European Maritime Safety Agency

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SAFETY ANALYSIS OF DATA REPORTED IN EMCIP

ANALYSIS ON MARINE CASUALTIES AND INCIDENTS INVOLVING FISHING VESSELS

April 2018

EMSA

List of Abbreviations / Glossary

AE	Accidental Event. This is an event that is assessed to be inappropriate and significant in the sequence of events that led to the marine casualty or marine incident (e.g. human erroneous action, equipment failure)[1].
AT	Action Taken
AIB	Accident Investigative Body
AI Directive	Directive 2009/18/EC
CF	Contributing Factor. This is a condition that may have contributed to an accident event or worsened its consequence (e.g. man/machine interaction, inadequate illumination)[1].
ECFA	Event and Contributing Factors Analysis
EMCIP	European Marine Casualty Information Platform
FSA	Formal Safety Assessment
F/V	Fishing Vessels
HEA	Human Erroneous Action
LBP	Length between perpendiculars
LOA	Length over all
MS	Member States (EU States, Iceland and Norway)
SA	Safety Area
SI	Safety Issue. This is an issue that encompasses one or more contributing factors and/or other unsafe conditions[1].
SR	Safety Recommendation

Disclaimer

The marine casualty and incident data presented is strictly for information purposes only. The analysis and the statistics presented derive from the data that the AIB of the Member States have reported in the EMCIP. Both reflect the information at the time the data was extracted (01/08/2017). While every care has been taken in preparing the content of the report to avoid errors, the Agency makes no warranty as to the accuracy, completeness or recurrency of the statistics in the report. The Agency shall not be liable for any kind of damages or other claims or demands incurred as a result of incorrect, insufficient or invalid data, or arising out of or in connection with the use, copying or display of the content, to the extent permitted by European and national laws. The information contained in the report should not be construed as legal advice.

[1] As defined in IMO A.28/Res.1075 dated 24/02/2014.

Table of Contents

1. Executive summary

EMSA has developed a methodology to analyse data reported in the European Marine Casualty Information Platform (EMCIP) with the view to detect potential safety issues.

Between July 2017 and December 2017, the Agency has conducted an analysis focused on fishing vessels (F/V) to assess the workability and the effectiveness of such a methodology.

The project has been conducted at two levels:

- A high level analysis of all the reported occurrences, either investigated or not, with a view to prepare general statistics and identify possible trends;
- A more detailed analysis on “Accidental Events”, “Contributing Factors” and “Safety recommendations” based on the investigations that have been completed (occurrences with “Investigation Status” equal to “Finished”).

Seven potential safety issues have been identified for casualties with ships. They have to do with the training and skills of the persons on board F/V, the safety assessment and review carried out for the fishing operation, legislation, standards and their implementation on fishing vessels, the work methods used, maintenance, management factors and tools and hardware (emergency) when fire/explosion are involved.

The safety assessment and the methods used and applied on board F/V were identified also as the main safety issues for occupational accidents.

This result depicts the outcome of data analysis from the reported occurrences in EMCIP and should be the starting point to a process of a more formal and detailed approach on each of the areas of concern.

In this regard, the methodology applied has shown itself to be effective in detecting safety issues, hence supporting the preparation of a solid baseline for any further work related to analysis of data stored in EMCIP.

This document presents the outcome of the analysis and also aims at presenting a template for possible future similar analyses based on the methodology applied.

2. Relevant legislation

The document is based or makes reference to the following legislative or regulatory provisions:

Directive 2009/18/EC establishing the fundamental principles governing the investigation of accidents in the maritime transport sector and amending Council Directive 1999/35/EC and Directive 2002/59/EC of the European Parliament and of the Council.

Directive 97/70/EC setting up a harmonised safety regime for fishing vessels of 24 metres in length and over.

IMO Resolution MSC.255(84) Adoption of the code of the international standards and recommended practices for a safety investigation into a marine casualty or marine incident (Casualty Investigation Code)

IMO Resolution A.1075(28) Guidelines to assist investigators in the implementation of the Casualty Investigation Code (Resolution MSC.255(84))

IMO MSC-MEPC.3/Circ.3 Revised harmonised reporting procedures – Reports required under SOLAS regulation I/21 and MARPOL, articles 8 and 12

IMO MSC-MEPC.3/Circ.4 rev 1 Revised harmonised reporting procedures - Reports required under SOLAS regulations I/21 and XI-1/6, and MARPOL, articles 8 and 12

IMO MSC 92/26/Add.2 featuring the International regulations for the safety of fishing vessels (Torremolinos)

3. Background

This chapter provides the context of the analysis and its goals.

3.1 Assessing safety issues analysing EMCIP data

The European Marine Casualty Information Platform (EMCIP) provides the means to store data and information related to marine casualties and incidents involving: (i) ships flying the flag of one of the MS; (ii) occur within MS's territorial waters as defined by UNCLOS, and; (iii) involve other substantial interest of the MS (e.g., when a EU citizen is involved).

The system contains a wide amount of data concerning notifications and investigations reported by MS as per reporting requirements stemming from Directive 2009/18/EC (hereinafter: AI Directive). Currently, around 19,500 occurrences have been stored in the database; out of them almost 1,000 are investigations and the rest notifications.

Furthermore, around 37,000 occurrences outside the scope of the AI Directive have been reported by MS, including 31,700 "historical" events that occurred before its entry into force.

This information is a useful source to assess qualitative and quantitative characteristics of casualty events, including the root causes of marine casualties and incidents.

General information on the EMCIP system and its model (i.e. the ECFA) is provided in Appendix A.

EMSA has undertaken an assessment of EMCIP data aimed at detecting potential safety issues[1] concerning fishing vessels with a view to prepare periodic reports, pointing out high priority safety issues" that would deserve further consideration.

The following principles have been taken into account for this initiative:

- A data-driven approach (based on EMCIP) has been followed to identify potential safety issues. Safety reports and other sources have been used as complementary sources of intelligence when needed.
- The EMCIP taxonomy was the main tool for better organising the information.

[1] A "safety issue" is defined by the IMO Res.A.1075(78) as an issue that encompasses one or more contributing factors and/or other unsafe conditions.

3.2 Methodology supporting the analysis

The methodology has been structured in the following high-level steps:

