is presented in the following sub-sections.

3.2 WORK PACKAGE 2.1 - CURRENT PRACTICES AND PROCEDURES IN ACCIDENT INVESTIGATION

Prior to any move towards a common methodology, the working practices and methodologies for marine accident investigation in place at the time must be understood and assessed. For the CA, this included an assessment of the remit of the investigative agencies, an appreciation of their Terms of Reference and an understanding of their capabilities.

Implicit in accident investigation is an assessment of the causes of the accident, i.e., an appraisal of the status of the human element in that scenario. Although human factor elements can be initially classified under the headings of organisational, training, managerial and ergonomic, these must be further refined in order that they can be usefully employed in an accident investigation. Some marine accident investigation branches are already researching issues related to the refinement of human error categorisation. Lines of communication both within the national body for marine accident investigation and without, i.e., to whom do they report, needed to be appreciated along with an assessment of the staff organisation and the facilities available.

A guideline document was issued to members on 23 February 1996. Over the coming months this generated a response from experts from each of the member states. The Technical Secretariat collated the individual responses into a summary document that compared members' answers against each other. This is presented in Appendix 1. The main points of note that arose from the summary document were:

Current procedures:

- Generally very similar in remit and function.
- Initial reporting of the incident is followed by a preliminary inquiry.
- The results of which are used to close out the incident or initiate a more detailed inquiry.
- Some differences exist with the conduct and remit of the full inquiry.

- Most will use the results of the full inquiry to initiate legal proceedings if these are warranted.
- Any legislative changes are based on the results of the full inquiry.

Existing information:
- Most respondent have, or are implementing, accident/incident databases.
- Only the **Netherlands** indicated the situation pertaining to vessel traffic logging.

Current and future research:
- Human element research is prominent in current and future requirements.
- Efforts are underway in several member states to centralise accident/incident data on PC databases.
- Effort has also been directed towards improving report form formats as well as assessments of ASRS and CHIRP.

Background and Training of investigators:
- Backgrounds are very similar throughout the member states, both in terms of professional qualifications and relevant experience.
- In-house training is offered as to the conduct of marine investigations; other aspects are also considered as required.

3.3 WORK PACKAGE 2.2 - TRAINING BEST PRACTICE FOR ACCIDENT INVESTIGATORS

Accident investigators tend to be experienced mariners whose knowledge of procedures at sea can be effectively used in an investigation. However, there are other traits desirable in an investigator, but these depend largely upon the Terms of Reference under which they are operating. Other abilities might include training in interview techniques as adopted by national law enforcement agencies to enable an investigator to have a better appreciation of how best to conduct an interview with a witness. If an accident results in legal proceedings it may be that the investigator is called to a trial as an expert witness. Some training programmes of this nature already exist.

Training may also be carried out in respect of report writing. A report is the usual "deliverable" of an investigation and therefore needs to be carefully written as well as technically competent. Areas of factual reporting need to be clearly distinguished from areas of conjecture so that the report may be seen to be offering the facts, and the investigating officers' interpretation of them.

For this Work Package, it was originally expected that the CA would arrange a discussion forum on the subject of best practice in training, and would disseminate the results. During the course of the project, however, the CA decided the needs of this Work Package would be best served by producing a proposal to DGVII of the Commission for a pilot scheme for an Open Flexible Learning (OFL) Programme for Maritime Accident Investigator Training Best Practice.

A principal aim of setting up the CA on accident investigation and hazardous incident reporting is to ensure that accurate information is gathered on accident causes. This

permits effective countermeasures to be identified and evaluated, leading to improved European maritime safety. A key element of this is the implementation of a common accident investigation methodology.

In order to facilitate this, it is essential to develop common training and competencies throughout the member states. Any common scheme must ensure that data collection and analysis is carried out on the same basis. To effect this, personnel must be trained in a manner that provides a guaranteed level of quality data in the correct detail. Further, commonality of training and competencies will ensure the mobility of personnel throughout the EU, allowing free movement and cultural exchange.

Marine accident investigators are usually experienced mariners. While this experience gives vital understanding needed in accident investigation, it does not necessarily provide all the desirable skills. An essential part of the task is the elicitation of relevant information, its interpretation and the unambiguous presentation of conclusions. This is of particular importance where the investigation may lead to legal proceedings in which the findings will be challenged. To this end, depending on their terms of reference, investigators must have some or all of the following competencies:

- Interviewing techniques
- Report writing
- Law related to accident investigation
- Expert witness
- Ship surveyor training
- Tanker and shipboard safety, etc.

Preliminary information on this from Work Package 2.1 indicated that training methods and investigators' technical backgrounds vary considerably between member states. The positive and negative aspects of these have to be weighed up in order that a common minimum level of training may be suggested.

A central question was identified as being how levels of competency are to be established across Europe. A step towards this may be the collection and analysis of data, possibly leading to a European accident investigation corps. The scarcity of formal training among member states was highlighted, with training almost always 'on the job', leading to major variations in the form of training between member states. Advantages to commonality of training included the prospect of mobility for investigators and of assistance in accident investigation for smaller states who may have less resources. Other key areas for discussion were identified such as the background of investigators, the objective of the investigation (nearly all lead to judicial proceedings), and the relevance of the IMO course on Marine Accident and Incident Investigation. Currently, the only formal training courses attended by accident investigators were technical, such as surveying, fire fighting etc. None were specific to accident investigation.

The preamble to the IMO course notes that it is important that investigators are employed exclusively in that job to avoid the possibility of conflict of interest. This could be an important point for commonality of any training course. Countries where investigators are employed exclusively in that role were identified as Denmark, Finland, Germany, Norway, Sweden and United Kingdom.

The benefits of telematic distance learning technology as demonstrated under the SOCRATES project (European Televersity Programme) were explored. This showed that the necessary technology exists and therefore the CAC has to concentrate on the training content.

Issues surrounding the development of a suitable training scheme for maritime accident investigators were discussed at several meetings and the results filtered into a document that laid down the members' views on what a suitable training course should consist of and how it should be structured. The culmination of this is presented in Appendix 2.

3.4 WORK PACKAGE 2.3 - COMPETENCIES OF INVESTIGATION PERSONNEL

The assessment and measurement of the competencies of investigation personnel is not an easy task and one which is further complicated by the various Terms of Reference under which different organisations are operating. One effective method of measuring competencies is to present the known facts of a marine accident and to ask the relevant national bodies to prepare a report 'in their usual fashion'. These reports could then be assessed for consistency and thus give a direct insight to the differing methodologies in operation across Europe. Originally, it was expected that the role of the CA would be the setting up and running of a working group to investigate the most efficient method of measuring and quantifying investigation personnel competencies.

During the course of the project, however, the CA decided that many of the aspects of this Work Package had been adequately covered elsewhere in the project. Accordingly, the members of the CA decided not to pursue this Work Package in its own right.

3.5 WORK PACKAGE 2.4 - BEST PRACTICE IN METHODOLOGIES FOR ACCIDENT INVESTIGATION

The assessments in Work Packages 2.1 and 2.2 were used to determine which aspects of the methodologies currently employed are desirable and which features can be dispensed with. An intention of this part of the work was the recognition that some practices thought to be desirable in a common methodology may be resisted by some countries who do not have them because of the cost, but may also be resisted by countries who have what they believe to be better systems.

It was the original intention that for this work package, the CA would arrange a meeting of the to discuss and provide recommendations on a common methodology and the cost benefits associated with it.

To achieve this a two-fold approach was followed, which considered two aspects:

(a) The people who perform this process, and
(b) The accident investigation process itself.

In the first case, it was found important to address the qualifications of the investigators, in terms of background and training in relevant areas and also identify the composition of the investigation team. These elements were provided for the current situation as well as for a desired future one.

In the second case, the member states were requested to provide their experience during the accident investigation process. The investigation procedure was divided into several stages:

- Data collection
- Reconstruction of the accident scenario
- Analysis of the data in the accident scenario
- Identification of potential safety problems and development of safety actions

In all of the above stages the member states' experiences and positions were recorded aiming at identifying potential commonalities, which would be probably used in developing the best practice accident investigation methodology.

A guideline document was issued to members on 5 October 1998 and over the coming months this generated a response from experts from each of the member states. The Technical Secretariat collated the individual responses into a summary document that compared members' answers against each other. This is presented in Appendix 3.

3.6 WORK PACKAGE 2.5 - CHIRP BEST PRACTICE

In the aviation industry, Confidential Hazardous Incident Reporting Programmes (CHIRP) allow personnel to report, on a confidential basis, any incident which they regard as hazardous. By definition this sort of scheme excludes nothing from the reporting process and therefore includes all aspects of the human element within that industry. These reports are collated centrally and analysed statistically with feed back to the industry via publication of, usually sanitised, incident reports. As a result of various political and legal problems, such schemes appear not to have been implemented across Europe. This Work Package sought to identify best practice for a marine version of CHIRP and learn from past experience, the lessons of relevance to European implementation of such a scheme. Consideration was also given to the incentives necessary to facilitate improved reporting of incidents.

Initially, some members of the CAC were sceptical about whether a marine version of the aviation CHIRP would be appropriate. This was because it was felt that a voluntary CHIRP would be too patchy to be statistically significant and a voluntary confidential CHIRP would not be a success. Nonetheless, members persevered and were able to define the framework for how a pilot scheme for such a scheme should be set up and administered. The resulting framework document is presented in Appendix 4.

3.7 WORK PACKAGE 2.6 - ACCIDENT DATA

Essential to the whole process of accident investigation is agreement on the type and quality of data to be obtained and the level of detail at which this should be examined. Experience with some accident reporting databases has shown that a requirement for too much detail can not only lead to inconsistencies in the reports, but can actually bring the database system to a halt. Clearly, the opposite situation is not desirable either, i.e., one where not enough detail will only yield meaningless statistics. A balanced and an effective agreement between these two extremes can only be obtained via discussions with all interested parties in the marine field.

One of the reasons for setting up this Work Package was to address the need for information on accident causes, which can then be used to design and evaluate possible risk-reducing measures. Information therefore, must be reliable, easy to interpret and representative of the maritime and inland-water shipping traffic in European waters. Initially the proposed procedure to determine what information was necessary was to make an inventory of past and on-going risk analysis projects. This stock-taking exercise had to reveal:

- What data was (effectively) used in the risk analyses;
- What data was missing (and hampered a thorough analysis).

When completed, it was anticipated that an overall assessment of the results would highlight those areas where further efforts in data collection should be made. As a first step this is included the ability to determine which vessel operating parameters and inputs to 'black box' recorders would be most beneficial for accident investigation and risk analysis purposes.

A guideline document was issued to members on 23 February 1996 and over the coming months this generated a response from some of the member states. The Technical Secretariat collated the individual responses into a summary document that compared members' answers against each other. This is presented in Appendix 5.

3.8 WORK PACKAGE 2.7 - POPULATION STATISTICS

In principle, one of the ways to improve European maritime safety is to use accident data in order to analyse maritime risks. To do this requires the total population statistics to be gathered for the movement of maritime traffic within European waters and to be effective the different sources and quality of data needed to be assessed.

Generally speaking, accident data are too few and heterogeneous to permit classical statistical analysis. To overcome this, reliance on incident data and/or logical models of the *'maritime'* system combined with failure rates for the components is required, the so called 'PSA methodology'. This method has recently been used in the SAFECO project to consider the risk for collision at sea. It is then necessary to be able to assess the probability of a near position between vessels and for that purpose information of maritime traffic - population statistics - is vital. Clearly, such statistics are also important in other maritime safety studies.

Among the *'official'* registers of population statistics are the DAMA and Lloyd's Maritime Information Service databases. Both registers have been built up for other reasons than risk analysis studies and therefore have shortcomings with respect to completeness and quality. In order to evaluate the quality of the register data, and possibly complement or partly replace these data, it would be possible to use sampling methods to get more precise and complete data from a representative sample of shipping companies. Such methods could also be considered to evaluate incident data.

When considering what type of population statistics should be used it is first necessary to note that the use of the statistics is mainly to estimate the frequency of certain risky situations, i.e. closeness in time and space between vessels. The ideal situation would be to construct a register for all vessels above a certain size and include their position, course and speed at all times in the period in question. It is recognised however, that this is an impossible demand. A more realistic one could be to register vessel type, origin and destination port and corresponding times, mean speed and route. This approach should make it possible to make a crude estimate of the number of risky situations without taking into account changes of speeds and routes caused by, for example, bad weather. On the other hand these are probably the only statistics which can possibly be obtained from different data registers.

A guideline document was issued to members on 8 August 1997. The Technical Secretariat collated individual responses into a summary document that compared members' answers against each other. This is presented in Appendix 6.

3.9 WORK PACKAGES 2.8 & 2.9 - COMMON ACCIDENT METHODOLOGY

Under the CA's original Terms of Reference it was proposed that Work Packages 2.8 and 2.9 would cover different albeit complementary areas with respect to setting up an acceptable pan-European maritime accident investigation methodology. However, following the assessments made in the activities detailed in the preceding Work Packages, the CAC decided that these Work Packages should be combined. Building on the previous assessments, it was found that common features of national schemes can be brought forward in addition to making proposals on further improvements. These could then be used to set the basis for, and evaluate, the cost/benefit implication of a common accident investigation methodology.

At a forum to consider this issue the CAC discussed the national requirements for a common methodology across the different member states. It was considered that the implementation of a European wide methodology would take years to achieve, possibly as much as 10 years, however it was to be hoped that a consensus view could be reached much sooner. A number of difficulties were foreseen by member states that have already agreed to follow the IMO methodology and therefore it would be administratively difficult to support a different EU approach. It was suggested that a common European approach should be developed which exceeded the requirements of the IMO and which could be adopted by the member states on a voluntary basis. Some states warned that investigators can not work to two systems and suggested that initially the CAC should

adopt the IMO approach and later, if it was found to be deficient, make efforts to improve it.

At the conclusion of the discussion forum a consensus view was reached on what should be a specification for a pan-European Common Maritime Accident Investigation Methodology. This is presented in Appendix 7.

3.10 WORK PACKAGE 2.10 - ACQUISITION OF DATA AND COLLATION OF AN APPROPRIATE DATABASE

The common methodology provides a framework for the provision of data but not for its collation and analysis. As an extension of this it was also apparent that an investigation into data acquisition and the setting up of a central database was required. To achieve this, it was important to consider the most appropriate reporting conduit both for marine accidents and hazardous incidents. The remit of the CA in this Work Package was to ensure that these lines of communication were clearly defined and agreed and to provide the framework for a common methodology for the collation and analysis of maritime accident data. By extension this would also include possibly determining what would be the future data provision.

Early in discussions on this Work Package it became apparent that there were some widely differing views on the approach that should be adopted. Although all members agreed that to define an appropriate database would not be difficult, most felt that it would not be the most efficient use of resources as a number of databases for this purpose already existed in various formats. The IMO database was specifically mentioned by some and, even though it had some shortcomings and was not in widespread use, it had been accepted, at least in principle, by a large number of maritime states.

As discussions progressed the CAC came to the conclusion that if the CA had any role in this matter it should be to try and influence the IMO into defining and adopting their database quickly. To this end, it was suggested that member states' IMO representative be contacted to further this as a matter of urgency.

In conclusion the CA decided to collectively issue a document to the Commission recommending that the Commission urge all member states to comply with the requirements of the IMO model. The CA's communiqué to the Commission is contained in Appendix 8.

2.11 WORK PACKAGE 2.11 - HUMAN ELEMENT/ REMEDIAL TOOLS

The overall aim of improving the accident investigation methodology is to highlight those areas in ship operation/management that engender unsafe practices. A logical progression of this is the identification of 'remedial tools' to effectively improve safety. When related to the human element these tools are almost always effected through improvements in training for the personnel involved.

There have been a number of serious accidents in recent years that have resulted in considerable loss of life and environmental damage. Historically, these incidents have led to legislative solutions largely concerned with vessel design and operation. This approach has generally ignored the root causes of accidents in favour of more technically orientated solutions.

It is well established however, that human or organisational error is a contributory factor in almost all maritime accidents. The existing data on causes of accidents is unclear as regards the classification of the causes of human failure, and a more sophisticated investigation methodology is needed in order to develop effective countermeasures that are able to be evaluated.

The eventual success of any remedial measures adopted will be determined to a great extent by the manner of their implementation. In pursuance of this, the support and participation of employees is vital, and will only come about if there is strong commitment from all levels of management. To this end, remedial tools should be practical rather than vague and theory-based, be clearly effective and usable, and be subject to evaluation. Inevitably, the content and delivery of training will be of paramount importance in any implementation strategy.

The following elements were identified as central to this work package:

- Conceptual framework
- Accident investigation and reporting
- Identification and categorisation of factors
- Formulation and implementation of remedial measures

CONCEPTUAL FRAMEWORK

In seeking causes of accidents, the traditional culprits are engineering failure and individual human error. However, analyses of relatively recent disasters have called attention to other causes. In these cases, the subsequent enquiries found faults in the organisational structures and procedures that were judged to be at least as important as physical failures, or even individual human error. In their third report in 1993 ‘Organising for Safety’, the Advisory Committee on the Safety of Nuclear Installations (ACSNI), Study Group on Human Factors wrote of proactive safety management:

> *“Accidents rarely have a single cause. Some of the causes are events at the time of the accident, such as mechanical failures and individual errors. Other causes, such as poor inspection or failure of supervision, may have no immediate effect. In that case they remain latent until some further factor pushes the situation over the edge. Bad organisation makes these latent failures more common. Key steps in safety management therefore are the deliberate identification of hazards, the assessment of them, and making sure there are rules and procedures, training, and most importantly commitment to reduce the associated risk.”*

ACCIDENT INVESTIGATION AND REPORTING

This should use the modern accident causation models to identify the underlying causes of an accident. Detailed accident investigations have often lead to efforts at preventing

the repetition of accidents that have already occurred through the identification of immediate causes at the expense of the underlying causes. This can happen particularly where technical investigators have profound expertise in the area of proximate cause, but their knowledge of human factors in accident causation and safety management is superficial and naive.

If investigators have the necessary human factors competency, the causal factors can be identified and categorised in the accident investigation report.

IDENTIFICATION AND CATEGORISATION OF FACTORS

This is an essential step in the identification of trends in accident causation which could then lead to the formulation of remedial measures. Several classification schemes were suggested and details of others have since been submitted.

It was suggested that as well as training, suitably flexible guideline questions could be formulated for accident investigators. The question set would have to be flexible and adaptable so that information is not lost, while at the same time, enabling causal factors to be readily categorised.

It was recommended the setting up of a database of causal factors, based on the above mentioned question set, would permit the targeting and prioritisation of remedial measures.

FORMULATION AND IMPLEMENTATION OF REMEDIAL MEASURES

It is widely accepted that the over-arching goal of a proactive safety strategy is the creation of a suitable/positive safety culture. The most effective way of achieving this is through the implementation of remedial tools that have been formulated through the steps outlined above. ACSNI propose that a positive safety culture depends on, and accident rates tend to be lower when:

- *"RESOURCES of time, money, and other limited assets, are devoted to safety. That is, when there is evidence of strong commitment that is not merely verbal;*
- *PARTICIPATIVE relations exist between staff at different levels. That is, all members of staff identify hazards and suggest remedies, provide feedback on results of action, and feel that they 'own' the procedures adopted to pursue safety. There are comprehensive formal and informal communications;*
- *VISIBILITY of senior management is high;*
- *NEED FOR PRODUCTION is properly balanced against safety so that the latter is not ignored*
- *QUALITY OF TRAINING is high. Firstly, for management, which should include ways of ensuring safety as well as economic efficiency. It is particularly important not to overlook social and inter-personal skill. If a policy of improving communications is to be implemented, supervisors and managers should spend time on developing that ability. Beyond management, there is a need both for formal safety training, and also for training in safe skills. The former is needed to get policies and procedures known, understood, and adopted. Safe skills training can*

reduce the risk of slips and lapses. It also, if the content is well chosen, ensures that safety forms an integral part of the skill rather than being a separate compartment of work. In this, as in all training, it should be recognised that quality is at least as important as quantity. Counting the hours spent on training is not a sufficient indicator."

These recommendations are founded on the experiences a wide variety of industries and are equally relevant to the maritime industry. Remedial tools and implementation strategies used in other industries, particularly those in the area of transport, such as air and rail could be reviewed and, where appropriate, "marinised".

"Marinisation" of established methods and procedures will be of greatest importance in the area of implementation due to the maritime industry's particular culture and structure.

The deliverable from this Work Package produced a specification for a database concerning shipping accidents. It includes scope to include the human factor and allows for statistical analysis. The full specification document is presented in Appendix 9. It must be emphasised that the proposed method can only be successful if maritime accident investigators receive training in human factors and further, to finalise the proposed method for accident analysis and the database, input of human factors specialists is required.

4 Conclusions

- This Concerted Action was initiated under the 4th FP with the two-fold strategic aims of facilitating the development of a common methodology for the investigation of maritime accidents and the reporting of hazardous incidents, as well as to improve the understanding of human factors as related to accidents. Through the dedication and motivation of the nominated experts of the different member states, it is believed that both of these aims have been broadly achieved.

- With a project of this length, complexity and also its ground breaking remit, it is inevitable that deviations to the original work plan, as contained in the Terms of Reference, would be necessary due to advances in technology and also because of changes in philosophy in some member states. Notwithstanding this, on the whole the changes have not been extensive and have been initiated by the members themselves only after full and serious debate.

- A number of important deliverables have resulted from this CA. In particular are the output from Work Packages 2.2, 2.5, 2.8/2.9 2.10 and 2.11. Of particular note is the proposal stemming from Work Package 2.5, the outline for a pilot scheme to initiate a Confidential Hazardous Incident Reporting Programme (CHIRP), which has been presented to the Commission for consideration in the 5th FP. Deliverables from Work Packages 2.1, 2.4, 2.6 and 2.7 have taken the form of ‘State of the Art’ studies. While these deliverables will not in themselves lead to additional studies, they have been a necessary and integral part of the overall scope of work and resulted in all members being aware of the foundations necessary to build a pan-European maritime accident investigation procedure. Indeed, a number of members have expressed the opinion that the ‘State of the Art’ deliverables are valuable documents in their own right and ones that can be used as a source of reference should a member state wish to know the procedure followed in other member states.

- The project has identified that there will still be significant scope for increasing maritime safety by making a study, and learning from, an assessment of the human element and how it impacts on maritime accidents. A specification for a database has been developed which, if implemented will allow a maritime accident investigator to ask a number of questions to those involved to provide an insight into the human element and how it may have played a part in the accident. The specification has been formulated so as to make it suitable for use as an analysis tool.

- Generally speaking, each member state trains their maritime accident investigators differently. While the core training may be broadly similar, the emphasis that some states place on certain aspects of the training differs greatly, for example, investigators in some states undergo a far higher amount of human factors training than in others. The project has identified what can be considered a ‘base’ level and style of training for what may become a pan-European corps of maritime accident investigators.

- It is fair to say that considerably more ‘incidents’ than ‘accidents’ occur and equally fair to say that for each ‘incident’ or ‘near miss’, there are important lessons to be learned. It has long been recognised, and the project has reinforced, that great benefit can be had from the collection of details of the circumstances of ‘near misses’ and perhaps more importantly disseminating examples of ‘near misses’ to persons who would benefit from it. The project has outlined the requirements of the whole system for collation, confidentiality, analysis and dissemination of ‘near misses’.

Appendices

CONTENTS

Appendix 1
WP2.1 - Accident Investigation Practices & Procedures

The deliverable from this Work Package produced a ‘State of the Art’ paper outlining the current methodology (1996) adopted in member states for the accident investigation. Responses have been ordered according to the alphabetical listing of the member states.

WORK PACKAGE 2.1 - CURRENT PRACTICES AND PROCEDURES IN ACCIDENT INVESTIGATION

1. NAME OF NATIONAL INVESTIGATION AUTHORITY?

DENMARK	Opklarings og Kontrolenheden (OKE): The Casualty Investigation and Supervision Board.
FINLAND	Onnettomuustutkintakeskus: Accident Investigation Board (AIB)
FRANCE	Ministère chargé de la Maritime Marchande (Ministère de l'Equipement du Logemont des Transports et du Tourisme)
GERMANY	Seeamt (The Maritime Board of Inquiry) and Bundesoberseeamt (Federal Maritime Board of Appeal)
GREECE	Greek Ministry of the Mercantile Marine
IRELAND	The Department of the Marine.
ITALY	Safety Division of the Navigation and Traffic Department of the Italian Ministry of Transport and Navigation. (An ad hoc 'Investigation Committee' is appointed case by case).
NETHERLANDS	The Casualty Investigation Department (CID) of the Netherlands Shipping Inspectorate (SI), of the Directorate-General for Shipping and Maritime Affairs of the Ministry of Transport, Public Works and Water Management
NORWAY	The Norwegian Maritime Directorate (NMD).
PORTUGAL	Local Maritime Port Authority (Capitania) and the Maritime Police (Policia Mariítima)
SPAIN	Permanent Commission for the Investigation of Maritime Casualties
SWEDEN	(a) National Board of Accident Investigation: for large accidents or those of a 'delicate nature'; (b) 'Maritime Declaration': Special investigation made in a court; (c) Investigation by the Maritime Administration, based on a standing delegation from the Accident Investigation Board or as a follow up to a Maritime Declaration.
UK	The Marine Accident Investigation Branch (MAIB).

2. REGULATORY REGIME?

	2.1 Reports to:	2.2 Independent	2.3 Founded
DENMARK	The Director of the Danish Maritime Authority.	Yes	1990
FINLAND	Government, Ministry of Justice and General Public	Yes, independent within the Ministry of Justice	1996
FRANCE	Regional Director, and Section des Enquêtes après Accidents Maritimes (SEAM)	Regulatory authority	General organisation 1981; SEAM 1996
GERMANY	Federal Ministry of Transport	Yes	1985
GREECE	Public Prosecutor, and possibly, the Directorate of Marine Labour	No	1970
IRELAND	Minister of the Marine	No	Foundation of the State. Currently, 1894 Marine Shipping Act
ITALY	Minister of Transport and Navigation	No	1942
NETHERLANDS	Marine Board of Inquiry (Admiralty Board)	As far as possible within the SI/DGSM	1909
NORWAY	NMD	Maritime Investigators are independent	1906
PORTUGAL	Directorate General of Maritime Affairs of the Portuguese Navy		
SPAIN	Director General of the Merchant Marine	No	1988
SWEDEN	(a) To the Government and General Public; (b) To the General Public; (c) To the Government and the General Public.	Yes	(a) 1978; (b) Historical (c) 1970
UK	Secretary of State for Transport	MAIB is independent within the Department of Transport	1989

3. WHAT ARE THE CURRENT PROCEDURES FOR ACCIDENT INVESTIGATION?

	3.1 What obligations are there on the ship's master, crew or rescue service to report accident and who to?	**3.2 Who decides on level of investigation?**	**3.3 Who are the personnel involved?**
DENMARK	The owner of a Danish ship is required by law to report to the Danish Maritime Authority any accident causing damage to the ship or injuries to persons on board. The master is required to report to the Court to arrange for a shipping enquiry to be held before a judge; in foreign countries, the inquiry will be held before the Danish Consul.	The Head of the Board, or, in exceptional cases, the Director.	The Casualty Investigation Board and Supervision Board consists of five experts who, in their official status, are government representatives.
FINLAND	The Ship's Master is obliged to send immediately a Casualty Reporting Form to the Finnish Maritime Administration. Rescue Service has to inform the Accident Investigation Board.	The Accident Investigation Board	Minor accidents: the permanent staff of the AIB. Major accidents: a dedicated Investigation Commission, containing outside experts as necessary.
FRANCE	Ship's Master and rescue services have to report incident to the nearest inspector.	Regional Director or Sous-direction de la Securité des Navires (SN)	French government representatives.
GERMANY	Ship's masters, pilots, owners, maritime authorities, classification societies, shipyards, navy have to report incidents to the competent Board of Inquiry.	The Chairman of the Board of Inquiry. Normally initial on-the-spot inquiries are carried out by the water police; in cases of very serious casualties, the Chairman and Permanent Assessor will be on the scene to carry out inquiries.	The Chairman and the Permanent Assessor are appointed by the Federal Ministry of Transport and assisted by three assessors, chosen from a list of experts from the shipping industry, naval institutions, polytechnics, and active and former seagoing staff. Experts are chosen depending on the merits of the case. Persons involved have the right to be assisted by a legal advisor.

3. WHAT ARE THE CURRENT PROCEDURES FOR ACCIDENT INVESTIGATION? (continued)

	3.1 What obligations are there on the ship's master, crew or rescue service to report accident and who to?	**3.2 Who decides on level of investigation?**	**3.3 Who are the personnel involved?**
GREECE	Public Marine Legal Code requires that the master, owners, and agent of the vessel should report any incident or fault to the Inspectorate of the Mercantile Marine. Crimes or incidents that may endanger shipping should be reported to the local port authorities. Crew complaints should be directed to port authorities.	The harbourmaster.	The harbourmaster makes an initial investigation and reports to the Directorate of Marine Safety, which enters details in the Marine Accident Logbook. The report is sent to the Board of Marine Accidents, which consists of 5 members: officers from the Navy, the Coast Guard and the Merchant Marine, and one attorney specialising in marine law. Finally, the report is sent to the public prosecutor who brings the case before the common law courts.
IRELAND	Marine accidents must be reported to the Department of the Marine within 3 days.	The marine surveyor, at the discretion of the Minister of the Marine	Preliminary: investigators usually nautical/ship /engineer surveyors from the Marine surveyor's office; expert witnesses are rarely used and there is no legal representation. Formal: the court comprises a higher court judge assisted by nautical/technical assessors; experts are used as needed; there is full legal representation for all parties.
ITALY	Vessel Masters and rescue services to inform nearest Maritime or Customs Authority	Marine Director	Investigation Committee is created case-by-case from experts in the marine field.

3. WHAT ARE THE CURRENT PROCEDURES FOR ACCIDENT INVESTIGATION? (continued)

	3.1 What obligations are there on the ship's master, crew or rescue service to report accident and who to?	**3.2 Who decides on level of investigation?**	**3.3 Who are the personnel involved?**
NETHERLANDS	Masters are obliged to report all events, such as damage to their vessels or accidents involving their crew, to the authorities (SI, police, etc.).	Casualty Investigation Department	• The preliminary investigation is carried out by surveyors from the Shipping Inspectorate (SI). • Expert witnesses are drawn from SI, police, any other government body, sometime research institutes • SI has a legal representative when it is an involved party. • The head of the Casualty Investigation Department acts as the state representative, advising on disciplinary and other actions.
NORWAY	Any incident must be reported to the Maritime Investigator concerned or the Norwegian Maritime Directorate. The report can also be sent directly to the Ship Control, local police, etc.	The Maritime Investigator. For serious accidents the Ministry of Justice can appoint a Commission of Inquiry, in which case a Maritime Inquiry is not required.	A 'normal accident' is investigated by the Maritime Investigator. He has police authority in matters connected with seaworthiness of ships. He performs interrogation and collects information, with help of Board of experts or NMD for professional judgements. A Maritime Inquiry is compulsory in case of: loss of life, serious injury, poisoning, collision, grounding, serious damage to ship, fire/explosion of importance, or considerable shifting of cargo. Normally held in nearest port and involves: a court judge, the Maritime Investigator, some expert witnesses, 1 or 2 police/legal representatives, 1 or 2 NMD/Ship Control, seafarers from the ships (master, other officers, ratings).

3. WHAT ARE THE CURRENT PROCEDURES FOR ACCIDENT INVESTIGATION? (continued)

	3.1 What obligations are there on the ship's master, crew or rescue service to report accident and who to?	**3.2 Who decides on level of investigation?**	**3.3 Who are the personnel involved?**
PORTUGAL		Captain of the Port, i.e. the person in charge of the local maritime port authority, assesses the initial report to decide on the level of investigation.	Qualified personnel from the investigation division take over the enquiries, sometimes with the assistance of outside experts.
SPAIN	The ship must inform the Marine Headquarters of any incident.	Depending on seriousness, the Director General of the Merchant Marine or the Minister.	Merchant Marine functionaries, building and maintenance inspectors, operational inspectors, maritime safety and pollution control inspectors.
SWEDEN	Immediately to the Maritime Administration, which informs the Board of Accident Investigation.	Board of Accident Investigation.	The Board, the Courts, and the Administration have standing staffs which can be complemented by experts.
UK			• Inspector's Inquiry: only for major accidents, carried out by one or more inspectors. Report is submitted to the Chief Inspector, who reports to the Secretary of State for Transport. • Inspector's Investigation and Report: Usually carried out by one inspector. • Administrative Inquiry: for less serious cases, often conducted by correspondence. Much of this work is carried out by MAIB's administrative staff acting on the instructions of inspectors.

3. WHAT ARE THE CURRENT PROCEDURES FOR ACCIDENT INVESTIGATION? (continued)

	3.4 Open/closed investigation?	**3.5 Assistance of special facilities and outside experts?**	**3.6 What is the next stage and what powers do the investigators have?**
DENMARK	Closed, in most cases.	Yes. The Board has established a network of personally appointed persons within maritime organisations and industry. The Board can draw on those persons and other outside experts as necessary.	• The report is an important factor in whether legal action is taken. • Legal proceedings will be taken by the Court and follow normal Court proceedings. • The Board's recommendations will be followed up but it cannot enforce their implementation. • The draft report is circulated among all involved persons but the final report cannot be disputed. • The final report is made public and sent to the IMO in accordance with its procedures.
FINLAND	Closed	Investigators can hire outside experts and use the services of other government agencies.	• Investigation report is intended to help prevent accidents not apportion blame. • Legal actions are initiated by the Public Prosecutor. • For major accidents the report is delivered to the Government, which decides on further actions. For minor accidents the report is delivered to the Ministry of Justice, which informs the competent administration. • After a specified period the administration must report on actions taken. • No right of appeal against the findings of the report, although the report can be criticised. • The report is made public and the IMO is informed.
FRANCE	Closed	Yes	• Legal action only on special request from public prosecutor. • Recommendations are followed up annually for small incidents, and at a special working group for characteristic incidents. • No right of appeal but all parties can make 'observations' on the draft report. • Findings of the report made public and communicated to the IMO

3. WHAT ARE THE CURRENT PROCEDURES FOR ACCIDENT INVESTIGATION? (continued)

	3.4 Open/closed investigation?	**3.5 Assistance of special facilities and outside experts?**	**3.6 What is the next stage and what powers do the investigators have?**
GERMANY	Open (in principle).	Laboratories, simulators, research facilities and their experts will be used, if appropriate.	The purpose of the investigation is to prevent future accidents by establishing causes of casualties and to review and develop, where necessary, regulations, guidelines, and traffic systems. • Certificates of competency or licenses can be suspended or revoked. Findings may be used under civil law or criminal proceedings. • Recommendations are submitted directly to the responsible authority for action. • There is a right of appeal: a full re-hearing may be carried out but the findings of this are conclusive. • Findings of the Maritime Board of Inquiry are made public and communicated to the IMO according to its procedures.
GREECE	Closed		• Legal action can be taken based on the report • The public prosecutor undertakes legal proceedings. • The public prosecutor conducts an investigation and the case is brought to the law courts. If necessary accused seamen also face disciplinary hearings independent of the courts. • There is a right of appeal through Court of Appeal • Serious cases involving loss of ships or loss of life reported to IMO.
IRELAND	Open	Yes	• Legal action cannot be taken based on the report, but certificates of competency may be cancelled or suspended • Criminal legal proceedings would have to be initiated by the Director of Public Prosecutions, civil proceedings by any aggrieved party • Follow up action may be initiated by the Department of the Marine • There is no right of appeal • Findings are made public

3. WHAT ARE THE CURRENT PROCEDURES FOR ACCIDENT INVESTIGATION? (continued)

	3.4 Open/closed investigation?	3.5 Assistance of special facilities and outside experts?	3.6 What is the next stage and what powers do the investigators have?
ITALY	Open, normally	Yes	If results indicate the need to amend existing laws or issue new ones, the relevant bodies are informed and required to take proper action. Results are communicated to IMO according to agreed procedures for inclusion on the IMO database.
NETHERLANDS	Open, in almost all cases.	Assistance may be sought from medical advisors, shipbuilding advisors or, when appropriate, external institutes.	• The only legal action that can be taken is a disciplinary action (withdrawal of license for a specified period). • If other legal actions are required, the Department of Justice has to start or continue the Police Investigation. • The report is usually presented to Ministry of Transport for follow up. The report is then passed to the Director General of the DGSM with the request to comment. This may result in the introduction of a law or by-laws. There is no power to demand a follow up. • There is no right of appeal, although aggrieved party can ask Queen for a reduction in sentence; • All decisions and findings are made public and cases are sent to IMO in accordance with its procedures.
NORWAY	The report from the Maritime Investigator is not normally published. The Maritime Inquiry is open	Maritime Investigators have freedom to seek assistance as needed.	• Report of Maritime Investigator is used for action. • The prosecuting authorities will undertake the legal proceedings. • Recommendations are reviewed with a view to improving regulations. • There is no right of appeal, although an new inquiry may be held, upon the request of the MI, the NMD or the shipowner, if new evidence emerges. • MI's report will end up on DAMA. When requested by IMO, reports are made according to MSC/Circ.433. Some relevant cases are used by Norwegian delegations working in IMO subcommittees.

3. WHAT ARE THE CURRENT PROCEDURES FOR ACCIDENT INVESTIGATION? (continued)

	3.4 Open/closed investigation?	**3.5 Assistance of special facilities and outside experts?**	**3.6 What is the next stage and what powers do the investigators have?**
PORTUGAL	Closed, with few exceptions	Yes	• Legal action can be taken based on the report. • Legal proceedings would be undertaken by the administrative and judicial authorities or by the police force. • Recommendations will be followed up by the competent authorities (in theory). • There is a right of appeal. • The responsible authorities may decide to publish in the media. The findings are communicated to the IMO if it is found that the established regulations were insufficient to avoid the accident.
SPAIN	Closed	No	• The report cannot be used for legal; it is technical and does not apportion blame. • If it is thought there has been negligence the case is handed over to the legal authorities. • There is a right of appeal. • The findings of the report and its recommendations are communicated to the IMO and interested countries in accordance with international agreements.
SWEDEN	Closed in most cases. Open if investigated in court.	Yes.	• The report may be used in legal action. • Legal proceedings would be undertaken by the competent authority, normally the Maritime Administration. • The report may be used as a basis for regulations. • There is no formal right of appeal against the report, although it may be criticised, which can lead to further investigation (very rare). Appeals can be made against decisions based on the report according to normal legal principles.

3. WHAT ARE THE CURRENT PROCEDURES FOR ACCIDENT INVESTIGATION? (continued)

	3.4 Open/closed investigation?	**3.5 Assistance of special facilities and outside experts?**	**3.6 What is the next stage and what powers do the investigators have?**
UK	Closed	Yes.	The report may be used in legal action but they are not automatically available and can only be ordered by a judge. • Recommendations usually made to the MSA, which is required to respond. An MAIB/MSA liaison group discusses implementation of recommendations. Others who receive recommendations are requested to indicate by a given time whether they accept them. • Copies of draft reports are circulated to involved parties, who may submit alternative text, which must then be included in the report. • The most serious accident investigations are published; other noteworthy investigations are contained in the MAIB's Summary of Investigations, produced three times a year. Details of serious accidents are sent to IMO.

4. WHAT AREAS OF EXISTING INFORMATION ARE HELD NATIONALLY?

	4.1 Registers of vessels	4.2 Database of reported incidents	4.3 Database of investigated incidents and results of inquiry	4.4 Traffic density data	4.5 What use is made of these data currently?
DENMARK	Yes	Yes	Yes	Yes (for some areas)	Preventive measures, statistics, education, information
FINLAND	National register held by FMA	DAMA	More informative database under consideration	Yes, collected by the Unit of Statistics at the FMA	Various purposes on a case-by-case basis
FRANCE	No	Yes	Yes	No	Publication for members of safety commissions
GERMANY	Yes	Under development	Under development	Yes	Reports and statistics used in enhancing the safety of shipping
GREECE	Each Greek port has its own register of vessels	The Marine Accident Log Book of the Ministry of Mercantile Marine	Not computerised	Ports have information on arrivals/departures but no origin/destination tables	Statistical Bulletins published by National Statistical Service
IRELAND	For merchant and fishing vessels only		Hard-copy records only	Incomplete data for selected areas only.	
ITALY	Yes	No	Yes	Data collected by Port Authorities	Reference is made to the IMO casualty database
NETHERLANDS	Yes		Yes, ONOVIS database combines information from various sources.	Yes. Currently developing system for centralisation and aggregation of data.	Reference (jurisprudence) in preparing new cases; generic accident analyses assessing new measures.

4. WHAT AREAS OF EXISTING INFORMATION ARE HELD NATIONALLY? (continued)

	4.1 Registers of vessels	**4.2 Database of reported incidents**	**4.3 Database of investigated incidents and results of inquiry**	**4.4 Traffic density data**	**4.5 What use is made of these data currently?**
NORWAY	(a) NOR - Norwegian Ordinary Ship Register; (b) NIS - Norwegian International Ship Register Also DNV register	DAMA database	DAMA database	Port authorities keep records of traffic density; no national database.	Various purposes, including annual statistics published by NMD
PORTUGAL	Merchant ships: Directorate General for Navigation and Maritime Transport; fishing vessels: Directorate General for Fishing; pleasure craft Directorate General for Ships. Each vessel must be registered with its local maritime port authority and the Directorate General for Maritime Affairs.		Database at the Directorate General for Maritime Affairs, the Institute of Rescue Services and Shipwrecks, and the Directorate General for Fishing	Data kept at the Directorate General for Maritime Affairs.	
SPAIN	Yes	Yes	Yes	Yes	Reports and statistics are published.
SWEDEN	Yes	Yes, to a certain extent	Yes	Yes, to a certain extent	Of limited use.
UK	Merchant ships: Lloyd's Register of Ships CD-ROM; Fishing vessels: Department of Transport's Register of Ships and Seamen		Yes	Various surveys by Government and private-sector bodies but generally not used by MAIB.	The production of statistics, general reference and in answering Parliamentary questions and ministerial correspondence.

5. WHAT AREAS OF RESEARCH ARE BEING UNDERTAKEN/CONSIDERED?

	5.1 Human Element Research (both in the cause of accidents and the investigation of them)	**5.2 Analysis of existing information to provide correlations of traffic density and incidents**	**5.3 Formal Safety Assessments**	**5.4 Improvement of Current Procedures**	**5.5 Assessing Accident Investigation Procedures and Data Reporting Formats from Other Industrial Fields**
DENMARK	Yes: data collection procedures and PC-database will be evaluated	Yes to some degree	Yes	Yes	No
FINLAND	(a) human errors on the bridge and maritime accidents; (b) safety of Finnish maritime transport; (c) safe procedures for pilotage.	Yes, see (b) of 5.1	Yes, see (b) of 5.1	Yes through international co-operation and courses for selected experts.	Yes: AIB also investigates air, rail and industrial accidents.
FRANCE	N/A	N/A	N/A	N/A	N/A
GERMANY	Yes, in-depth research into the causes of human failure	Yes, use of knowledge-based solutions for early detection of risks in navigational watchkeeping	Under consideration	Continuously considered	Under consideration
GREECE	Within the framework of the MASIS project	Yes	No	Ministry of Mercantile Marine is responsible	No
IRELAND	No	No	No	Procedures currently under discussion.	As for 5.4

5. WHAT AREAS OF RESEARCH ARE BEING UNDERTAKEN/CONSIDERED? (continued)

	5.1 Human Element Research (both as cause of accidents and in investigations of them)	**5.2 Analysis of existing information to provide correlations of traffic density and incidents**	**5.3 Formal Safety Assessments**	**5.4 Improvement of Current Procedures**	**5.5 Assessing Accident Investigation Procedures and Data Reporting Formats from Other Industrial Fields**
ITALY	Yes: participated in MASIS and is participating in THAMES and will participate in MASIS II and ATMOS II	No specific research in this area. however it may be touched upon in other research projects	RINA chairs Working Party on Human Element of the International Association of Classification Societies (IACS)		
NETHERLANDS	Yes (as cause only)	Correlations of accident and traffic studied extensively	Undertaken for small craft and being considered for open-top container ships	Not investigation procedures	Not directly, at present
NORWAY	Yes (as cause only)	Yes, e.g. Estonia, Green Ships project		SAFIR PC-based system for reporting of accidents and incidents; Green Ships project; NAUTICUS system for ship classification	
PORTUGAL		Yes			
SPAIN	Yes	Yes	Yes	Yes: Improved accident report formats, including definitions of essential parameters	Yes: N. American NASA /FAA aviation safety reporting system (ASRS); European CAA/RAF, CHIRP and MOR

5. WHAT AREAS OF RESEARCH ARE BEING UNDERTAKEN/CONSIDERED? (continued)

	5.1 Human Element Research (both as cause of accidents and in investigations of them)	**5.2 Analysis of existing information to provide correlations of traffic density and incidents**	**5.3 Formal Safety Assessments**	**5.4 Improvement of Current Procedures**	**5.5 Assessing Accident Investigation Procedures and Data Reporting Formats from Other Industrial Fields**
SWEDEN	Yes	Not currently, but made earlier in COST 301	Yes	Yes	Yes
UK	No	No, but MAIB data have been used by others for this purpose	Provided data to UK Marine Safety Agency for research into Formal Safety Assessments	Not formally: procedures are continually reviewed and, if necessary, revised.	Not formally, but MAIB staff keep up to date with techniques in other fields

6. WHAT IS THE TYPICAL BACKGROUND OF THE INVESTIGATORS APPOINTED TO CARRY OUT THE INQUIRY?

	6.1 Are they normally ex-seafarers	6.2 Professional/academic qualifications	6.3 Training given to the investigators
DENMARK	Yes	Nautical education (shipmaster), marine engineer or naval architect	Ship surveyor training and special courses, e.g. tanker safety, and on-the-job training
FINLAND	Relevant professionals including ex-seafarers	Ship masters, marine engineering specialists, naval architects, psychologists	Expert witness, to perform interviews, report writing, legal aspects of accident investigation.
FRANCE	Yes (60%)	MOU inspector's qualification	No special training
GERMANY	Relevant professional experts including ex-seafarers	Ship masters, naval architects and experienced professionals of different skills	Report writing, interviewing and legal administrative procedures
GREECE	Harbourmasters conducting the preliminary inquiry are qualified Coast Guard officers. Board of Marine Accidents consists of experienced legal experts (supreme court judge, marine lawyers and master mariners)	University or equivalent	Interviewing techniques, report writing, law relating to accident investigation, specialist surveyors of the Inspectorate of Mercantile Marine, tanker and shipboard safety
IRELAND	Yes	Marine surveyor (nautical): Class 1 Master Mariner certificate with 2 years' command of a vessel trading worldwide. Marine surveyor (engineering): Class 1 engineering certificate, 2 years' experience as Chief Engineer Marine surveyor (ship): degree in naval architecture, at least 5 years' training in ship design and construction	Basic induction and on-the-job training in: interview technique, report writing, accident investigation related law; full induction and on-the-job ship surveyor training
ITALY	Relevant professionals	Professional engineer, naval architect or ship master qualifications	Report writing, understanding legislation

6. WHAT IS THE TYPICAL BACKGROUND OF THE INVESTIGATORS APPOINTED TO CARRY OUT THE INQUIRY? (continued)

	6.1 Are they normally ex-seafarers	6.2 Professional/academic qualifications	6.3 Training given to the investigators
NETHERLANDS	Yes	All inspectors hold a certificate to sail as either captain or chief engineer, or a BSc certificate in shipbuilding engineering and experience.	Courses and hands-on experience of the following: expert witness, interviewing, report writing, accident investigation related law, ship surveyor training, tanker and ship board safety
NORWAY	Normally ex-seafarers (Master, Chief Officer), some have complementary education in maritime law.	Through long service on board merchant ships the Maritime Investigator will have practical experience and skill in shipping matters and be at least 30 years old.	Report writing, understanding legislation, etc., and some experience in ship surveys.
PORTUGAL	Usually recruited from the Navy	Must have completed 9th grade of high school (owing to competition, 11th or 12th grade is usually necessary) and a complementary course in the scope of their respective speciality in the Navy.	On-the-job training in interview techniques, legal matters, inspection of damaged vessels, administrative matters.
SPAIN	Ex-seafarers and naval engineers	Master's Certificate, Chief Naval Engineer, Naval Engineer	Report writing, legal administrative procedure safety inspection (MOU, pollution, construction, etc.), Safety on Board courses.
SWEDEN	Relevant professionals, including ex-seafarers	Navigation, Technical, e.g. engines, naval architecture, psychology and others.	On-the-job training

6. WHAT IS THE TYPICAL BACKGROUND OF THE INVESTIGATORS APPOINTED TO CARRY OUT THE INQUIRY? (continued)

	6.1 Are they normally ex-seafarers	6.2 Professional/academic qualifications	6.3 Training given to the investigators
UK	Three types of investigator: Nautical, who will have served at sea, Engineer, who will have served at sea, Naval Architect, who, most likely, will not have served at sea	Nautical: Extra Master's Certificate of Competency, or Class 1 Deck Officer Certificate of competency *and* an appropriate degree; Engineer: Extra First-Class Engineer's Certificate of Competency, or Class 1 Engineer Officer Certificate of Competency and an appropriate degree; or Chartered Engineer Status with suitable experience; Naval Architect: Degree in Naval Architecture with appropriate experience; or Chartered Engineer Status with suitable experience.	Expert witness, interviewing techniques, report writing, the law on accident investigation, tanker safety, shipboard safety, surveyor's confirmatory training, fire fighting, transportation of dangerous goods by sea, GMDSS, fishing vessel operations, submarine operations, liferaft courses Investigation modules: foundering with loss of life, collision with loss of life, fire with loss of life, grounding, capsize, explosion, dangerous occurrence, accident of person.

Appendix 2
WP2.2 – Training Best Practice for Accident Investigators

The deliverable from this Work Package produced a proposal to the Commission for a pilot scheme to train Maritime Accident Investigators via an Open Flexible Learning (OFL) approach. The outcome of the Work Package gives the outline for how such a pilot scheme may work.

Public

Maritime Accident Investigator Training Best Practice

Open Flexible Learning (OFL) Pilot Scheme

A Proposal by the Concerted Action Committee on Casualty Analysis (FP4 Waterborne Transport Tasks 21 and 36)

Introduction

The Concerted Action Committee (CAC) on Casualty Analysis discussed the concept of establishing an Open Flexible Learning (OFL) package as a means of improving the training and competence of trainee maritime accident investigators.

Subsequently, it was decided that a proposal should be made to DG VII of the Commission for a pilot scheme to demonstrate its feasibility either as part of the 5th Framework Programme or separately.

Background

A principal aim of setting up the Concerted Action was to ensure that accurate information is gathered on accident causes. This should permit corrective countermeasures to be identified and evaluated, leading to improved European maritime safety. A key element of this process is the implementation of a common accident investigating methodology.

This can only be achieved by the development and adoption of common training and competencies throughout the member states. The objective is data collection and analysis on the same basis across the EU, which means personnel trained to provide a guaranteed level of quality data in the correct detail.

Commonality of training and competencies will offer enhanced mobility of personnel throughout the member states. This will open the prospect to a European *Accident Investigation Corps.*

The Aim

The objective of the study should be to offer high-level training to a widely dispersed target group of trainee investigators by means of a course or programme delivered in Open Flexible Learning (OFL) format. Developments in information technology have significantly expanded the means available for the delivery of education to distance learners, allowing great flexibility in terms of content, access and support through the provision of a mixed-mode learning environment.

The Investigator's Task
Marine accident investigators are usually experienced mariners. While this experience gives vital understanding needed in accident investigation it does not necessarily provide all the desirable skills. The task demands the examination of relevant information, its interpretation and the unambiguous presentation of conclusions.

There is the added factor that the investigation will almost certainly feature in civil/criminal legal proceedings in which the findings may be challenged.

To this end, the general view of the Concerted Action was that investigators should have most or all of the following competencies:

- Interviewing/interrogation technique;
- Compile and write the report;
- Law related to accident investigation;
- Role of the expert witness;
- Ship surveyor/inspector training;
- General and specific shipboard safety;
- Impact of the human factor.

IMO Model Course 3.11 - Marine Accident and Incident Investigation
The relevant IMO model course was considered. While the general content and material of the course seems appropriate, the “Human Factor” content (3 hours) appears inadequate. Accordingly, the course was considered unsuitable in its present format and structure, aside altogether from the problem of convening sufficient students to make a viable course.

Investigator Training - A Telematic Structure
CA members agreed on the following package of measures and observations:

- Telematically based distance learning (such as Internet, CD-ROM);
- IMO Code for the Investigation of Marine Casualties and Incidents;
- Investigation of Human Factors in Marine Casualties;
- Preparation of a Casualty Manual;
- Foster and develop a **Mentoring** system.

The factors favouring a telematically based program are persuasive. They are:

- Most investigators come through the ranks of Administration surveyor/inspector and acquire their expertise and investigating skills on-the-job;
- Because of the very low numbers of personnel recruited, no member State can offer a specific and structured primary training course for marine investigators;

- Small numbers, dispersed across Europe, make distance learning the only feasible methodology for delivering such training;
- Distance learning state-of-the-art is telematically based (Internet, CD-ROM, etc.) which offers access to high level education under the televersity concept;
- A recently completed project (ETP) under the SOCRATES Programme has validated this technology - further research in this area could now usefully focus on TRAINING CONTENT and LEARNING MODE.

Training content must be centred around and supported by the following considerations:

- The IMO Code for the Investigation of Marine Casualties and Incidents should foster a standard approach to casualty investigation with the sole purpose of correctly identifying the causes and underlying causes of casualties/incidents.
- The joint ILO/IMO Guidelines for the Investigation of Human Factors in Marine Casualties and Incidents offer practical advice for the systematic investigation of human factors in such events - and almost all marine casualties and incidents involve human factors. Therefore, structured courses should include specific training in the identification of these factors in marine casualties and incidents. The Guidelines were developed by the Joint ILO/IMO Working Group.
- The preparation of a suitable Casualty Manual should aid common training and the implementation of standardised procedures.
- Mentoring implies that one or two of the larger investigating agencies, or acceptable NGO's, offer mentoring/tutoring support to ‘undergraduate investigators’ in order to share expertise and to further ensure the commonality of training.

Pilot Scheme

The proposal to the EU advocates the implementation of an Open Flexible Learning (OFL) pilot scheme, comprising three active partners in association with three participating marine investigation agencies as test recipients of the trial programme. The total project is likely to need the following phasing and subdivision of work:

Work Package 1:	Feasibility: To identify the learning modes most suitable to specific aspects of investigator training.
Work Package 2:	Research and develop the material and content of the programme.
Work Package 3:	Create the multi-media package by which the programme must be delivered.
Work Package 4:	Test the learning modes and course material on the trial recipients.
Work Package 5:	Evaluate the trial and report the outcome.

Work Packages 1, 2 and 3 would almost certainly involve considerable overlap. Pedagogic design and development is dependent on the mix and choice of learning mode, and development costs within each mode vary substantially.

The concept of mixed-mode learning makes use of such facilities and resources as:

- **Computer networks (intranet/internet):** Offering world-wide 24 hour access, secure learning environment, direct student-tutor communication, asynchronous group discussion facilities, audio/video conferencing, automatic testing, learner tracking and recording, easy administration, etc.
- **Interactive multimedia (CD ROM):** Offering user control of information access, dynamic audio/video materials, etc.
- **Audio and video:** Offering easily accessible information, high presentation quality, etc.
- **Printed text:** Offering detailed information in a traditional format.

Each of these modes offers its own benefits and between them they allow the provision of an interactive learning environment which offers a 'just-in-time' solution to learners. But design and development costs for printed text format are only a fraction of the comparable costs for CD-ROM. Therefore, it would seem logical and cost effective to fund initial research around Work Package 1, while accepting the inevitability of some overlap into Work Package 2. Such a measure should help to establish realistic parameters and costs for the complete scheme.

The initial feasibility phase could be completed in 2/3 months, by a three-partner group having expertise in:

- Delivery of courses in Open Flexible Learning (OFL) format;
- Independent marine casualty investigation;
- Influence of Human Factors in marine casualty/investigation.

Appendix 3
WP2.4 – Best Practice in Accident Investigation Methodology

The deliverable from this Work Package produced a ‘State of the Art’ paper outlining the CAC members’ views on what would be the ‘best practice’ in carrying out and investigation into a maritime accident. Responses have been ordered according to the alphabetical listing of the member states.

WORK PACKAGE 2.4 - BEST PRACTICE IN METHODOLOGIES FOR ACCIDENT INVESTIGATION

A. PRE-INVESTIGATION PROCEDURE
INVESTIGATOR'S PROFILE

A-1 WHAT IS THE STATE OF THE ART WITH REGARD TO THE FOLLOWING QUESTIONS?

	1. What is the investigators background and expertise?	2. Do regular investigators have full time appointment?
DENMARK	Nautical education (Shipmasters), marine engineer or naval architect. Ship surveyor training and special courses, e.g. tanker safety, ARPA, Occupational Health and Maritime Medicine and "on the job"-training. Experience as Government Ship Surveyor.	YES, investigators have a full time appointment.
FINLAND	Relevant professionals including ex-seafarers, ship masters, marine engineering specialists, naval architects, psychologists.	The permanent staff of the Accident Investigation Board (AIB) has full time appointment in minor and major accidents. Also, in major accidents a dedicated Investigation Commission, containing outside experts is involved.
GERMANY	Investigators are fully educated mariners holding the equivalent of a foreign-going master's certificate ("AG" Certificate of Competency), having appropriate professional experience as masters and specific knowledge in matters of shipping law and administrative procedures. They must have undergone continual training in such subjects as the carriage of dangerous goods, fire-fighting, shipping safety, stability, etc. The chairman of each Maritime Board of Inquiry is a fully educated jurist with an in depth knowledge of shipping law. Some of the chairmen have double qualifications (being both jurists and master mariners). The three non-remunerated assessors sitting on each Maritime Board of Inquiry hearing are experts in different fields with both theoretical knowledge and extensive professional experience; their assignment to a particular hearing depends on the specific requirements of the case.	YES, investigators have a full-time appointment and have no other duties to discharge.
GREECE	Officers of the Hellenic Coast Guard	YES, they are employees in the Hellenic Coast Guard. But not

		employed on a full-time basis in Accident Investigation.

A-1 WHAT IS THE STATE OF THE ART WITH REGARD TO THE FOLLOWING QUESTIONS? (continued)

	1. What is the investigators background and expertise?	**2. Do regular investigators have full time appointment?**
IRELAND	Primarily they are marine surveyors (within the Nautical, Engineering and Naval Architect disciplines) and are given induction and pre-appointment training in that capacity. Training is focused on casualty investigation and supplemented thereafter by on-the-job training. Surveyors/investigators hold the top professional qualifications for their respective disciplines, and collectively include job experience such as: Shipmaster FG, chief engineer, classification society surveyor, marine and technical superintendent, offshore installation manager, safety inspector, shipyard naval architect. These surveyors comprise the technical staff of the Marine Survey Office (MSO) which is responsible for the regulatory functions of Ireland's maritime administration.	No full-time regular investigators. Casualty investigation is conducted by one or more regular MSO surveyors, appointed to the specific task – once the investigation is concluded they would normally revert to their substantive role, that of surveyor
ITALY	Ex seafarers. Naval architects. Persons with maritime education.	NO full time appointment as regular investigators.
NETHERLANDS	Ex-seafarers. People with maritime education	Part time appointment
NORWAY	Ex-seafarers on the nautical side (master, chief officer). Some have complementary education of maritime law. A new employed Maritime Investigator has normally been serving for the Ship Control and have done some ship surveys (the turnover is not so great of a total of seven investigators). The qualifications requirements include: long service in a responsible position on board merchant ships where they shall have acquired experience and practical skills in maritime and shipping matters. Shall be at least 30 years of age.	Yes, but some side activities are also included in the work description. The Maritime Investigator also handles matters related to violations of e.g. traffic separation zones, load-line, careless navigation, ship’s safety certificates etc.
PORTUGAL		

A-1 WHAT IS THE STATE OF THE ART WITH REGARD TO THE FOLLOWING QUESTIONS? (continued)

	1. What is the investigators background and expertise?	**2. Do regular investigators have full time appointment?**
SPAIN	Highly qualified professionals seafarers, Ship Masters, Chief Engineers, Radio-Electronic Officers and naval Architects, many of them with several years of experience on command as Masters and Chief Engineers on vessels of all types. They carry out investigation of any maritime accident under the instructions of DGMM.	Regular investigators are full time employed by the Maritime Directorate and they carry out safety inspections on vessels.
SWEDEN	Master mariners and in addition different courses. The investigators (2) should have sound knowledge of most types of vessels.	Full time
UK	In general, investigators have all had professional experience as Master Mariners. Marine Engineers or Naval Architects. An Extra Master Mariner's Certificate. Extra First Class Engineer's Certificate or a first degree in a related discipline, or a degree in Naval Architecture and normal requirements. However one Investigator is an experienced fishing vessel skipper and master of offshore oil industry vessels.	Full time

A-1 WHAT IS THE STATE OF THE ART WITH REGARD TO THE FOLLOWING QUESTIONS? (continued)

	3. Do novice investigators receive formal training?	**4. Do investigators receive formal training in human factors?**	**5. Do investigators receive formal training in conducting interviews?**
DENMARK	Novice investigators receive training – not formal - on the job from experienced investigators.	NO, formal training in human factors.	NO, formal training in how to conduct an interview.
FINLAND	Novice investigators receive training – not formal - on the job from experienced investigators. Additional courses given on human factors, performing as expert witness, to perform interviews, report writing, legal aspects of accident investigation.	NO, formal training; investigators are given additional courses on human factors.	NO, formal training, only additional courses on how to perform interviews.
GERMANY	Applicants, who possess appropriate knowledge both from their time of service in the merchant marine and from their time of employment in the administration, are selected with great care and, once appointed, are adequately trained and instructed for their new job. In view of the prerequisites each applicant has to fulfil, formalised training can be done without.	There is no formal training of investigators by psychologists or other ,"human factor specialists". When necessary, experts from these fields of knowledge will be called upon to participate.	First-instance investigators (including the Waterguard, Federal Border Guard, and Federal Customs) have been specifically trained for interviewing witnesses and other persons involved in a case. The Board chairmen possess the qualification for the office of justice under German law and, therefore, have adequate experience in the questioning of the parties involved in a case, including witnesses. On account of their experience and special knowledge, the permanent assessors are in a position to conduct interviews going even deeper. It is especially with regard to questioning "techniques" that the assessors can make particularly good use of their own experience and of their knowledge of the parties and witnesses to be heard.
GREECE	NO formal training is offered. Investigations are conducted in accordance with Law 712/1970.	NO	NO formal training. Interviews are conducted by filling in a set questionnaire as defined per Law 712/1970.

A-1 WHAT IS THE STATE OF THE ART WITH REGARD TO THE FOLLOWING QUESTIONS? (continued)

	3. Do novice investigators receive formal training?	**4. Do investigators receive formal training in human factors?**	**5. Do investigators receive formal training in conducting interviews?**
IRELAND	Yes, by observing and assisting during actual investigations. The training is not formalised in the sense that there is no structured course of training in casualty investigation.	NO.	YES, as an element of confirmatory surveyor training – but not within the scope of a structured course.
ITALY	Only experts are used as investigators.	NOT at present.	NOT at present.
NETHERLANDS	A little training on the job, not formalized.	NO	NO
NORWAY	YES, but not formalized	No, but they are aware of IMO checklist on the matter.	No, but read a lot of police reports regarding e.g. pleasure yachts violations, which have given a good insight in how an interview / interrogation can be performed. The Maritime Investigator interviewed found sketches of the accident scenario, drawn by those involved, very useful.
PORTUGAL			
SPAIN	Investigation is carried out by experienced investigators assisted by novice investigators in order to get experience. Most of investigators are working on ship safety inspections, Hull, engine, operational and Port State Control Officers.	NO, but they are assisted by professionals.	NO
SWEDEN	YES (not formalized)	NO (not formal training)	NO (not formal training)
UK	On the job training is carried out but with a formalized structure of key tasks and types of investigation that should be completed. Various core courses have been identified and an investigator is	MAIB investigators have had formal training in human factors by a human factor specialist.	YES, on the job training.

	obliged to undertake them as soon as possible after he/she has joined.		

A-1 WHAT IS THE STATE OF THE ART WITH REGARD TO THE FOLLOWING QUESTIONS? (continued)

	6. Do investigators receive formal training in gathering physical evidence?	**7. Are investigations normally carried out in a team or by one investigator?**	**8. What is the composition of an investigation team?**	**9. Is legal expertise required in the investigation team?**
DENMARK	Investigators receive formal training as a Ship Surveyor, which include training in gathering physical evidence, not formalised as an Investigator.	Investigations are normally carried out by one Investigator, occasionally in a team.	When carried out in a team, this is normally composed of investigators with different technical knowledge and could be supplemented by outside technical experts.	Normally legal expertise is not required in the investigation team. However, the Investigator has the possibility to seek legal advice from an in house Legal Division if so required.
FINLAND	NO, only on the job training.	Investigations are carried out in different teams depending on the accident. Minor accidents: the permanent staff of the AIB, one or (nowadays preferably) two investigators. Major accidents: a dedicated Investigation Commission of at least three persons, containing and using outside experts as necessary.	The composition of the investigation team depends on the accident in question. The team can include experts in various fields.	The investigators need legal knowledge in performing the investigation. Legal expert is not required to be part of the team.

A-1 WHAT IS THE STATE OF THE ART WITH REGARD TO THE FOLLOWING QUESTIONS? (continued)

	6. Do investigators receive formal training in gathering physical evidence?	**7. Are investigations normally carried out in a team or by one investigator?**	**8. What is the composition of an investigation team?**	**9. Is legal expertise required in the investigation team?**
GERMANY	There is NO specific training provided in this field, as specialists from various fields will be called upon to take part in investigations, as appropriate.	Investigations are normally carried out in a team.	Maritime Boards of Inquiry will call upon specialists to take part in investigations. As the case may be, such specialists may come from a classification society, a university or maritime college, a shipyard, an administrative body, from the medical profession, or they may be experts or scientific personnel as may otherwise be required for the identification of the causes of an accident / casualty.	YES, it is in particular the chairman, who must have passed the Great State Legal Test, whereby he has acquired the qualification for the office of justice as well as that for the higher echelon of administrative service and for being called to the Bar. Permanent assessors, too, will have comprehensive legal knowledge, which is due, among other things, to their training to become master mariners, in the course of which they have acquired an in-depth knowledge of national and international maritime law. More than that, they will have acquired a general knowledge of public law in the course of their employment in the German administration.
GREECE	Some members of the investigation team receive training in obtaining physical evidence.	A team of 2-4 persons conducts the investigation.	The team consists of a First and a Second Investigator and 2-4 other experts as necessary (e.g. naval architects, marine officers etc.).	Elementary knowledge of legal issues is required. However, there is no persons trained exclusively in law, participate in the team on a regular basis.

A-1 WHAT IS THE STATE OF THE ART WITH REGARD TO THE FOLLOWING QUESTIONS? (continued)

	6. Do investigators receive formal training in gathering physical evidence?	**7. Are investigations normally carried out in a team or by one investigator?**	**8. What is the composition of an investigation team?**	**9. Is legal expertise required in the investigation team?**
IRELAND	YES, as an element of confirmatory surveyor training	It depends on the complexity and or gravity of the case. Normally, by one investigator	If required, external legal and technical expertise will be available to assist the investigator.	Normally, NOT But if, in the course of inquiries, the investigator needs legal assistance he has channelled access to the law offices of the State.
ITALY	There is NO specific training provided in this field, as specialists from various fields will be called upon to take part in investigations, as appropriate.	One investigator in most cases: an investigation committee is set up in some cases for very serious casualties.	Experts in the maritime field.	NO explicit legal expertise, even though investigators have a knowledge in the field.
NETHERLANDS	NO	Mostly one investigator, sometimes more but not in a team.	Not applicable	YES (maritime acts)
NORWAY	NO, but physical evidence are collected when necessary	Individually by one investigator. For very serious accidents a Commission of Inquiry can be appointed.	N/A, according to above but the MI is using expertise from the Norwegian Maritime Directorate, DNV or others in special matters.	The Maritime Investigator is a legal expert himself in the subject matter. He has a double role of both finding the cause(s) and giving recommendations to the police.
PORTUGAL				
SPAIN	NO	Investigations are carried out by a team of experts assisted by specialists as legal experts, scientists etc.	The team is composed by expert seafarers and Naval Architects assisted by legal experts	Legal expertise is not required but the Merchant Directorate Civil Servants have passed examination on legal issues.

A-1 WHAT IS THE STATE OF THE ART WITH REGARD TO THE FOLLOWING QUESTIONS? (continued)

	6. Do investigators receive formal training in gathering physical evidence?	**7. Are investigations normally carried out in a team or by one investigator?**	**8. What is the composition of an investigation team?**	**9. Is legal expertise required in the investigation team?**
SWEDEN	NO	Depends on type of accident. Some investigations are carried out in a team and some by one investigator.	Specialists are normally not a member of the team, but can always be consulted if necessary.	Legal experts are normally not a member of the team, but can always be consulted if necessary.
UK	YES, on the job training	Major accidents are investigated by a team, others by an individual investigator.	Depends on the type of accidents. Normally, the team includes investigators only, but sometimes outside expertise is sought (e.g. metallurgists, fire experts, forensic specialists, ROV operators, oceanographical specialists etc.)	YES. All investigators must have a certain amount of maritime legal knowledge.

A-2 WHAT IS DESIRABLE IN THE *FUTURE* WITH REGARD TO THE FOLLOWING QUESTIONS?

	1. What should be the investigators background?	**2. Should regular investigators have full time appointment?**	**3. Should novice investigators receive formal training?**	**4. Should investigators receive formal training in human factors?**	**5. Should investigators receive formal training in conducting interviews?**
DENMARK	Nautical education (Shipmasters), marine engineer or naval architect. Ship surveyor training and special courses, e.g. tanker safety, ARPA, Occupational Health and Maritime Medicine and ”on the job”- training. Experience as Government Ship Surveyor.	YES	Novice investigators receive training – not formal - on the job from experienced investigators	YES, some formal training in human factors is desired.	YES, some formal training in how to conduct an interview is desired.
FINLAND	Relevant professionals including ex-seafarers, ship masters, marine engineering specialists, naval architects, psychologists.	YES, full time appointment for two to three investigators, more training for the outside experts about investigation procedures.	YES, training could be more formalised.	YES, training could be more formalised.	YES, training could be more formalised.

A-2 WHAT IS DESIRABLE IN THE *FUTURE* WITH REGARD TO THE FOLLOWING QUESTIONS? (continued)

	1. What should be the investigators background?	**2. Should regular investigators have full time appointment?**	**3. Should novice investigators receive formal training?**	**4. Should investigators receive formal training in human factors?**	**5. Should investigators receive formal training in conducting interviews?**
GERMANY	Fully educated mariners holding the equivalent of a foreign-going master‘s certificate (“AG” Certificate of Competency), having appropriate professional experience as masters and specific knowledge in matters of shipping law and administrative procedures. They must have undergone continual training in such subjects as the carriage of dangerous goods, fire-fighting, shipping safety, stability, etc.	YES	On-the-job training should continue to be governed by the applicant‘s qualifications, and formalisation is therefore not required.	Specialised training in the form of seminars would be welcomed.	Measures of further education would be welcomed in this field as well.
GREECE	Persons with experience of maritime operations and a requisite educational background	YES	YES	YES	NOT essential

A-2 WHAT IS DESIRABLE IN THE *FUTURE* WITH REGARD TO THE FOLLOWING QUESTIONS? (continued)

	1. What should be the investigators background?	**2. Should regular investigators have full time appointment?**	**3. Should novice investigators receive formal training?**	**4. Should investigators receive formal training in human factors?**	**5. Should investigators receive formal training in conducting interviews?**
IRELAND	No significant change to current practice.	The ideal arrangement would allow a completely separate and independent investigation authority, but this is not considered to be a feasible option for a small Administration	A structured and qualifying course of training for accident investigators is highly desirable.	A structured and qualifying course of training in human factors is highly desirable.	A structured and qualifying course of training in how best conducting interviews is highly desirable.
ITALY	Naval architects: master mariner: chief engineer. Ship surveyor training or navigation experience.	A full time independent investigation authority should be established.	A structured training before job training within the investigation branch.	YES, desirable within the local investigation branch or parent organisations.	YES, desirable within the local investigation branch or parent organisations.
NETHERLANDS	A special training for investigators should be introduced	It is desirable	Should be formalised	YES, desirable	YES, desirable
NORWAY					
PORTUGAL					
SPAIN	The investigators should be independent from Administration, Owners, Shippers, Cargo Receivers, Insurance	YES	YES	YES, on human factor and psychology.	YES

A-2 WHAT IS DESIRABLE IN THE *FUTURE* WITH REGARD TO THE FOLLOWING QUESTIONS? (continued)

	1. What should be the investigators background?	**2. Should regular investigators have full time appointment?**	**3. Should novice investigators receive formal training?**	**4. Should investigators receive formal training in human factors?**	**5. Should investigators receive formal training in conducting interviews?**
SWEDEN	Master mariners with knowledge of different type of vessels	Full time	Not necessary, as long as they receive training from experienced investigators	Not necessary, as long as specialists are available and could be consulted. Different existing courses cover the need for basic knowledge regarding human factors.	Investigators should have knowledge about how to conduct an interview.
UK	As now (i.e., basically Master Mariners), but more investigators and, in addition, one or two human factor experts.	Full time appointment	Training should be more formalised and be more wide reaching, incorporating exchange training with other nation investigation authorities.	Extension of this training should be made. A human factor specialist will be responsible for conducting the training possible supplemented by other experts.	YES, to date several investigators have attended courses on interviewing and it is intended that this will extended so that all investigators attend interview technique training.

A-2 WHAT IS DESIRABLE IN THE *FUTURE* WITH REGARD TO THE FOLLOWING QUESTIONS? (continued)

	6. Should investigators receive formal training in gathering physical evidence?	**7. Should investigations normally be carried out in a team or by one investigator?**	**8. What should be the composition of an investigation team?**	**9. Should legal expertise be required in the investigation team?**
DENMARK	Investigators should receive formal training as Ship Surveyors, which include training in gathering physical evidence.	Investigations should be carried out by one Investigator, occasionally in a team.	When carried out in a team, this should be composed of investigators with different technical knowledge and also supplemented by outside technical experts	Normally legal expertise is not required in the investigation team. However, the Investigator should have the possibility to seek legal advice from an in house Legal Division if so required
FINLAND	YES, training could be more formalised.	A team of two investigators should be assigned to all minor accidents.	The composition of the investigation team should depend on the accident in question. The team should include experts in various fields.	The investigators should have legal knowledge in performing the investigation. Legal expert is not required to be part of the team.
GERMANY	Specific further education measures would be desirable.	In a team	Specialists may come from a classification society, a university or maritime college, a shipyard, an administrative body, from the medical profession, or they may be experts or scientific personnel as may otherwise be required for the identification of the causes of an accident / casualty.	YES
GREECE	YES, as current practice. Greek investigating teams at present do include experts as they are considered necessary.	In a team, as current practice.	YES, as current practice, i.e. two investigating officers with 2-4 experts are considered satisfactory.	Yes

A-2 WHAT IS DESIRABLE IN THE *FUTURE* WITH REGARD TO THE FOLLOWING QUESTIONS? (continued)

	6. Should investigators receive formal training in gathering physical evidence?	**7. Should investigations normally be carried out in a team or by one investigator?**	**8. What should be the composition of an investigation team?**	**9. Should legal expertise be required in the investigation team?**
IRELAND	A structured and qualifying course of training is highly desirable.	No significant change to current field practice. However, it is anticipated that MSO surveyors/investigators will conduct investigations on behalf of a new Marine Casualty Investigation Board (MCIB).	Subject to normal financial constraints and other resources, it is always desirable to appoint a multi-skilled investigation team incorporating the full range of specialisations and expertise.	It is desirable to appoint a multi-skilled investigation team incorporating the full range of specialisations including legal expertise.
ITALY	YES, desirable. Investigators should receive formal training as Ship Surveyors, which include training in gathering physical evidence.	Investigations should be carried out by one Investigator, occasionally in a team.	According to Chief Investigator decision.	This should be a basic knowledge of the investigators, but not a real expertise.
NETHERLANDS	YES, desirable	Team in serious accidents (major disasters)	It is desirable to carry out the investigation in a team, which includes legal experts, human factors specialists, technical experts, specialised scientists, etc.	Desirable
NORWAY				
PORTUGAL				
SPAIN	YES	In a team assisted by legal experts		
SWEDEN	Not necessary, as long as specialists are available and could be consulted	To be depended on the type of accident	To be depended on the type of accident	To be depended on the type of accident
UK		Team of at least three, including a human factors specialist.	Outside experts like fire experts, forensic specialists,	YES

			ROV operators, including Human Factor specialists.	

B. INVESTIGATION PROCEDURES

B1. DATA COLLECTION

	10. Are all reported accidents investigated? If not, what selection criteria are used in deciding which accidents to investigate?	**11. Is there any mandatory system in place to report incidents or near misses? If so, are they investigated?**	**12. Do investigators have access to all incident relevant information (i.e. evidence)?**
DENMARK	YES, all reported accidents are investigated	YES, when a vessel is involved in an accident which causes damage to the vessel or in case of loss of life or injury to persons on board it is mandatory to report. Not in case of near misses.	YES, the Investigator has access to all incident relevant information.
FINLAND	**YES, all reported accidents are investigated according to the law for accident investigation. In practise the level of investigation is decided by the AIB depending on the severity of the accident.**	**NO mandatory system for reporting incidents, although according to the law for accident investigation, incidents which could have led to a major accident, will be investigated.**	**YES**
GERMANY	Accidents/casualties will be investigated into when there is a “public interest” to do so. This will be the case when the Federal Republic of Germany is accordingly obliged under the provisions of applicable international conventions or when the causes of an accident/casualty must be clarified and there is ground for believing that insight may be gained therefrom for the prevention of future casualties.	YES, there is a mandatory system for reporting accidents/casualties and near misses. (Section 11 of the German Marine Casualties (lnquiries and Investigations) Act is the relevant legal provision.).	When an accident/casualty has taken place within the area of jurisdiction of the Federal Republic of Germany, there will regularly be a possibility to gather all relevant information. In cases of accidents/casualties on the High Seas and in foreign territorial waters, a great deal depends on the degree of co-operation with foreign authorities, the persons involved and insurers. It is a sad experience that, notwithstanding the good will of those involved to co-operate, national rules and regulations prevent the exchange of data.

B1. DATA COLLECTION (continued)

	10. Are all reported accidents investigated? If not, what selection criteria are used in deciding which accidents to investigate?	**11. Is there any mandatory system in place to report incidents or near misses? If so, are they investigated?**	**12. Do investigators have access to all incident relevant information (i.e. evidence)?**
GREECE	NO, marine accidents are investigated in the following cases: a) Total or constructive total loss of a Greek ship b)Permanent loss of vessel control c)Death or serious injury of personnel, d)Damage to cargo or vessel exceeding ¾ of its value e) Vessel abandoned to underwriters	NO, only if they come under the following cases: a) Total or constructive total loss of a Greek ship b)Permanent loss of vessel control c)Death or serious injury of personnel, d)Damage to cargo or vessel exceeding ¾ of its value e) Vessel abandoned to underwriters	YES
IRELAND	NO. The decision to investigate is a judgement call by the Chief Surveyor, based on the gravity of the case. All "serious casualties" are investigated, but lesser accidents and incidents are not – especially if an adequate investigative report (statutory) has been submitted by the safety officer of the ship/company in question.	YES.	YES
ITALY	NO, the decision to investigate is taken by the coast guard or by the magistrate.	YES, for incidents, NOT, no for near misses.	YES, investigators can access all the information they require for carrying out their duty.
NETHERLANDS	NO Criteria should be: severity, personal injury, lessons to be learned, change of legislation	Incidents YES, (mandatory reported incidents are investigated) Near misses NO, (near misses are investigated concerning their possible impact)	YES.
NORWAY	YES	NO, but very much information is received from “the other party” or “the public” regarding violations and negligence.	YES, he has a police man’s authority.

PORTUGAL			

B1. DATA COLLECTION (continued)

	10. Are all reported accidents investigated? If not, what selection criteria are used in deciding which accidents to investigate?	**11. Is there any mandatory system in place to report incidents or near misses? If so, are they investigated?**	**12. Do investigators have access to all incident relevant information (i.e. evidence)?**
SPAIN	All reported accidents are investigated following instructions from the Marine Director.	There is a mandatory system for reporting accidents. The near misses hardly are made public, hence it is not possible carry out investigation.	YES, full access to all accident information
SWEDEN	NO. Criteria: Accidents of interest for safety and environment. If the accident resulted in a fatality. If there are important lessons to be learned.	Yes. If there are important lessons to be learned.	YES

B1. DATA COLLECTION (continued)

	10. Are all reported accidents investigated? If not, what selection criteria are used in deciding which accidents to investigate?	**11. Is there any mandatory system in place to report incidents or near misses? If so, are they investigated?**	**12. Do investigators have access to all incident relevant information (i.e. evidence)?**
UK	All serious casualty under the International Maritime Organisation's (IMO) definition, or in any case where there is widespread public concern. Virtually all other accidents involving loss of life or the loss of a vessel will be investigated by an Inspector , even though they are not "serious casualties", unless: - The initial report is sufficiently comprehensive to make it clear that no further investigation is required; or - An investigation is being carried out by some other responsible body such as a Port Authority, an overseas administration or the Police on behalf of HM Coroner or the Procurator Fiscal; or - The vessel lost is of such a size and type that neither she nor her crew are required to be certificated by the Maritime and Coastguard Agency, and there is no loss of life. All accidents which are not investigated by an Inspector would be made subject to Administrative Inquiry unless either it is clear from the initial report that the incident was minor, or the initial report itself is considered to be adequate.	*The following are dangerous occurrences are required to be reported provided that they might have been liable, taking into account the circumstances of the occurrence, to cause serious injury or to cause damage to the health of any person:* (1) the fall of any person overboard; (2) any fire or explosion; (3) the collapse or bursting of any pressure vessel, pipeline or valve or the accidental ignition of anything in a pipeline; (4) the collapse or failure of any lifting equipment, access equipment, hatch-cover, staging or bosun's chair or any associated load-bearing parts; (5) the uncontrolled release or escape of any harmful substance or agent; (6) any collapse of cargo, unintended movement of cargo sufficient to cause a list, or loss of cargo overboard; (7) any snagging of fishing gear which results in the vessel heeling to a dangerous angle; (8) any contact by a person with loose asbestos fibre except when full protective clothing is worn.	Generally, YES

		Hazardous Incidents (e.g. near misses) do not have to be reported.	

B1. DATA COLLECTION (continued)

	13. Can evidence that is collected by the investigator lead to direct sanctions?	**14. Are investigations normally carried out on the spot as soon as possible after the occurrence of the incident or accident?**	**15. If the investigation is carried out on the spot, what background information is obtained in advance (ship particulars such as name, flag state, owners, classification society etc.; technical characteristics; company directives, composition of the crew etc.)?**
DENMARK	Collected evidence does not lead to direct sanctions. However, the final Investigation Report may indirectly lead to a lawsuit.	YES, when investigations are in the opening phase of the investigation normally carried out on the spot as soon as possible after the occurrence of the accident.	Depending on time, all possible background information on the vessel, owner, crew etc. is obtained in advance of the investigation on the spot.
FINLAND	Investigation report is intended to prevent accidents not to apportion of blame or to assign responsibility. It should not be used for any other purpose. Legal actions are initiated by the Public Prosecutor.	YES, whenever possible. Depending also on the type of the accident.	**All information, which is deemed necessary and which can be obtained (ship particulars such as name, flag state, owners, classification society, technical characteristics, company directives, composition of the crew etc.; also VTS recordings).**
GERMANY	Some sanctions provided by law can be implemented immediately after the accident/casualty, including the withdrawal of certificates of competency and the imposition of a navigation ban for the territorial waters of the Federal Republic of Germany; otherwise, such sanctions may be implemented upon the conclusion of the Board‘s investigations.	Within the area of jurisdiction of the Federal Republic of Germany, preliminary investigations will be carried out on the spot and without delay. In cases having occurred on the High Seas and in foreign territorial waters, inquiries will be conducted with participation from the competent foreign investigating bodies and, sometimes, with assistance from Local German consular representations.	Whenever feasible, any background information of relevance to given investigations on the spot will be obtained in advance; otherwise, it will be gathered afterwards.
GREECE	NOT as a result of the preliminary enquiry (investigation). Legal sanctions follow the findings of the Board of Marine Accidents (ASNA)	If possible, YES. Experts forming part of the team collect evidence immediately.	General Ship particulars.

B1. DATA COLLECTION (continued)

	13. Can evidence that is collected by the investigator lead to direct sanctions?	**14. Are investigations normally carried out on the spot as soon as possible after the occurrence of the incident or accident?**	**15. If the investigation is carried out on the spot, what background information is obtained in advance (ship particulars such as name, flag state, owners, classification society etc.; technical characteristics; company directives, composition of the crew etc.)?**
IRELAND	NO, the job of the investigator is find out "what happened" –to establish the causal factors, in other words. The imposition of any sanctions is the responsibility of a judicial authority.	YES – where practicable.	Whatever background information is conveniently to hand, but the lack of such data would not be allowed to delay the investigator responding as in 14 above.
ITALY	YES	YES, as soon as possible.	As much information as possible will be gathered in advance, otherwise it will be collected afterwards.
NETHERLANDS	YES	YES whenever possible (10% of all cases)	Ship particulars and flag state
NORWAY	YES, the Maritime Investigator gives a recommendation to the police/ prosecutor regarding disciplinary matters.	YES, if it is found necessary	The Maritime Investigator writes a fax/letter to the Master/company requesting information that is relevant (according to his own judgement) for the type of accident.
PORTUGAL			
SPAIN	According Spanish Law, the investigator can produce his report to Court of Justice for legal proceedings according Civil or Penal Law or it can be started an Administrative proceeding according Law 27/92 Ley de Puertos y Marina Mercante (Law on Ports and Merchant Marine)	YES	Much information is obtained on the spot by electronic link. On vessels where is applicable the ISM code, the Shore Staff is also involved and they will provide any required information
SWEDEN	NO	YES (if necessary)	All available

B1. DATA COLLECTION (continued)

	13. Can evidence that is collected by the investigator lead to direct sanctions?	**14. Are investigations normally carried out on the spot as soon as possible after the occurrence of the incident or accident?**	**15. If the investigation is carried out on the spot, what background information is obtained in advance (ship particulars such as name, flag state, owners, classification society etc.; technical characteristics; company directives, composition of the crew etc.)?**
UK	NO, not as far as MAIB investigations are concerned. On occasions a Court may require MAIB to produce all its evidence but this is shown to both prosecutors and defence. Any declaration made by a person cannot be used as evidence against him/her, or his/her spouse.	It depends on the type of accident. Evidence gathering in most cases is best done as soon as possible after the accident; on occasions this is not so.	As much background information as possible. Some information is gleaned from MAIB's in-house sources, and other information can be obtained by telephone, fax, etc. to the vessel's owners, the state regulatory authority, ports, etc.

B1. DATA COLLECTION (continued)

	16. Which methods are used in the fact-fining process?	**17. Does the fact-finding process include only the events and unsafe actions that lead to the incident of accident or are the underlying factors also included in this fact-finding process?**	**18. How often the following items are included in the fact finding process? (++= always, +=often, +/- = occasionally, - = rare, -- = never)** **For the answer, please refer to the end of the document!**
DENMARK	Inspection of the location. Gathering or recording of physical evidence. Relevant interviews where cultural and language differences are taken into account. Review of documents on board, including written testimonies of what had happened. Conduct of special studies (by experts from outside). Identification of conflicts in evidence (e.g. simulation). Identification of missing information. Consultation of the Voyage Data Recorder and other recorded data of the particular voyage (e.g. VTS).	The fact-finding process also include the investigation of underlying factors	
FINLAND	Inspection of the location. Gathering or recording of physical evidence. Relevant interviews where cultural and language differences are taken into account. Review of documents on board, including written testimonies of what had happened. Conduct of special studies Identification of conflicts in evidence using simulation as a regular tool Identification of missing information. Consultation of the Voyage Data Recorder and other recorded data of the particular voyage (e.g. VTS).	The underlying factors are also included in this fact-finding process.	

B1. DATA COLLECTION (continued)

	16. Which methods are used in the fact-fining process?	**17. Does the fact-finding process include only the events and unsafe actions that lead to the incident of accident or are the underlying factors also included in this fact-finding process?**	**18. How often the following items are included in the fact finding process? (++= always, +=often, +/- = occasionally, - = rare, -- = never)** **For the answer, please refer to the end of the document!**
GERMANY	Inspection of the location. Gathering or recording of physical evidence. Relevant interviews where cultural and language differences are taken into account. Review of documents on board, including written testimonies of what had happened. Conduct of special studies (by experts from outside). Identification of conflicts in evidence (e.g. simulation). Identification of missing information. Consultation of the Voyage Data Recorder and other recorded data of the particular voyage (e.g. VTS).	All conditions and circumstances relevant to a given case will be included in accident/casualty investigations.	
GREECE	The following three stages are followed a. Expert investigation. Preliminary Investigation. Formal Investigation	Includes events and acts that lead to the accident and also underlying causes	

B1. DATA COLLECTION (continued)

	16. Which methods are used in the fact-fining process?	**17. Does the fact-finding process include only the events and unsafe actions that lead to the incident of accident or are the underlying factors also included in this fact-finding process?**	**18. How often the following items are included in the fact finding process? (++= always, +=often, +/- = occasionally, - = rare, -- = never)** **For the answer, please refer to the end of the document!**
IRELAND	Inspection of the location Gathering or recording of physical evidence, including photography. Relevant interviews, including depositions, statements, etc. Review of documents on board, including written testimonies Not always conduct of special studies Identification of conflicts in evidence, but simulation is not a regular tool in this regard. Identification of missing information Consultation of the Voyage Data Recorder with particular emphasis on VTS, where relevant and available.	Underlying factors feature prominently in the fact finding process	
ITALY	Inspection of the location Gathering or recording of physical evidence, including photography. Relevant interviews, including depositions, statements Review of documents on board, including written testimonies Not always conduct of special studies Identification of conflicts in evidence, but simulation is not a regular tool in this regard. Identification of missing information Consultation of the Voyage Data Recorder.	Underlying factors are addressed.	

B1. DATA COLLECTION (continued)

	16. Which methods are used in the fact-fining process?	**17. Does the fact-finding process include only the events and unsafe actions that lead to the incident of accident or are the underlying factors also included in this fact-finding process?**	**18. How often the following items are included in the fact finding process? (++= always, +=often, +/- = occasionally, - = rare, -- = never)** **For the answer, please refer to the end of the document!**
NETHERLANDS	Inspection of the location, if possible Gathering or recording of physical evidence Relevant interviews, including depositions, statements, Review of documents on board, including written testimonies Conduct of special studies only in very severe cases Identification of missing information Consultation of the Voyage Data Recorder	Almost always only the direct causes, not the underlying factors	
NORWAY	Inspection of the location Gathering or recording of physical evidence, including photography. Relevant interviews, including depositions, statements, Review of documents on board, including written testimonies Not always conduct of special studies Identification of conflicts in evidence, but simulation is not a regular tool in this regard. Identification of missing information Consultation of the Voyage Data Recorder with particular emphasis on VTS, where relevant and available All above could be relevant but very much dependant on the situation. The Maritime Investigator uses his common sense and experience to gather enough material in order to as far as possible understands what has happened.	Yes, examples were shown were shore based management had been scrutinized.	

B1. DATA COLLECTION (continued)

	16. Which methods are used in the fact-fining process?	17. Does the fact-finding process include only the events and unsafe actions that lead to the incident of accident or are the underlying factors also included in this fact-finding process?	18. How often the following items are included in the fact finding process? (++= always, +=often, +/- = occasionally, - = rare, -- = never) For the answer, please refer to the end of the document!
PORTUGAL			
SPAIN	Inspection of the location Gathering or recording of physical evidence Relevant interviews Review of documents on board, including written testimony Not always conduct of special studies Identification of conflicts in evidence, but simulation is not a regular tool in this regard. Identification of missing information Consultation of the Voyage Data Recorder	The investigator team will elaborate a report on findings, not the opinions. The factors of the accident will be decided by Court, not by the investigators. The investigator team should be able to define the underlying factors and state them in the final report.	The final report of the accident can include all these items, but not necessarily
SWEDEN	Inspection of the location Gathering or recording of physical evidence, including photography. Relevant interviews, including depositions, statements, Review of documents on board, including written testimonies Not always conduct of special studies Identification of conflicts in evidence, but simulation is not a regular tool in this regard. Identification of missing information Consultation of the Voyage Data Recorder with particular emphasis on VTS, where relevant and available All above could be relevant but dependent on the type of accident and available information.	Include underlying factors	

B1. DATA COLLECTION (continued)

	16. Which methods are used in the fact-fining process?	17. Does the fact-finding process	18. How often the following

		include only the events and unsafe actions that lead to the incident of accident or are the underlying factors also included in this fact-finding process?	**items are included in the fact finding process? (++= always, +=often, +/- = occasionally, - = rare, -- = never)** **For the answer, please refer to the end of the document!**
UK	Inspection of the location Gathering or recording of physical evidence Relevant interviews, including depositions, statements, etc., with interpretation if necessary Review of documents on board, including written testimonies Sometimes conduct of special studies Sometimes identification of conflicts in evidence(simulation) Identification of missing information When relevant, consultation of the Voyage Data Recorder	Underlying factors are included in both the fact finding process and the analysis of the accident	

B2. RECONSTRUCTION OF THE ACCIDENT SCENARIO

	19. Is a narrative of what has happened reconstructed?	**20. Does the narrative describe the chain of events preceding the accident?**	**21. Does the narrative describe the recovery phase of an accident (e.g. SAR, environmental protection measures)?**
DENMARK	YES	YES	YES
FINLAND	YES	YES	YES
GERMANY	A comprehensive narrative is given of the established facts.	The chain of events preceding the accident/casualty is described to the extent that events are in a direct context with the accident/casualty.	Search and rescue operations, oil spill recovery action, etc. will be included in the evaluation within the overall context of accident/casualty investigation.
GREECE	YES, as part of the report	YES, it includes all facts related to the accident	Always
IRELAND	YES	YES	YES
ITALY	YES	YES	YES
NETHERLANDS	YES	YES	YES
NORWAY	YES, a report is written (normally in Norwegian).	YES	YES
PORTUGAL			
SPAIN	Sometimes, not always possible	YES	Sometimes
SWEDEN	YES	YES	YES
UK	YES	YES	YES, normally SAR and salvage. Environmental protection measures are usually the Marine Pollution Control Unit’s responsibility

B2. RECONSTRUCTION OF THE ACCIDENT SCENARIO (continued)

	22. Do these narratives include unsafe acts by the people involved?	**23. Are explanations given for these unsafe acts?**	**24. Are these explanations linked with the mental and physical conditions of the persons before, during and after the event and are these explanations based on psychological and/or physiological expertise?**
DENMARK	YES	YES	YES, but not on a ”formal” psychological and/or physiological expertise.
FINLAND	YES	YES	YES, explanations are based on psychological and/or physiological expertise where relevant
GERMANY	The assessment of “faulty behaviour” of anyone involved in a given case is part of the fact-finding process.	YES, a full explanation is given of the form and character of such faulty behaviour.	Part of the accident/casualty investigation is the assessment of the mental and physical conditions to which the persons involved in a given case were subjected before, during, and after the accident/casualty. To this end, psychiatric and medical expert opinions will be sought in appropriate cases.
GREECE	If required and contribute to the unfolding of events	Always	The conditions of the individuals involved are investigated. In general a psychologist is not required although this may be considered necessary.
IRELAND	YES (also unsafe conditions)	YES	NO
ITALY	YES	YES	YES, where possible.
NETHERLANDS	YES	YES	Sometimes
NORWAY	YES	The involved parties give their version of the scenario. The Maritime Investigator concludes based on the whole picture of the material collected.	Yes, as an expert judgement by the Maritime Investigator.
PORTUGAL			
SPAIN	Not necessary.	The task of the investigator team is to identify the truth among unclear explanations of witness, evidence and so.	YES
SWEDEN	YES	YES	Some times if relevant

UK	YES, if necessary	YES	Where possible

B2. RECONSTRUCTION OF THE ACCIDENT SCENARIO (continued)

	25. Are the unsafe acts and events in the narratives related to underlying factors?	**26. If underlying factors are mentioned are they related to the management policy of the company and regulations?**
DENMARK	YES, to some extent.	It depends, the underlying factors could be related to management policy of the company and regulations.
FINLAND	YES	YES
GERMANY	When necessary, the underlying facts of the case and the general environmental conditions prevailing are included in accident/casualty investigations.	YES, underlying factors related to the management policy of companies and to their compliance with IAWS and regulations are also subject of investigation.
GREECE	YES	YES
IRELAND	Possible	YES
ITALY	In general YES	YES
NETHERLANDS	Sometimes, only if applicable	Sometimes
NORWAY	YES	YES
PORTUGAL		
SPAIN	Usually. When the person feels guilty of the accident tries to protect himself/herself by avoiding details of the accident.	Under new ISM the Company should have a proper Safety Management Policy.
SWEDEN	YES	YES
UK	YES	YES

B3. ANALYSIS OF THE DATA IN THE ACCIDENT SCENARIO

	27. Are unsafe acts (error type and violation type) systematically categorized and put in a data base?	**28. Are underlying factors systematically categorised (e.g. in the form of so called general failure types of the TRIPOD model) categorised and put in a data base?**
DENMARK	YES	YES
FINLAND	NOT presently, but will be in the future.	NOT presently, but will be in the future.
FRANCE		
GERMANY	Maritime Boards of Inquiry will forward their findings (systematically categorised and encoded) for input into, and evaluation through, an appropriate IT system.	Basic facts will be encoded for their input into, and evaluation through, an IT system.
GREECE	YES	Statistical processing does take place. Serious accidents are reported to the IMO.
IRELAND	NO	NO
ITALY	NO	NO
NETHERLANDS	NO	NO
NORWAY	YES, into the DAMA database.	YES, DAMA is to a certain degree coding basic causes but may be considered as not complete.
PORTUGAL		
SPAIN	YES, the Spanish Marine Directorate analyse the frequency and type of accidents and takes measures accordingly The accident reports are forwarded to IMO according SOLAS.	YES, there is a system to categorise the accidents in order to learn and provide further safety measures.
SWEDEN	YES	YES
UK	YES	YES

B4. IDENTIFICATION OF POTENTIAL SAFETY PROBLEMS AND DEVELOPMENT OF SAFETY ACTIONS

	29. Are trends in the causation of accidents and incidents identified?	**30. Are recommendations made for each accident separately or are recommendations for trends in accident causation?**	**31. Are recommendations proposed to prevent future accidents and incidents?**	**32. To what extent the countermeasures minimise the effects of accidents and incidents (live-saving equipment, double hulls, double systems)?**
DENMARK	YES	Recommendations are made both for individual accidents and for trends in accident causation.	YES	These countermeasures are intended to minimise the effect of specific types of accidents and incidents and can be related to all types of equipment, constructions and personnel behaviour.
FINLAND	**YES, some identical accidents are grouped together for parallel investigation.**	**For each individual accident the recommendations are given separately, but some identical accidents are grouped together for parallel investigation and common recommendations are formulated.**	YES, accident investigation is intended to prevent future accidents and incidents.	Accident investigations are intended to prevent future accidents and recommendations are given on any topic, which can contribute to the safety.
GERMANY	Some causes, such as watchkeeping practices that are not in compliance with applicable standards, are identified more often than others; a more intensive evaluation of causes would be desirable and would certainly serve to confirm suspected trends.	Proposals and suggestions for improvement may be gathered from the “Tenors”, which summarise the findings of the Maritime Boards of Inquiry. Competent authorities are thus put in a position to draw their conclusions and to take any steps they deem necessary.	YES, as the main purpose of recommendations is to prevent future accidents/casualties of a similar kind.	The findings from maritime casualty investigations have led to major improvements in ships‘ safety with regard to equipment and construction, to surveys, to rule-work in general, and notably to the improvement and easy flow of shipping traffic as a result of new or amended fairway buoyage systems. Other improvements due to such findings relate to VTS, traffic surveillance, and evacuation systems. National accident prevention regulations as well as international regulations (e.g. IMO Code of Safe Practice for Solid Bulk Cargoes) have also been improved as a result of the findings of

				Maritime Boards of Inquiry.

B4. IDENTIFICATION OF POTENTIAL SAFETY PROBLEMS AND DEVELOPMENT OF SAFETY ACTIONS (continued)

	29. Are trends in the causation of accidents and incidents identified?	**30. Are recommendations made for each accident separately or are recommendations for trends in accident causation?**	**31. Are recommendations proposed to prevent future accidents and incidents?**	**32. To what extent the countermeasures minimise the effects of accidents and incidents (live-saving equipment, double hulls, double systems)?**
GREECE	YES	On a case-by-case basis.	YES	In general, they improve safety, but it is also a question of adherence to regulations by seamen
IRELAND	Generally, YES	Separately for each accident	YES – long-standing practice.	The recommendations in casualty investigation reports focus primarily on practices and procedures which, in the judgement of the investigator(s), will best prevent a recurrence of a similar casualty. The lessons learned, from which the general maritime community may benefit, are promulgated through selected published reports and notices to mariners.
ITALY	YES, generally.	Separately for each accident.	To some extent.	To some extent.
NETHERLANDS	Not systematically	Each accidents YES, trends only whenever observed	YES	Sometimes, mostly based on the causes
NORWAY	Trend analysis is not the job for the Maritime Investigator. This will be done annually by another department of Norwegian Maritime Directorate.	For each accident separately.	Yes, this is part of the job to feedback information/ suggestions to Norwegian Maritime Directorate.	Full extent
PORTUGAL				
SPAIN	The Spanish Marine Directorate analyse the frequency of accidents and takes measures	A single accident is analysed; if the causation can be avoided, thence new regulations are dictated.	YES, at national and international level.	The application of countermeasures sometimes takes many years and they are only for vessels even not constructed. There are so many old vessels where these safety measures will not be

	accordingly.			applicable.

B4. IDENTIFICATION OF POTENTIAL SAFETY PROBLEMS AND DEVELOPMENT OF SAFETY ACTIONS (continued)

	29. Are trends in the causation of accidents and incidents identified?	**30. Are recommendations made for each accident separately or are recommendations for trends in accident causation?**	**31. Are recommendations proposed to prevent future accidents and incidents?**	**32. To what extent the countermeasures minimise the effects of accidents and incidents (live-saving equipment, double hulls, double systems)?**
SWEDEN	YES	Recommendations are made for each accident separately	YES	Depending on the outcome of the investigation the recommendations can results in new requirement regarding equipment, procedures or routines and by those means lessons can be learned to avoid recurrence.
UK	YES, where possible	Mainly for each accident, but reference is made to similar accidents (if any) to strengthen the recommendations.	YES	All aspects, ranging from Life Saving Appliances to Management Procedures and Flag State regulations etc.

B4. IDENTIFICATION OF POTENTIAL SAFETY PROBLEMS AND DEVELOPMENT OF SAFETY ACTIONS (continued)

	33. To what extent countermeasures prevent directly the unsafe acts the errors and violations?	**34. To what extent are these countermeasures intended to take away the underlying factors?**	**35. Are reports containing the accident scenario, the analysis of the data and actions to be undertaken to overcome the identified accident published?**
DENMARK	Depending on the actual accident, the countermeasures intended to prevent the unsafe acts, the errors and violations.	The countermeasures could also be related to the underlying factors.	YES
FINLAND	Accident investigations are intended to prevent future accidents and recommendations are given on any topic, which can contribute to the safety.	Accident investigations are intended to prevent future accidents and recommendations are given on any topic, which can contribute to the safety.	YES, as paper copies and as complete reports in the internet.
GERMANY	The findings from maritime casualty investigations have significantly contributed to a downward trend in accidents/casualties in the approaches to ports and in pleasure yachting.	The findings of Maritime Boards of Inquiry may contribute to give an impetus for improving safety of shipping and protection of the marine environment in general on an international level.	The findings from maritime casualty investigations are disseminated to expert circles by means of a monthly publication and are also made available to interested media. In addition, certain findings are printed in an abbreviated version in the national Notices to Mariners. As hearings before Maritime Boards of Inquiry are public this also contributes to the propagation of findings.
GREECE	They reduce the frequency of accidents provided seamen comply with the new regulations		They are published but only after the investigation is completed and the sentences by the courts have been passed.
IRELAND	The recommendations in casualty investigation reports focus primarily on practices and procedures which, in the judgement of the investigator(s), will best prevent a recurrence of a similar casualty. The lessons learned, from which the general maritime community may benefit, are promulgated through selected	The recommendations in casualty investigation reports focus primarily on practices and procedures which, in the judgement of the investigator(s), will best prevent a recurrence of a similar casualty. The lessons learned, from which the general maritime community may benefit, are promulgated through	YES partially, For legal reasons it is not always possible to publish the complete casualty report, or perhaps any report. Amending legislation has been proposed so as to overcome this restriction.

	published reports and notices to mariners.	selected published reports and notices to mariners.	

B4. IDENTIFICATION OF POTENTIAL SAFETY PROBLEMS AND DEVELOPMENT OF SAFETY ACTIONS (continued)

	33. To what extent countermeasures prevent directly the unsafe acts the errors and violations?	**34. To what extent are these countermeasures intended to take away the underlying factors?**	**35. Are reports containing the accident scenario, the analysis of the data and actions to be undertaken to overcome the identified accident published?**
ITALY	No study available.	No study available.	NO
NETHERLANDS	Quite often, instruction, training, education and partly in the form of punitive action	Hardly	YES
NORWAY	Full extent	Full extent	YES
PORTUGAL			
SPAIN	All safety measures are intended to prevent directly and indirectly unsafe actions and accidents but not always these measures arrive on time. (e.g. double hull tanker system is only for new vessels, not for existing vessels).	Any safety measures tries to reach the core of the problem, but not always are enough.	The reports of the accidents are restricted only for interested parties.
SWEDEN	Depending on the outcome of the investigation the recommendations can results in new requirement regarding equipment, procedures or routines and by those means lessons can be learned to avoid recurrence.	Depending on the outcome of the investigation the recommendations can results in new requirement regarding equipment, procedures or routines and by those means lessons can be learned to avoid recurrence.	YES
UK	All aspects, ranging from Life Saving Appliances to Management Procedures and Flag State regulations etc.	All aspects, ranging from Life Saving Appliances to Management Procedures and Flag State regulations etc.	The reports of major accident investigations are published. Other accident reports are available on application to interested parties, and in addition short reports are published in MAIB's Safety Digest. It is hoped that in the future all reports will be made publicly available in any way the Chief Inspector thinks best. This could be by publishing, on

			the Internet, on application etc.

Members' submissions to Question 18

How often are the following items included in the fact-finding process?
(++ = always, + = often, +/- = occasionally, - = rare, -- = never)

DENMARK

People factors	++	+	+/-	-	- -
1. ability, skills, knowledge of the people involved	x				
2. personality (mental condition, emotional state)		x			
3. physical condition (medical fitness, fatigue, use of alcohol or drugs)	x				
4. activities prior to the accident/occurrence	x				
5. assigned duties at the time of accident/occurrence	x				
6. actual behaviour at time of accident/occurrence	x				
7. attitude	x				
Organisation on board					
8. division of tasks and responsibilities	x				
9. composition of the crew (competence/nationality)		x			
10. workload (both overload or underload)/complexity of tasks		x			
11. work hours/rest hours		x			
12. procedures and standing orders	x				
13. communication (internal and external)	x				
14. on board management and supervision	x				
15. organisation of on board training and drills		x			
16. teamwork		x			
17. planning of work		x			
Working and living conditions					
18. level of automation	x				
19. ergonomics of equipment and the working environment		x			
20. adequacy of living conditions				x	
21. adequacy of food					x
22. opportunities for recreations					x
23. vibrations, heat, noise ship motion				x	
Ship factors					
24. design		x			
25. state of maintenance	x				
26. equipment (availability, reliability)	x				
27. cargo characteristics, including securing, handling and care	x				
28. certificates		x			
Shore side management					
29. policy on recruitment				x	
30. safety policy and philosophy		x			
31. management commitment to safety		x			
32. scheduling of leave periods					x
33. general management					x
34. assignment of duties					x
35. ship-shore communication		x			
External influences and environment					
36. weather and sea conditions	x				
37. port and transit conditions (VTS, pilots etc.)	x				
38. traffic density	x				
39. ice conditions	x				
40. regulations, survey and inspections		x			

FINLAND

People factors	++	+	+/-	-	- -
1. ability, skills, knowledge of the people involved	x				
2. personality (mental condition, emotional state)		x			
3. physical condition (medical fitness, fatigue, use of alcohol or drugs)	x				
4. activities prior to the accident/occurrence	x				
5. assigned duties at the time of accident/occurrence	x				
6. actual behaviour at time of accident/occurrence	x				
7. attitude	x				
Organisation on board					
8. division of tasks and responsibilities	x				
9. composition of the crew (competence/nationality)	x				
10. workload (both overload or underload)/complexity of tasks	x				
11. work hours/rest hours	x				
12. procedures and standing orders	x				
13. communication (internal and external)	x				
14. on board management and supervision	x				
15. organisation of on board training and drills	x				
16. teamwork	x				
17. planning of work	x				
Working and living conditions					
18. level of automation	x				
19. ergonomics of equipment and the working environment	x				
20. adequacy of living conditions			x		
21. adequacy of food				x	
22. opportunities for recreations			x		
23. vibrations, heat, noise ship motion		x			
Ship factors					
24. design	x				
25. state of maintenance	x				
26. equipment (availability, reliability)	x				
27. cargo characteristics, including securing, handling and care	x				
28. certificates	x				
Shore side management					
29. policy on recruitment			x		
30. safety policy and philosophy	x				
31. management commitment to safety	x				
32. scheduling of leave periods		x			
33. general management		x			
34. assignment of duties		x			
35. ship-shore communication	x				
External influences and environment					
36. weather and sea conditions	x				
37. port and transit conditions (VTS, pilots etc.)	x				
38. traffic density	x				
39. ice conditions	x				
40. regulations, survey and inspections	x				

GERMANY

People factors	++	+	+/-	-	- -
1. ability, skills, knowledge of the people involved	x				
2. personality (mental condition, emotional state)			x		
3. physical condition (medical fitness, fatigue, use of alcohol or drugs)	x				
4. activities prior to the accident/occurrence	x				
5. assigned duties at the time of accident/occurrence	x				
6. actual behaviour at time of accident/occurrence	x				
7. attitude	x				
Organisation on board					
8. division of tasks and responsibilities	x				
9. composition of the crew (competence/nationality)	x				
10. workload (both overload or underload)/complexity of tasks	x				
11. work hours/rest hours	x				
12. procedures and standing orders	x				
13. communication (internal and external)	x				
14. on board management and supervision	x				
15. organisation of on board training and drills	x				
16. teamwork	x				
17. planning of work	x				
Working and living conditions					
18. level of automation	x				
19. ergonomics of equipment and the working environment	x				
20. adequacy of living conditions			x		
21. adequacy of food				x	
22. opportunities for recreations				x	
23. vibrations, heat, noise ship motion	x				
Ship factors					
24. design	x				
25. state of maintenance	x				
26. equipment (availability, reliability)	x				
27. cargo characteristics, including securing, handling and care	x				
28. certificates	x				
Shore side management					
29. policy on recruitment	x				
30. safety policy and philosophy	x				
31. management commitment to safety	x				
32. scheduling of leave periods	x				
33. general management		x			
34. assignment of duties		x			
35. ship-shore communication	x				
External influences and environment					
36. weather and sea conditions	x				
37. port and transit conditions (VTS, pilots etc.)	x				
38. traffic density	x				
39. ice conditions			x		
40. regulations, survey and inspections	x				

GREECE

People factors	++	+	+/-	-	- -
1. ability, skills, knowledge of the people involved	x				
2. personality (mental condition, emotional state)	x				
3. physical condition (medical fitness, fatigue, use of alcohol or drugs)	x				
4. activities prior to the accident/occurrence	x				
5. assigned duties at the time of accident/occurrence	x				
6. actual behaviour at time of accident/occurrence	x				
7. attitude	x				
Organisation on board					
8. division of tasks and responsibilities	x				
9. composition of the crew (competence/nationality)	x				
10. workload (both overload or underload)/complexity of tasks	x				
11. work hours/rest hours	x				
12. procedures and standing orders	x				
13. communication (internal and external)	x				
14. on board management and supervision			x		
15. organisation of on board training and drills	x				
16. teamwork	x				
17. planning of work	x				
Working and living conditions					
18. level of automation	x				
19. ergonomics of equipment and the working environment	x				
20. adequacy of living conditions	x				
21. adequacy of food	x				
22. opportunities for recreations			x		
23. vibrations, heat, noise ship motion				x	
Ship factors	x				
24. design	x				
25. state of maintenance	x				
26. equipment (availability, reliability)	x				
27. cargo characteristics, including securing, handling and care	x				
28. certificates	x				
Shore side management					
29. policy on recruitment				x	
30. safety policy and philosophy			x		
31. management commitment to safety			x		
32. scheduling of leave periods					x
33. general management			x		
34. assignment of duties		x			
35. ship-shore communication			x		
External influences and environment					
36. weather and sea conditions	x				
37. port and transit conditions (VTS, pilots etc.)	x				
38. traffic density	x				
39. ice conditions	x				
40. regulations, survey and inspections	x				

IRELAND

People factors	++	+	+/-	-	- -
1. ability, skills, knowledge of the people involved	x				
2. personality (mental condition, emotional state)			x		
3. physical condition (medical fitness, fatigue, use of alcohol or drugs)		x			
4. activities prior to the accident/occurrence	x				
5. assigned duties at the time of accident/occurrence	x				
6. actual behaviour at time of accident/occurrence	x				
7. attitude		x			
Organisation on board					
8. division of tasks and responsibilities		x			
9. composition of the crew (competence/nationality)	x				
10. workload (both overload or underload)/complexity of tasks		x			
11. work hours/rest hours	x				
12. procedures and standing orders	x				
13. communication (internal and external)	x				
14. on board management and supervision	x				
15. organisation of on board training and drills	x				
16. teamwork	x				
17. planning of work		x			
Working and living conditions					
18. level of automation		x			
19. ergonomics of equipment and the working environment	x				
20. adequacy of living conditions	x				
21. adequacy of food	x				
22. opportunities for recreations				x	
23. vibrations, heat, noise ship motion			x		
Ship factors					
24. design	x				
25. state of maintenance	x				
26. equipment (availability, reliability)	x				
27. cargo characteristics, including securing, handling and care	x				
28. certificates	x				
Shore side management					
29. policy on recruitment		x			
30. safety policy and philosophy	x				
31. management commitment to safety	x				
32. scheduling of leave periods		x			
33. general management		x			
34. assignment of duties	x				
35. ship-shore communication	x				
External influences and environment					
36. weather and sea conditions	x				
37. port and transit conditions (VTS, pilots etc.)	x				
38. traffic density	x				
39. ice conditions	x				
40. regulations, survey and inspections	x				

ITALY

People factors	++	+	+/-	-	- -
1. ability, skills, knowledge of the people involved				x	
2. personality (mental condition, emotional state)					x
3. physical condition (medical fitness, fatigue, use of alcohol or drugs)				x	
4. activities prior to the accident/occurrence					x
5. assigned duties at the time of accident/occurrence			x		
6. actual behaviour at time of accident/occurrence			x		
7. attitude					x
Organisation on board					
8. division of tasks and responsibilities			x		
9. composition of the crew (competence/nationality)		x			
10. workload (both overload or underload)/complexity of tasks			x		
11. work hours/rest hours					x
12. procedures and standing orders			x		
13. communication (internal and external)			x		
14. on board management and supervision		x			
15. organisation of on board training and drills			x		
16. teamwork			x		
17. planning of work					x
Working and living conditions					
18. level of automation					x
19. ergonomics of equipment and the working environment					x
20. adequacy of living conditions					x
21. adequacy of food					x
22. opportunities for recreations					x
23. vibrations, heat, noise ship motion					x
Ship factors					
24. design				x	
25. state of maintenance			x		
26. equipment (availability, reliability)		x			
27. cargo characteristics, including securing, handling and care		x			
28. certificates	x				
Shore side management					
29. policy on recruitment					x
30. safety policy and philosophy					x
31. management commitment to safety			x		
32. scheduling of leave periods					x
33. general management			x		
34. assignment of duties		x			
35. ship-shore communication		x			
External influences and environment					
36. weather and sea conditions		x			
37. port and transit conditions (VTS, pilots etc.)		x			
38. traffic density		x			
39. ice conditions		x			
40. regulations, survey and inspections	x				

THE NETHERLANDS

People factors	++	+	+/-	-	- -
1. ability, skills, knowledge of the people involved		x			
2. personality (mental condition, emotional state)				X	
3. physical condition (medical fitness, fatigue, use of alcohol or drugs)			x		
4. activities prior to the accident/occurrence			x		
5. assigned duties at the time of accident/occurrence	x				
6. actual behaviour at time of accident/occurrence	x				
7. attitude			x		
Organisation on board					
8. division of tasks and responsibilities			x		
9. composition of the crew (competence/nationality)			x		
10. workload (both overload or underload)/complexity of tasks			x		
11. work hours/rest hours			x		
12. procedures and standing orders		x			
13. communication (internal and external)		x			
14. on board management and supervision			x		
15. organisation of on board training and drills		x			
16. teamwork		x			
17. planning of work		x			
Working and living conditions					
18. level of automation		x			
19. ergonomics of equipment and the working environment			x		
20. adequacy of living conditions			x		
21. adequacy of food				x	
22. opportunities for recreations				x	
23. vibrations, heat, noise ship motion				x	
Ship factors					
24. design		x			
25. state of maintenance	x				
26. equipment (availability, reliability)	x				
27. cargo characteristics, including securing, handling and care		x			
28. certificates		x			
Shore side management					
29. policy on recruitment			x		
30. safety policy and philosophy			x		
31. management commitment to safety			x		
32. scheduling of leave periods				x	
33. general management		x			
34. assignment of duties	x				
35. ship-shore communication		x			
External influences and environment					
36. weather and sea conditions	x				
37. port and transit conditions (VTS, pilots etc.)		x			
38. traffic density			x		
39. ice conditions		x			
40. regulations, survey and inspections	x				

NORWAY

As a general conclusion all items presented below can be addressed if it is found relevant. It is very much depending on what has happened during the accident.

People factors	++	+	+/-	-	- -
1. ability, skills, knowledge of the people involved					
2. personality (mental condition, emotional state)					
3. physical condition (medical fitness, fatigue, use of alcohol or drugs)					
4. activities prior to the accident/occurrence					
5. assigned duties at the time of accident/occurrence					
6. actual behaviour at time of accident/occurrence					
7. attitude					
Organisation on board					
8. division of tasks and responsibilities					
9. composition of the crew (competence/nationality)					
10. workload (both overload or underload)/complexity of tasks					
11. work hours/rest hours					
12. procedures and standing orders					
13. communication (internal and external)					
14. on board management and supervision					
15. organisation of on board training and drills					
16. teamwork					
17. planning of work					
Working and living conditions					
18. level of automation					
19. ergonomics of equipment and the working environment					
20. adequacy of living conditions					
21. adequacy of food					
22. opportunities for recreations					
23. vibrations, heat, noise ship motion					
Ship factors					
24. design					
25. state of maintenance					
26. equipment (availability, reliability)					
27. cargo characteristics, including securing, handling and care					
28. certificates					
Shore side management					
29. policy on recruitment					
30. safety policy and philosophy					
31. management commitment to safety					
32. scheduling of leave periods					
33. general management					
34. assignment of duties					
35. ship-shore communication					
External influences and environment					
36. weather and sea conditions					
37. port and transit conditions (VTS, pilots etc.)					
38. traffic density					
39. ice conditions					
40. regulations, survey and inspections					

SPAIN

As a general conclusion, the items presented below can be included in the final report of the accident investigation, but not necessarily.

People factors	++	+	+/-	-	- -
1. ability, skills, knowledge of the people involved					
2. personality (mental condition, emotional state)					
3. physical condition (medical fitness, fatigue, use of alcohol or drugs)					
4. activities prior to the accident/occurrence					
5. assigned duties at the time of accident/occurrence					
6. actual behaviour at time of accident/occurrence					
7. attitude					
Organisation on board					
8. division of tasks and responsibilities					
9. composition of the crew (competence/nationality)					
10. workload (both overload or underload)/complexity of tasks					
11. work hours/rest hours					
12. procedures and standing orders					
13. communication (internal and external)					
14. on board management and supervision					
15. organisation of on board training and drills					
16. teamwork					
17. planning of work					
Working and living conditions					
18. level of automation					
19. ergonomics of equipment and the working environment					
20. adequacy of living conditions					
21. adequacy of food					
22. opportunities for recreations					
23. vibrations, heat, noise ship motion					
Ship factors					
24. design					
25. state of maintenance					
26. equipment (availability, reliability)					
27. cargo characteristics, including securing, handling and care					
28. certificates					
Shore side management					
29. policy on recruitment					
30. safety policy and philosophy					
31. management commitment to safety					
32. scheduling of leave periods					
33. general management					
34. assignment of duties					
35. ship-shore communication					
External influences and environment					
36. weather and sea conditions					
37. port and transit conditions (VTS, pilots etc.)					
38. traffic density					
39. ice conditions					
40. regulations, survey and inspections					

SWEDEN

People factors	++	+	+/-	-	- -
1. ability, skills, knowledge of the people involved	x				
2. personality (mental condition, emotional state)	x				
3. physical condition (medical fitness, fatigue, use of alcohol or drugs)	x				
4. activities prior to the accident/occurrence	x				
5. assigned duties at the time of accident/occurrence	x				
6. actual behaviour at time of accident/occurrence	x				
7. attitude	x				
Organisation on board					
8. division of tasks and responsibilities		x			
9. composition of the crew (competence/nationality)		x			
10. workload (both overload or underload)/complexity of tasks		x			
11. work hours/rest hours		x			
12. procedures and standing orders		x			
13. communication (internal and external)		x			
14. on board management and supervision		x			
15. organisation of on board training and drills		x			
16. teamwork		x			
17. planning of work		x			
Working and living conditions					
18. level of automation		x			
19. ergonomics of equipment and the working environment		x			
20. adequacy of living conditions				x	
21. adequacy of food				x	
22. opportunities for recreations				x	
23. vibrations, heat, noise ship motion					
Ship factors					
24. design		x			
25. state of maintenance		x			
26. equipment (availability, reliability)		x			
27. cargo characteristics, including securing, handling and care		x			
28. certificates		x			
Shore side management					
29. policy on recruitment				x	
30. safety policy and philosophy			x		
31. management commitment to safety			x		
32. scheduling of leave periods			x		
33. general management		x			
34. assignment of duties			x		
35. ship-shore communication			x		
External influences and environment					
36. weather and sea conditions	x				
37. port and transit conditions (VTS, pilots etc.)	x				
38. traffic density	x				
39. ice conditions	x				
40. regulations, survey and inspections	x				

UK

People factors	++	+	+/-	-	- -
1. ability, skills, knowledge of the people involved	x				
2. personality (mental condition, emotional state)	x				
3. physical condition (medical fitness, fatigue, use of alcohol or drugs)	x				
4. activities prior to the accident/occurrence	x				
5. assigned duties at the time of accident/occurrence	x				
6. actual behaviour at time of accident/occurrence	x				
7. attitude		x			
Organisation on board					
8. division of tasks and responsibilities	x				
9. composition of the crew (competence/nationality)	x				
10. workload (both overload or underload)/complexity of tasks	x				
11. work hours/rest hours	x				
12. procedures and standing orders	x				
13. communication (internal and external)	x				
14. on board management and supervision	x				
15. organisation of on board training and drills	x				
16. teamwork		x			
17. planning of work	x				
Working and living conditions					
18. level of automation	x				
19. ergonomics of equipment and the working environment	x				
20. adequacy of living conditions			x		
21. adequacy of food				x	
22. opportunities for recreations				x	
23. vibrations, heat, noise ship motion		x			
Ship factors					
24. design	x				
25. state of maintenance	x				
26. equipment (availability, reliability)	x				
27. cargo characteristics, including securing, handling and care	x				
28. certificates	x				
Shore side management					
29. policy on recruitment		x			
30. safety policy and philosophy	x				
31. management commitment to safety	x				
32. scheduling of leave periods	x				
33. general management	x				
34. assignment of duties	x				
35. ship-shore communication	x				
External influences and environment					
36. weather and sea conditions	x				
37. port and transit conditions (VTS, pilots etc.)	x				
38. traffic density	x				
39. ice conditions				x	
40. regulations, survey and inspections	x				

Appendix 4
WP2.5 – CHIRP Best Practice

This Work Package produced a proposal to the Commission for a pilot scheme to set up a CHIRP. The outcome of the Work Package gives the outline for how such a pilot scheme may work.

Public

Confidential Hazardous Incident Reporting Programme

Pilot Scheme

A Proposal by the Concerted Action Committee on Casualty Analysis (FP4 Waterborne Transport Tasks 21 and 36)

Introduction
The Concerted Action Committee (CAC) on Casualty Analysis discussed the idea of establishing a Confidential Hazardous Incident Reporting Programme (CHIRP) as a means of improving safety at sea. Such a scheme has already brought a number of benefits to the aviation industry in several countries and it is believed that there is considerable scope for the transfer of technology to the European marine community.

Subsequently, it was decided that a proposal should be made to DG VII of the Commission for a pilot scheme to demonstrate its feasibility either as part of the 5th Framework Programme or separately.

The Aim
The aim of an EC wide confidential reporting system is to improve safety at sea by introducing a system whereby mariners of any of the countries involved can report any event touching on safety without fear of prosecution or disciplinary action being taken against them.

Organisation
For the CHIRP to be successful it will need to be headed by a marine specialist capable of understanding and commenting on reports sent by individuals from all areas of the marine community including:

- Deck Officers
- Engineers
- Crew
- Pilots
- VTS and Other Port and Harbour Staff
- Workboat Operators
- Fishermen
- Recreational Craft Operators

That person will need to be supported by an administrator to deal with receipt of reports, and the preparation and distribution of CHIRP bulletins.

The organisation must be seen to be absolutely confidential and independent. There should be no formal association with any government or European Union body and the CHIRP should be a self-standing unit. An absolute guarantee would have to be given that anyone submitting a report to CHIRP would never have his identity revealed.

The CHIRP must, however, be answerable to someone and it might be necessary for a Board of Trustees to be established with members being drawn from suitable bodies, such as the CAC, DGVII and representatives from industry.

The pilot scheme should involve at least two, and at the most three, member states and should apply to residents of the involved member states together with organisations such as ports and harbours in those states. Vessels owned by involved member state companies and those operating in and out of involved member state ports could also have access to the scheme.

The scheme should run, initially, for three years with a review of progress being conducted one year after its launch. Recommendations for permanent establishment should be made at the end of the second year.

Function

The CHIRP will exist to receive, collate and distribute hazardous incident reports from all sectors of the marine community. It must be more than a "posting box" as informed editorial content including understanding the causes of incidents and identification of corrective action will form a valuable part of the regular bulletins. All means of identifying the reporter would be removed before publication.

The CHIRP must be launched with sufficient publicity to ensure maximum awareness in the marine community. This might include the placing of advertisements in appropriate publications, the circulation and display of posters, and ensuring the availability of report forms in the workplace.

The success of the scheme will depend on it being respected, understood to be completely confidential, and being seen to be making a positive contribution to marine safety. Careful thought will be necessary on public relations issues as part of the scheme's establishment.

Once established the CHIRP would be self-running with responsibility for day to day finance, personnel and accommodation matters dealt with internally.

Appendix 5
WP2.6 - Accident Data

This Work Package produced a ‘State of the Art’ paper outlining the CAC members’ views on what would be the data requirements for including details of a maritime accident into a pan-European database. Responses have been ordered according to the alphabetical listing of the member states.

1. Name of project?

DENMARK	
FINLAND	Gathering and Recording Human-Related Causal Data in Marine and Other Accident Investigations
FRANCE	
GERMANY	
GREECE	
IRELAND	The Irish Marine Surveyor's Office (MSO) has no current or past programmes focused on risk analysis, and as far as we are aware no other agency within the State is similarly involved in any such maritime programmes. The data upon which a marine risk analysis project might be based is that rendered on the ARF form, however, this form in its present state would not be considered an effective risk analysis tool.
ITALY	
NETHERLANDS	Ship Platform Collisions
NORWAY	
PORTUGAL	
SPAIN	
SWEDEN	
U.K	Analysis of Fishing Vessel Accident Trends

2. Organisation of project?

DENMARK	
FINLAND	
FRANCE	
GERMANY	
GREECE	
IRELAND	A statistical survey for the Irish Marine Emergency Service (IMES) was undertaken by the Nautical Enterprise Centre in late 1995. The project evaluated and analysed about 1600 search and rescue (SAR) incidents which were the subject of emergency co-ordination measures within the Irish Search and Rescue Region during the period January 1994 - July 1995.
ITALY	
NETHERLANDS	The project is organised as an international working-group. Participants are:

	UK: Health & Safety Executive, Offshore Safety Department Norway: Norwegian Petroleum Directorate Netherlands: Directorate General for Shipping and Maritime Affairs State Security of Mines Denmark: Ministry of Energy, Mobile Units Section The project is lead by DGSM, who also paid the contract up to now. The size is medium. The first phase of the project is finished and reported in "A Critical Review of Ship-Platform Collision Frequency Models", By MaTSU, June 1995.
NORWAY	
PORTUGAL	
SPAIN	
SWEDEN	
U.K.	This small project was carried out by Economics, Aviation, Marine and International Division of the UK Department of Transport. The work was completed in August 1995.

3. Goal?

DENMARK	
FINLAND	Computerized investigation reporting systems such as MINMOD, which require completion of standard forms using specific classification schemes to summarize the information, have a significant impact upon the investigative process itself. A major positive aspect of a standard classification scheme is that it provides a structure to data collection and may provide some consistency across investigations. However, it also creates the problem of collecting data only to fill out the form, potentially inhibiting a full investigation of all aspects of the accident. Therefore, a careful determination of what data are needed is critical when developing the classification scheme of an accident database. Another problem arises due to the fact that virtually no taxonomy can represent the full spectrum of possible causes. If the taxonomy is too rigid, investigators will, at times, be required to "force-fit" the taxonomy to their specific case, resulting in inaccurate entries. Because of this, any taxonomy must allow for inexperienced (yet useful) data reporting. Systems designers should carefully weigh these influences when designing their systems to best fit the purpose and scope of the database.
FRANCE	
GERMANY	
GREECE	
IRELAND	Identify the causes, superficial or otherwise, of maritime incidents.
ITALY	
NETHERLANDS	The overall objective of the project is to reach a regional consensus over the method of analysis of the probability of ship-platform collision

	Results are to be used in assessing risks of new offshore equipment to be installed. The collision risk is addressed as part of the so-called "safety cases", which are compulsory for every offshore installation. The deliverable for phase 1 was a generic insight into the strengths and weaknesses of existing risk assessment models. The deliverable for the second phase is also a generic insight. Future phases might address model development in a more direct way.
NORWAY	
PORTUGAL	
SPAIN	
SWEDEN	
U.K.	The objective of the study was to carry out a thorough risk analysis of accidents to persons on fishing vessels.

4. Subject?

DENMARK	
FINLAND	The taxonomy or classification scheme affects the data collected as well as the data reported
FRANCE	
GERMANY	
GREECE	
IRELAND	
ITALY	
NETHERLANDS	The area under consideration is the North Sea. Specific attention is given to the UK, Norwegian and Dutch continental shelf. The project focuses on accident probability. Accident consequences are not explicitly modelled. However, emphasis is on passing vessels rather than visiting supply vessels, because the latter don't give rise to structural failure of the offshore structure.
NORWAY	
PORTUGAL	
SPAIN	
SWEDEN	
U.K.	The area under consideration was the operational area of UK-registered fishing vessels which were the subject of the study. The data comprised over 500 incidents reported to MAIB between January 1991 and November 1994.

5. Systematic?

DENMARK	
FINLAND	
FRANCE	
GERMANY	
GREECE	
IRELAND	The project was a low cost exercise that involved the examination of the IMES incident records. The analysis was confined to: • type of incident • outcome of incident • location of incident • type of vessel(s) involved • nationality of persons/vessels involved • seasonal variations • rescue agencies tasked
ITALY	
NETHERLANDS	The study in itself is a review. The models under review however use risk analysis techniques. Two models viz. CRASH and COLLIDE use event trees to model accident probability. MANS and COLLIDE use statistical accident analysis to calibrate the predictions against past experience for the whole North Sea.
NORWAY	
PORTUGAL	
SPAIN	
SWEDEN	
U.K.	The study involved a simple risk analysis and also produced cross frequencies and developed fault trees.

6. Scenarios (for risk analysis only)?

DENMARK	
FINLAND	
FRANCE	
GERMANY	
GREECE	
IRELAND	

<table>
<tr><td>ITALY</td><td></td></tr>
<tr><td>NETHERLANDS</td><td>Hazards: major damage of the platform, possibly collapse.

Scenarios:
1. A disabled drifting large merchant ship collides with an offshore platform.
Sub-scenarios: attempt to anchor or to tow, succeeding or failing.
2. A passing vessel colliding with an offshore platform when at sea speed.
Sub-scenarios: errant vessel (temporary no effective watchkeeping on the bridge) or blind vessel (bad visibility combined with inoperabl or incorrectly operated radar).
Both scenarios use the "geometric factor" as a basis. This factor is determined by the number of ships passing the platform under consideration and the passing distances. This geometric factor represents a (weighted) number of ships that potentially threatens the platform, if the engine would fail (scenario 1) or if no corrective measures were taken (scenario 2).
In scenario 1, engine failure rates are derived from incident statistics. In scenario 2, the probability of failure to take corrective measures is calibrated with accident statistics. The CRASH and COLLIDE models use fault trees and event trees to break down this probability. This provides a basis for understanding the process and for prediction of the effect of measures.</td></tr>
<tr><td>NORWAY</td><td></td></tr>
<tr><td>PORTUGAL</td><td></td></tr>
<tr><td>SPAIN</td><td></td></tr>
<tr><td>SWEDEN</td><td></td></tr>
<tr><td>U.K.</td><td>The three main variables that were analyses were "kind of injury", "accident type" and "activity of injured person". These can be broken down as follows:
<table>
<tr><th>Kind of Injury</th><th>Accident Type</th><th>Activity of Injured Person</th></tr>
<tr><td>Hypothermia</td><td>Fire</td><td>Going to vessel</td></tr>
<tr><td>Strained back</td><td>Missing at Sea</td><td>Watchkeeping</td></tr>
<tr><td>Concussion</td><td>Slips/falls</td><td>Shooting gear</td></tr>
<tr><td>Eye</td><td>Mechanical lifting</td><td>Using deck machinery</td></tr>
<tr><td>Minor fracture</td><td>Machinery/equipment</td><td>Handling/stowing fish</td></tr>
<tr><td>Death</td><td>Electric shock</td><td>Mooring/anchoring</td></tr>
<tr><td>Strains/sprains</td><td>Explosion</td><td>Galley./mess/pantry</td></tr>
<tr><td>Crush</td><td>Fall overboard</td><td>Leaving vessel</td></tr>
<tr><td>Cuts/wounds</td><td>Carrying/lifting by hand</td><td>Preparing/stowing gera</td></tr>
<tr><td>Amputation</td><td>Open/close hatch</td><td>Hauling gear</td></tr>
<tr><td>Dislocation</td><td>Moving/falling object</td><td>Gutting fish</td></tr>
</table></td></tr>
</table>

	Major fracture	Other	Workshop duties
	Bruising		Casting off/weighing anchor
			Off duty
			Other

7. Data?

DENMARK	
FINLAND	USA Coast Guard's accident investigation and reporting processes.
FRANCE	
GERMANY	
GREECE	
IRELAND	Data from the Irish Marine Emergency Service (IMES).
ITALY	
NETHERLANDS	The data used is specified below per item: • Geometric factor: Shipping traffic is derived from Lloyd's voyage records (commercially available, world-wide, merchant ships, database form). These were analysed, together with expert knowledge on shipping routes, to form the European Traffic Database (available for EURET 1.3-TAIE participants, North Sea, route-bound ships). Validation was done on the Dutch continental shelf with aerial surveys and is on-going on the UK continental shelf with local radar surveys. • Engine failure rate: Engine failure rate is derived from Lloyd's casualty information system (commercially available world-wide, all ships over 100 GRT, database form), based on reported tug assistance. • Calibration of accident probability: Overall calibration is based on all available accident statistics. Mainly Lloyd's and records from national offshore and shipping authorities (confidential to some extent). A distinction is made between accident type (scenario 1 or 2) and ship type (passing or visiting, merchant, supply or fishing). • Event trees and fault trees: Data in event trees and fault trees is mainly based on expert opinion. Lacking or unreliable data: • Engine failure rate for periods shorter than 6 hours • Distinction between visiting and passing vessel in accidents • Factors in the fault and event trees, such as the probability that the watchkeeper has fallen asleep or is absent, drunk or disabled, radar

	failure etc.
NORWAY	
PORTUGAL	
SPAIN	
SWEDEN	
U.K.	All data was received from MAIB accident databases. Over 500 incidents occurring in the operational area of UK fishing vessels were analysed. The analysis was restricted to simple frequency data.

8. Result?

DENMARK	
FINLAND	The study has provided a number of examples to support four important factors that are relevant to the accuracy, reliability, and completeness of data within *any* accident database. These issues included: • an understanding of the purpose of the database; • the expertise needed to identify data of interest; • the taxonomy used to represent those data within the database; and • the computer interface of the data entry program. Problems with any one of these items can significantly degrade the value of the data within the database. It is not sufficient just to tell investigators to "investigate the cause of the accident." Even the best investigation efforts can be derailed if the other steps in the process are ambiguous or poorly designed.
FRANCE	
GERMANY	
GREECE	
IRELAND	The data set available offered little or no possibility of any meaningful identification of the causes, superficial or otherwise, of these incidents. This is not surprising as the IMES has no remit to investigate casualties - their function is to co-ordinate immediate response efforts by the various rescue agencies - although they have a stated interest in promoting measures to reduce risk.
ITALY	
NETHERLANDS	The study did identify strengths and weaknesses of available models.
NORWAY	
PORTUGAL	
SPAIN	

SWEDEN	
U.K.	The study is a useful exercise but it is acknowledged that the dataset was quite small. It served as a useful illustration of the methods that could be used with a larger dataset at some future date. The report highlighted a number of limitations with the analysis with particular reference to the way in which the data was collected, i.e., it is provided by the crews of the fishing vessels who were involved in the incident.

9. Other?

DENMARK	
FINLAND	
FRANCE	
GERMANY	
GREECE	
IRELAND	
ITALY	
NETHERLANDS	Lacking and unreliable data mentioned under 7. might be partially addressed in a CHIRP system. However, it is questionable if data on falling asleep, absence etc. will ever be reported, even if confidential.
NORWAY	
PORTUGAL	
SPAIN	
SWEDEN	
U.K.	The MAIB database now contains details of 750 accidents to persons on fishing vessels. This, combined with comparable data from other member states, could form the basis of a much larger EU-wide study.

Appendix 6
WP2.7 - Population Statistics

This Work Package produced a ‘State of the Art’ paper outlining the CAC members’ views on the type of maritime population statistics currently available, the extent of data to be included and how the data should be gathered. Responses have been ordered according to the alphabetical listing of the member states.

WORK PACKAGE 2.7 - POPULATION STATISTICS

DEFINITIONS OF "INCIDENT" AND "ACCIDENT"

	ACCIDENT	INCIDENT
IMO	Marine casualty means an event that has resulted in any of the following: the death of, or serious injury to, a person that is caused by, or in connection with, the operations of a ship; the loss of a person from a ship that is caused by, or in connection with, the operations of a ship; the loss, presumed loss or abandonment of a ship; material damage to a ship; the stranding or disabling of a ship, or the involvement of a ship in a collision; material damage being caused by, or in connection with, the operation of a ship; damage to the environment brought about by the damage of a ship or ships being caused by, or in connection with, the operation of a ship or ships.	Marine incident means an occurrence or event being caused by, or in connection with, the operation of a ship by which the ship or any person is imperilled, or as a result of which serious damage to the ship or structure or the environment might be caused.
DENMARK	An event which has led to damage to a ship or an event where one or more crew members or passengers have perished or have been injured during their stay on board.	(The term "near miss" is used instead of "incident". An event which quite easily could have developed into a casualty. NB: It is intended to adopt the definitions given in the draft IMO Code for the Investigation of Marine casualties and Incidents.
FINLAND		
FRANCE		
GERMANY	An accident has to be considered if, by the operation of a vessel, her safety, in particular the safety of persons aboard, the safety of traffic or the condition of the waters have been seriously endangered, or if a vessel or her cargo has suffered serious damage; if a vessel is sunk, reported missing or abandoned or if a person has been killed or reported missing.	Marine incident means an occurrence or event being caused by, or in connection with, the operation of a ship by which the ship or any person is imperilled, or as a result of which serious damage to the ship or structure or the environment might be caused (IMO).
GREECE	Any event which causes: total actual or constructive loss of a Greek vessel or a floating construction; the abandonment of such to insurers; permanent or temporary abandonment of the vessel by the crew; loss of or damage to the cargo transported by the vessel in excess of one quarter of that carried; serious damage that results in the loss of control of the vessel; loss of life or serious injury to a member of the crew or passenger.	No distinction is made between maritime incidents and accidents.
IRELAND	Adopts the IMO definition.	Adopts the IMO definition.

DEFINITIONS OF “INCIDENT” AND “ACCIDENT” (continued)

	ACCIDENT	INCIDENT
ITALY	It is not customary practice to differentiate between accident and incident. The definitions typically applied are those suggested by IMO, "casualty" and "serious casualty"	
NETHERLANDS	Every event that a ship has met with, which has caused deadly or serious injury or significant damage	Event that is not an accident and that is related to the functioning of a ship and that has brought the safety of persons in danger
NORWAY	An undesired event that results in harm to people, damage to property or loss to process	An undesired event which, under slightly different circumstances, could have result in harm to people, damage to property or loss to process
PORTUGAL		
SPAIN	There is no distinction in the Spanish Maritime Normative between *incident* and *accident*.	
SWEDEN		
U.K.	Accident means any contingency whereby: there is loss of life or major injury to any person on board, or any person is lost from, a ship or a ship's boat; a ship is lost or presumed to be lost, or is abandoned or materially damaged; a ship strands or is in collision; a ship is disabled; any loss of life or major injury or material damage, or serious harm to the environment, is caused by a ship.	Hazardous incident means any incident or event, not being an accident or a dangerous occurrence, by which the safety of a ship or any person is imperilled, or as a result of which serious damage to any ship or structure or damage to the environment might be caused.

1. What vessel traffic data is presently available in your country?

DENMARK	A. Danish ports – ships entering and leaving the port; B. VTS[1] Great Belt – ships passing the Great Belt; C. VTS Sound – ships passing the southern part of the Sound; D. Danish Military Authorities – certain ships passing Danish waters;
FINLAND	
FRANCE	
GERMANY	All vessels in internal waters of Federal Republic of Germany carrying dangerous or polluting goods;
GREECE	
IRELAND	Ferries All RO/RO ferries sailing from Irish ports are required to report their departure details on each occasion; Tankers Ships bound for or leaving Community ports and carrying dangerous or polluting goods to notify the Competent Authorities;
ITALY	Port Authorities - all vessels entering/leaving Italian ports.
NETHERLANDS	A. MANS - North Sea /Channel; B. VONOVI - data from air observations; C. Port Authorities – Ships entering/leaving Dutch ports D. Dirkzwager - Ships entering/leaving some Dutch ports E. Nercus Port Authorities - Ships entering/leaving Dutch ports
NORWAY	Some information available from the following sources: • Port Administrations; • Institute of Transport Economics; • Statistics Norway; • Norwegian Coastal Directorate;
PORTUGAL	
SPAIN	A. Port Authorities – all vessels entering Spanish ports B. Port Control Stations - more accurate dates and times but only available at some ports
SWEDEN	

[1] Vessel Traffic Service

1. What vessel traffic data is presently available in your country? (continued)

U.K.	A. Port records B. Coastguard data C. Customs data D. COAST data – commercial system which will contain some details of cross-North Sea ships

2. What does the data include, ie, number of vessels leaving a particular port, time and date of departure, vessel's flag, age and type, and where it is bound?

DENMARK	Name, Int. Call Sign, Flag, Tonnage, Cargo, Last port of call, Arrival time, Departure time, Next port of call; Type of ship, Tonnage, Draught, Pilot on board, See B
FINLAND	
FRANCE	
GERMANY	Name, distinctive number or letters, type, flag, main dimensions, port of destination, ETA, ETD, intended route, correct technical names of goods with their UN numbers, classes and details of loading on board;
GREECE	
IRELAND	Ferries Name, port of departure, date and time of departure, where bound and number of passengers on board; Tankers The requirements for the information to be supplied to the Competent Authorities are being applied, mostly, to the case of dangerous goods and so statistical data is limited and incomplete;
ITALY	All, except age.
NETHERLANDS	All except time and age; All (including position) except origin/destination ; All; All; All
NORWAY	
PORTUGAL	
SPAIN	Arrival time and date, particulars of the ship and cargo, next port, ETD and ETA to next port Arrival time and date, particulars of the ship and cargo, next port, ETD and ETA to next port
SWEDEN	
U.K.	Vessel name, type, flag, destination, date and time of arrival/departure; Numbers transiting Dover Straits, incomplete individual vessel data; Vessel name, cargo type, destination, port of arrival; D. Vessel type and routing;

3. Who collects the data, ie, Port Authorities, National Agencies, Classification Societies, Insurance Companies, Ship Owners?

DENMARK	Danish ports; VTS Great Belt; VTS Sound; Military Authorities;
FINLAND	
FRANCE	
GERMANY	VTS Centres (Federal Administration); Port authorities;
GREECE	
IRELAND	Ferries Port and harbour authorities, Irish Marine Emergency Service (IMES); Tankers Port and harbour authorities, Irish Marine Emergency Service (IMES);
ITALY	Port Authorities.
NETHERLANDS	MSCN - original data from ferry companies (ferries) and Lloyd's (tankers); DGG ; Port Authority; Dirkzwager; Port Authority (according to EC directive).
NORWAY	
PORTUGAL	
SPAIN	Port Authorities Port Control Station
SWEDEN	
U.K.	A. Individual ports; HM Coastguard; Customs and Excise; D. COAST project contributors;

4. In what format is the data available, ie, electronic, hard copy?

DENMARK	Electronic/hard copy; Hard copy; Hard copy
FINLAND	
FRANCE	
GERMANY	Federal Administration – Electronic; Ports – Hard copy/Electronic;
GREECE	
IRELAND	Ferries IMES – electronic, port and harbour mixed electronic/hard copy; Tankers Mixed electronic/hard copy;
ITALY	Hard copy.
NETHERLANDS	electronic; electronic; paper; Electronic; Electronic.
NORWAY	
PORTUGAL	
SPAIN	Electronic Paper (electronic on a near future);
SWEDEN	
U.K.	Hard copy; D.

5. By whom is the data published?

DENMARK	Some data published by Danish Statistical Department; Not published; Not published;
FINLAND	
FRANCE	
GERMANY	Data not published except for monthly statistics of number of vessels and types of cargo;
GREECE	
IRELAND	Ferries Very little of this information is in the public domain; Tankers None of this information is in the public domain;
ITALY	Data are not published.
NETHERLANDS	DGG; DGG; Not published; Not published; Not published.
NORWAY	
PORTUGAL	
SPAIN	
SWEDEN	
U.K.	UK Government Statistical Services; Not published; Not published; D. Dovre Safetec (information obtained from the Norwegian submission for Action 4);

6. Please assess the accuracy/quality of the data on a scale 1-5, where 1=Very Reliable and 5=Unreliable?

DENMARK	2 2 2
FINLAND	
FRANCE	
GERMANY	VTS Centres – 1; Ports – no assessment;
GREECE	
IRELAND	Ferries 1; Tankers 4-5;
ITALY	Data quality can be classified 2.
NETHERLANDS	Ferries - 3, Tankers - 1; 2; 1; 1; 1.
NORWAY	
PORTUGAL	
SPAIN	In general 1, but less accurate on ETD; 1
SWEDEN	
U.K.	1 (for the available data which is not complete); 1 (about 440 vessel movements/day transiting and cross channel); Unknown; 2.

7. Is the data: a) Confidential b) Easily recoverable c) Cost involved

DENMARK	Recoverable; Easily recoverable; Easily recoverable; Confidential (to some extent)
FINLAND	
FRANCE	
GERMANY	Yes No VTS Centres - No Ports - Yes
GREECE	
IRELAND	Ferries Easily recoverable from IMES but involves some cost and eventually depending on the consent of shipowners; the same applies to port and harbour authorities but they might reluctant to divulge some information affecting their commercial or corporate interests; Tankers Not easily recoverable, involving some considerable cost and there might be some difficulties on the publication of commercially sensitive information;
ITALY	Easily recoverable, not cost involved.
NETHERLANDS	a) No b) Yes c) Yes a) No b) Yes c) No a) ? b) No c) ? a) No b) Yes c) Yes a) Yes b) No c) N/A.
NORWAY	
PORTUGAL	
SPAIN	a) Yes b) Yes c) ? a) ? b) ? c) ?
SWEDEN	
U.K.	; ; Confidential; D. Cost involved (subscription) (?);

Appendix 7
WPs 2.8 & 2.9 – Specification for a Common Methodology

The results of Work Package 2.8 have been combined with Work Package 2.9 to produce a summary document outlining the CAC's views on an idealised Common Maritime Accident Investigation Methodology. The final deliverable reflects the consensus view of all members.

Specification for a Common Maritime Accident Investigation Methodology

A Document Produced by the Concerted Action Committee on Casualty Analysis (FP4 Waterborne Transport Tasks 21 and 36)

Introduction
The Concerted Action Committee for Tasks 21 and 36 of the CEC DGVII Fourth Framework Waterborne Transport Programme consider that, in so far as local laws and regulations permit, the following approach should be utilised on a pan-European basis for the investigation of maritime accidents.

THE MARITIME ACCIDENT INVESTIGATION BODY
What type of body should investigated maritime accidents?
Maritime accident investigations should be carried out by a separate and independent body from that carrying out the regulatory function.

THE MARITIME ACCIDENT INVESTIGATOR
What should be the investigator's background?
Professional mariners of both the navigation and engineering disciplines as staff, together with Naval Architects either as staff or brought in on an ad hoc basis.

Should regular investigators have a full-time appointment?
All regular investigators should have a full-time appointment.

Should novice investigators receive formal training?
All novice investigators should receive training but the degree to which this is formalised should be left to the discretion of the individual member states.

Should investigators receive formal training in human factors?
All investigators should receive some formal training in human factors aspects.

Should investigators receive formal training in conducting interviews?
All investigators should receive some formal training in conducting interviews.

Should investigators receive formal training in gathering evidence?
All investigators should receive some formal training in gathering evidence.

Should investigators receive other training?
Ideally, investigators should receive training in information technology, underwater appraisal techniques and business management.

Should investigations normally be carried out in a team or by one investigator?
Ideally, investigations should normally be carried out by a team of investigators, however whether this is possible is largely dependent on available resources.

What should be the composition of an investigation team?
Teams of adequately skilled people, depending on the circumstances of the case, should carry out all investigations. Where the team does not posses all the necessary relevant skills these should be available from outside experts called in specifically for the case.

Should legal expertise be required in the investigation team?
Where the team does not posses legal expertise themselves, these should be available from outside experts called in specifically for the case.

THE MARITIME ACCIDENT INVESTIGATION PROCEDURE
When should an accident investigation start?
An investigation should start as soon after the event as possible.

What should be done first?
Proper planning of the investigation is important prior to arriving at the accident scene. This will involve the investigation team discussing and planning the witness interviews they intended to hold and reviewing the vessel's plans and history.

What should be the considerations during evidence collection?
Evidence should be collected in the following areas:

- Witness statements;
- Physical measurement;
- Technical assessment;
- Photographic;
- Electronic (including data loggers and radar loggers);
- Documentary (including log books, note books, course recorders and engine movement logs);
- Vessel traffic management and information service logs and transcripts;
- Radio communication records.

A management support system is necessary to ensure there is a consistent approach to evidence collection. Initially this may be achieved by a 'check-off' list.

What should happen after physical evidence has been collected?
All personnel involved in the investigation should be de-briefed and an initial assessment of the cause should be put forward although in due course it is likely that this assessment may be refined or totally changed. Personnel not directly involved in the investigation or evidence collection should assess only the evidence as it stands to determine whether the investigation team had become slightly prejudiced in their views because of other factors not supported by evidence.

What factors should the evidence analysis consider?
Evidence analysis should not be considered a discreet phase of the process but would probably be ongoing throughout the reminder of the investigation. It is possible for evidence analysis to be based on a formalised system or on the circumstances of the case.

What should be the outcome of a maritime accident investigation?
A maritime accident investigation should result in an analysis of the circumstances of the case and the development of recommendations to prevent recurrence. The results should be disseminated through a publicly available final report, published in its entirety and entered into a database for further analysis and comparison in the future. The database fields should be sufficient for individual member states to carry out a trend analysis within their existing accident definitions and statistical systems.

Dissemination of the results should be through both free of charge hard copy publications and electronic means posted to the Internet, possibly for inclusion on the DGVII web site. In addition to full and complete final reports, there should also be summary reports giving an outline of the circumstances of the accidents together with any ensuing recommendations.

Appendix 8
WP 2.10 – Data Acquisition and Collation of a Database

This Work Package produced a summary document containing the CAC's recommendation to enable necessary and sufficient data to be available for the purposes of maritime accident investigation. The final deliverable reflects the consensus view of all members.

Public

Requirements of the IMO Accident Reporting System

Communiqué

A Document Produced by the Concerted Action Committee on Casualty Analysis (FP4 Waterborne Transport Tasks 21 and 36)

The Concerted Action Committee (CAC) for Tasks 21 and 36 of the CEC DGVII Fourth Framework Waterborne Transport Programme consider that, in so far as local laws and regulations permit, the Directorate-General for Transport of the Commission (DGVII) should urge the responsible bodies of each member state to comply with the requirements of the IMO accident reporting system.

During the deliberations of the CAC, members expressed the view that it is necessary to provide a common methodology for the collation and analysis of maritime accident data. Although the initial intention was for the EU member states to unilaterally define a methodology for use in their countries, it was later seen as an unnecessary duplication of effort because the International Maritime Organisation (IMO) has partly defined, although not implemented, such a maritime accident system specification. The IMO's database has, in principle at least, been adopted by a wide range of maritime states.

At the conclusion of the deliberations, the CAC's consensus view was that the Commission should use their influence to ensure that the requirements of the IMO accident reporting system are complied with by all EU member states. The CAC considers that the Commission should use whatever steps and means it deems necessary in this respect to bring this matter to the attention of the responsible body in each member state.

Appendix 9
WP 2.11 – Human Element/ Remedial Tools

The deliverable from this Work Package produced a specification for a database concerning shipping accidents. It includes scope to include the human factor and allows for statistical analysis. It is an outline method believed not to be in place in any member state. It must be emphasised that the proposed method can only be successful if maritime accident investigators receive training in human factors and further, to finalise the proposed method for accident analysis and the database, input of human factors specialists is required.

Database on Shipping Accidents that Include the Human Factor

Pilot Scheme

A Proposal by the Concerted Action Committee on Casualty Analysis (FP4 Waterborne Transport Tasks 21 and 36)

Introduction

This text contains a proposal for a database concerning shipping accidents. It includes scope to include the human factor and allows for statistical analysis. It is an outline method believed not to be in place in any member state. It must be emphasised that the proposed method can only be successful if maritime accident investigators receive training in human factors and further, to finalise the proposed method for accident analysis and the database, input of human factors specialists is required.

In Canada and in Australia investigation methods, based on the theory of James Reason, are already in place. As the IMO accident database is already in existence, any other method should not contradict the IMO method. This means that a method can only be adopted if it requires no extra investigation to fill in the IMO-form, after the investigation are completed and after the data are entered into the computer. The method outlined here is in line with the IMO-procedure.

Systematic accident analysis and accident statistics offer the possibility to discover trends in causation. If trends in the causes of accidents are known, measures can be taken that will prevent accidents in the future. There is a long tradition in accident analysis in shipping. So far, only data on the effects of the causes were statistically analysed such as the number of ships that sunk or the number of collisions in a given period. However up to now causes that include the human factor were not systematically collected. Reasons for this are that it is difficult to abstract causes from accident scenarios that have more than local significance (considering the causes, every accident seems to be unique) and because human behaviour is difficult to classify. According to Wagenaar (1997) a method for accident analysis that includes the human factor, should:

- ***Be revealing***, which means that it distinguishes between events and the underlying causes, and that the underlying causes or latent conditions are informative because they were not easily identifiable in other ways;
- ***Be quantitative***, so that results can be accumulated across many accidents;
- ***Be valid***, in the sense that the revealed underlying causes are true and have predictive value for future accidents;
- ***Be reliable***, which means that when using the same method, independent analysts should come to the same conclusions;
- ***Be practical***, in the sense that the method is cost effective and no rare specialists need to be employed;

- ***Be consequential***, meaning that it should formulate clear and distinct results of which recommendations for accident prevention can be deducted.

So far, no method of accident analysis was able to meet the requirements listed above. Because of new insights in why and how errors are made and because methods have been developed that make it possible to classify latent failures, it now seems possible to develop a database about the causes of maritime accidents including the human factor. For the collection of useful data it is not only necessary to know all the unsafe acts and unsuccessful operations for recovery which have led to an accident (the sequence of events), but also to know the underlying causes. These are the latent failures which create the local conditions that promote the commission of errors and violations. Such latent conditions do not only exist at the specific time of the accident but are present long before the accident and remain into existence after the accident if no measures are taken that eliminate the so called root causes or latent conditions.

Before introducing a possible classification scheme and before giving some examples of how it can work, there follows a brief introduction of some aspects of the theory of Reason and Wagenaar in relation to the possibility of accident analysis in shipping.

Human Behaviour and Shipping

The transportation of cargo and people overseas with ships cannot be carried out without the fulfilment of certain functions. Five main functions can be identified:

1. ***Navigation*** *(route* planning, track keeping and collision avoidance);
2. ***Propulsion*** (the responsibility for the integrity of the ships propulsion system and associated auxiliaries);
3. ***Cargo Handling*** (loading, keeping the cargo (including passengers) in good condition and unloading);
4. ***Platform Maintenance*** (keeping the ship, its equipment (e.g. the auxiliary equipment) and the crew (the hotel function) in operational condition);
5. ***Ship Management*** (the allocation of tasks and responsibilities, control and supervision and communication).

For the fulfilment of these five main functions the crew has to perform tasks. Task performance can be sub-optimal and sometimes even be unsafe. If unsafe acts are not corrected or blocked, they will lead to an accident. Unsafe acts are either errors or violations.

Errors and Violations

According to Reason (1990), human error involves the failure of intentional planned mental or physical actions to achieve their desired outcome. Three different stages are passed in case of intentional actions:

1. Planning of the action;
2. Mental storage of the planned action into memory;
3. Execution of the action.

In each of these three stages something can go wrong. Planning failures are called *mistakes,* storage failures into memory are called *lapses* and execution failures are called *slips.*

There is a relation between slips, lapses and mistakes and modes or levels of control in which people function while planning their actions and performing their tasks. These levels of control are the *Skill-based level, the Rule-based level* and the *Knowledge-based level.*

The lowest level is the Skill-based level. This level is characterised by strong integrated, automatic actions. Routine activities are mostly carried out at the skill-based level.

Attentional checks are only occasionally needed to verify if the right sequence of events takes place. On the skill-based level, errors are governed by the variability of force, space, or time co-ordination (Reason, 1990). Errors at this level are the above mentioned 'slips' and 'lapses'. The slips and lapses occur because during the performance of tasks on skill-based level, people can become internally preoccupied or externally distracted.

People function on the rule-based level when they encounter problems for which they have some pre-packaged solution (If this is the case, you first do this and then do that ...). The internal standard rules are activated by signs. These signs are specific characteristics of the environment or situation that fulfil the conditions for applying that rule. The rules are applied without a full analysis or complete understanding of the problem. On the rule-based level, errors are made because bad rules are applied in a situation that is correctly appraised or a set of good rules is used in a wrongly assessed situation. Wrong habits, inexperience and lack of expertise, often play a role in rule-based mistakes.

On the knowledge-based level, actions are fully planned and the execution is under permanent control of conscious attention. Only when people have repeatedly failed to find a solution using known rules, they start to function on this level. Problems are solved by abstract or symbolic reasoning within some internalised mental model of the problem. At the knowledge-based level the errors are also called mistakes. They are made because of lack of information, improper mental models, wrong reasoning etc.

Slips, lapses, rule-based mistakes and knowledge-based mistakes are not made on purpose. There is however also unsafe behaviour that is intentional. While being aware that their behaviour is unsafe, people sometimes take risks. In that case we speak of *violations. A* violation is not every act against rules, regulations and good practice. It only is a violation when people are aware of the fact that their behaviour is unsafe. There are at least four different types of violations. According to Reason (1996) these categories are:

- **Routine violations.** These involve cutting corners, taking the path of least effort between two points;
- **Violations 'for kicks'.** Here the rules are broken to appear 'macho', for thrills, or to alleviate boredom;
- **Necessary violations.** Here, people discover that it is impossible to get the job done by sticking to rules or that they consider as impractical legislation . This can be due to inadequate tools, bad procedures or regulations, or other situational factors outside the control of the people on the spot.
- **Exceptional violations.** Here, people do risky things in extraordinary situations e.g.

when trying to safe the lives of others in acute danger. Exceptional violations mostly involve powerful emotions. For example, someone enters a hold of a ship and is overcome by fumes. The person behind is well aware of the danger, but is driven by the need to help a friend. He too is overcome; and so on.

Factors that can contribute to the commission of violations are things like low morale, lack of a safety culture on board, boredom, incompatible goals, inadequate procedures or inadequate equipment or tools.

Psychological Precursors

Unsafe acts: the errors and violations, are not random events. They have their immediate origins in psychological states of mind, or patterns of reasoning, which Wagenaar c.s. call psychological precursors. At the skill-based level, slips are mostly caused by attention problems. This can be inattention or over attention. Reason (1990) distinguishes the following slips or lapses that are due to inattention:

- Double-capture slip
- Omissions following interruptions
- Reduced intentionality
- Perceptual confusions
- Interface errors

According to Reason (1990), slips or lapses at the skill-based level due to over attention are:

- Omissions
- Repetitions
- Reversals

Even in an excellent mental and physical condition slips and lapses occur. No one is free of slips and lapses. However, the chance that they will occur increase when aspects like fatigue, stress or boredom play a role or when people are under the influence of drugs (legal or illegal) or alcohol or are in bad physical condition (e.g. illness).

Rule-based mistakes are due to the misapplication of good rules or by the good application of bad rules. The types of the misapplication of good rules Reason mentions are:

- First exceptions
- Countersigns and non-signs
- Information overload
- Rule strength
- General rules
- Redundancy
- Rigidity

Application of bad rules are:

- Encoding deficiencies
- Action deficiencies
- Wrong rules
- Inelegant rules
- Inadvisable rules

On the rule-based level, people are more aware of what they are doing than on the skill-based level. Although actions on the rule-based level are planned, the consequences of the actions are not fully overlooked. Actions are triggered by specific characteristics of the environment. If the conditions or conditional rules are under specified most likely the behaviour will be chosen that was successful in the past. This kind of selection is called frequency gambling. Rule-based mistakes are in between skill-based mistakes and knowledge-based mistakes. As the rules are applied more or less automatically without a full appraisal of the situation, the same underlying factors such as fatigue, stress, boredom and the influence of alcohol and drugs, mentioned earlier, may facilitate the occurrence of this type of mistakes. Besides these facilitating factors that are the same as mentioned for the skill-based mistakes, there are factors of more cognitive nature like wrong habits, inexperience, lack of procedure training and having no adequate procedures in place.

On the knowledge-based level people are fully aware of what they are doing. Only when the situation is such that there are no rules at hand to solve a particular problem, people tend to function on the knowledge-based level. Knowledge-based mistakes are mistakes in reasoning and are mostly due to bias or the use of inaccurate mental models. Reason distinguishes the following types of psychological precursors at the knowledge-based level:

- Confirmation bias
- Salience bias
- Framing bias
- Overconfidence
- Representative heuristic
- Available heuristic
- “As if” heuristic

In case of knowledge-based mistakes contributing factors are factors that influence the cognitive processes. Lack of situation awareness and in-adequate mental representation of the problem due to a lack of system knowledge, can facilitate the occurrence of knowledge-based mistakes.

It is very important that accident investigators can distinguish between the types of psychological precursors at the skill-based, the rule-based and the knowledge-based level that were mentioned in this paragraph. This is not possible without training. The Canadian Transportation Safety Board has developed a training program for investigators of accidents for the various modes of transport, including for shipping.

Defences
Accidents in shipping are rarely caused by one single error or violation. In most cases there is a sequence and/or coincidence of events and decisions. Fortunately, most of the time the unsafe acts in an error chain do not lead to accidents, because counter measures are taken as soon as people themselves, the system or others have detected that an unsafe act is leading to an accident. These counter-measures that block or minimise the effects of unsafe acts, are called defences. Defences can be built in the system, like computers asking for verification when the command for deleting files is given. Especially in the case of slips and lapses corrections are easily made if the result of an unsafe act is observable before the accident takes place. In those cases people can make the corrections themselves. Rule-based and knowledge-based mistakes are difficult to detect by the people that commit the unsafe act, because the actions are planned. Here others that see someone else make a mistake can take the counter measures.

If carried out in time, corrections can prevent the occurrence of accidents. Other defence mechanisms however are intended to minimise the effect of accidents. These defence mechanisms can range from safety boots to lifeboats.

Latent Conditions
So far we have discussed the actual event chain that leads to a certain accident. What was the causal chain of violations, errors and unsuccessful defences that led to the accident and what psychological precursors on skill-based, rule-based and knowledge-based level, played a role? The psychological precursors however are not an isolated case. Someone's state of mind is largely influenced by the physical and organisational environment (the working conditions and the way people work and live together on board). These are the latent conditions or so called underlying causes that create the local conditions in the working environment that promote the commission of errors and violations. The latent conditions relate to the management decisions or organisational factors such as design, hardware, operations maintenance, training, communication and the like. Latent conditions are not obvious at first sight when analysing a certain accident. Only when the actual event chain leading up to the accident is clear and after the psychological precursors for each event are classified, research for latent conditions can commence. In search for latent conditions it is important that only those latent conditions or underlying causes are registered that have a distinct relation with the accident. For instance it may be discovered that there are poor maintenance procedures on board, but they may have nothing to do with the causes of a particular accident. In such a case the poor maintenance procedures should not be mentioned in the data base.

In their TRIPOD-model Reason and Wagenaar have distinguished 11 latent conditions or what they call General Failure Types (GFT's). These GFT's are:

- **Hardware defects** (Failures due to poor state or unavailability of equipment and tools)
- **Design failures** (Failures due to poor design of individual equipment as well as the lay-out (e.g. the bridge configuration)
- **Poor maintenance procedures** (Failures due to poor quality of the maintenance procedures regarding quality, utility, availability and comprehensiveness).

- **Poor operating procedures** (Failures due to the poor quality of the operating procedures regarding utility, availability and comprehensiveness)
- **Error enforcing conditions** (Failures due to poor quality of the working environment regarding circumstances that increase the probability of mistakes, such as working with new procedures not everyone knows or the installation of new equipment not everyone can work with)
- **Poor housekeeping** (Failures due to poor housekeeping)
- **Incompatible** goals (Failures due to the poor way safety and internal welfare are defended against a variety of other goals like time pressure and limited budget)
- **Organisational failures** (Failures due to the way the work on board is managed and the company is operating (e.g. responsibilities and tasks are not properly assigned, workload, working hours)
- **Communication failures** (Failures due to poor quality or absence of lines of communication on board and between ship and shore)
- **Inadequate training** (Failures due to inadequate training or insufficient experience)
- **Inadequate defences** (Failures due to the poor quality of the protection against hazardous situations (like not stimulating people on board to wear safety helmets or to take certain measures when doing a hazardous task)

Indicators for hardware failures are:
- the availability, quality, reliability, suitability of materials, equipment and tools.

Indicators for design failures are ergonomic criteria like:
- user friendliness, unambiguity in display and control, standardisation, accessibility, complexity etc.

Poor maintenance procedures can be indicated by:
- the time that is spent on maintenance, the organisation and planning of maintenance etc.

Indicators for poor operating procedures are:
- incomprehensible and complex procedures, lack of procedures, no control on safety measures, the procedures are not documented and are not available etc.

Error enforcing conditions can be traced by indicators like:
- no facilities for the crew to relax, excessive workload, very long working hours (fatigue), heat, vibrations etc.

Signs for poor house keeping are:
- no clean working places, equipment that is not stored away, no cleaning up after a job has been carried out, no good washing facilities etc.

Incompatible goals can be recognised by signs that indicate that safety and economy are not in balance, like:
- the request of navigating the ship as safely as possible and be as quick as possible in a certain harbour. Signs for this can be low budgets for safety issues and maintenance, working under constant time pressure etc.

Organisational failures can be indicated by:

- the quality of the relationship between ship and shore (the company), the absence of regular consultation of others about work to be done, the absence of a safety culture, no explicit assignments of tasks and responsibilities, a crew size to small to carry out all necessary tasks, no supervision and control.

Indicators for communication failures are:

- the absence of a common working language, manuals that are not available in the working language of the ship, no use of standard marine vocabulary.

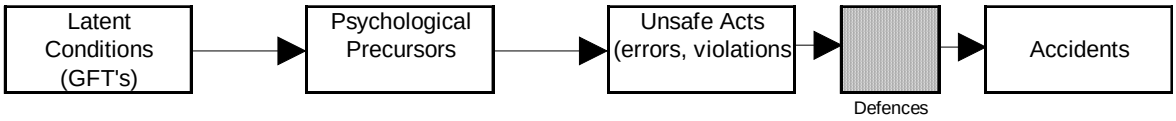
Indicators for inadequate training are:

- crew members doing tasks they are not trained for, no training in the use of special equipment on board, No stimulation by the company for additional training. No bridge resource management training or other simulator training for the crew etc.

Signs for inadequate defences are:

- no regular musters, lifeboat- and fire fighting drills, no control and poor maintenance of fire fighting and safety equipment, no personal protection aids like safety helmets etc. on board-

The complete generalised causation scenario discussed so far can be represented in the following figure:



GFT's

* Design
* Hardware
* Procedures
* Error enforcing conditions
* Housekeeping
* Training
* Incompatible goals
* Communication
* Organisation
* Maintenance management
* Defences

Psychological Precursors

* Double-capture slip
* Omissions following interruptions
* Reduced intentionality
* Perceptual confusions
* Interface errors
* Omissions
* Repetitions
* Reversals
* First exceptions
* Countersigns and non signs
* Information overload
* Rule strength
* General rules
* Redundancy
* Rigidity
* Encoding deficiencies
* Wrong rules
* Inelegant rules
* Inadvisable rules
* Confirmation bias
* Salience bias
* Framing bias
* Overconfidence
* Representative heuristic
* Available heuristic
* “As if” heuristic

Unsafe Acts

* Skill-based slips and lapses
* Rule-based mistakes
* Knowledge-based mistakes
* Routine violations
* Violations 'for kicks'
* Necessary violations
* Exceptional violations

Database Design

The data base must contain a breakdown of events and circumstances and for each event or circumstance the unsafe act, the psychological precursor and the GFT involved as far as applicable. The following examples can make this clear:

Case 1 (Collision)

Event/Circumstance	Unsafe Act	Psychological Precursor	GFT
No ARPA-functions on radar activated	Rule-based mistake	Wrong rules	Training
Ineffective (substandard) execution of watchkeeping			Training
Incorrect traversing traffic-lane	Routine violation	Rule strength	Incompatible goals
Strong stereotype that "fishermen never give way"	Rule-based mistake	General rule	
Expected the other vessel to turn to starboard	Knowledge-based mistake	Overconfidence bias	Training
Evasive action to port-side	Defence (Knowledge-based mistake)	Overconfidence bias	Training
Mariphone still on channel 12 (instead of 16)	Skill-based lapse	Omission	
No horn or light signals	Routine violation		Training
No mariphone contact			Training
First evasive action executed when the ships were too close	Knowledge-based mistake	First exception	

Case 2 (Grounding)

Event/Circumstance	Unsafe Act	Psychological Precursor	GFT
Excessive alcohol abuse	Violation 'for kicks’		
Unsuitable charts in use	Routine violation		Incompatible goals
Ship's position never recorded on the chart (order from shipowner - cost reduction)	Rule-based mistake	General rule	Incompatible goals
Inaccurate fixing of the ship's position	Knowledge-based mistake	Confirmation bias	Training
No radar-alarm activated (did not know how to operate)			Training
No watch-alarm activated	Defence (Rule-based mistake)	Inadvisable rule	
No lookout at the bridge	Routine violation		Organisation
No anti-slip coating on bridge-deck			Defence

Case 3 (Collision)

Event/Circumstance	Unsafe Act	Psychological Precursor	GFT
Master was not informed about fog by the OOW	Routine violation		Organisation
Successive non-responses when contacting VTS			Error Enforcing Condition
Incorrect information from VTS about traffic	Rule-based mistake	Information overload	Communication
Entering the harbour at full speed in dense fog	Rule-based mistake	Rule strength	Training
Incorrect interpretation of signs on radar-screen	Knowledge-based mistake	Confirmation bias	Training
No horn signals while in dense fog	Routine violation		Training
No evasive action to starboard	Knowledge-based mistake	Availability heuristic	Design
Sudden propulsion breakdown (propeller shaft brake was not engaged as a result of unfamiliarity with its function and operation)	Rule-based mistake	Wrong rules	Training
Insufficient shielding of thermal pipes			Hardware

Although the events and circumstances are unique and can not be used for statistical analysis, they should be stored in the database for the reconstruction of the error chain. The statistical analysis can be carried out on the second, the third and the fourth column.

POSSIBLE QUESTIONS NECESSARY FOR THE CONSTRUCTION OF A TABLE

To produce tables such as mentioned above, at least the following questions must be answered:

1. Type of accident (collision, grounding, sinking, fire etc.)

2. In which main function(s) did the error chain occur?

    Navigation

    Propulsion

    Cargo handling

    Platform maintenance

    Ship management

3. Which unsafe act ultimately led to the accident (the end of the error chain)? (the last fatal action)
4. What were the (unsuccessful) actions (if any) for recovery after the last fatal action as mentioned in question 3?

5. Why were the actions for recovery unsuccessful?

6. Could the accident have been prevented or its effects minimised after the last action and why were they not taken?

7. Which were the unsafe acts and attempts to stop the error chain that led to the last fatal action?

8. Could other actions have stopped the error chain at an early stage and why were they not taken?

9. What was the breakdown of events and conditions (distilled from questions 3 to 8)?

10. Which type of error/violation, psychological precursor and general failure type is connected to the mentioned events and conditions in question 9?

11. Fill in the table.

CAUTION: As yet, the list of questions is not extensive enough for an searching investigation.

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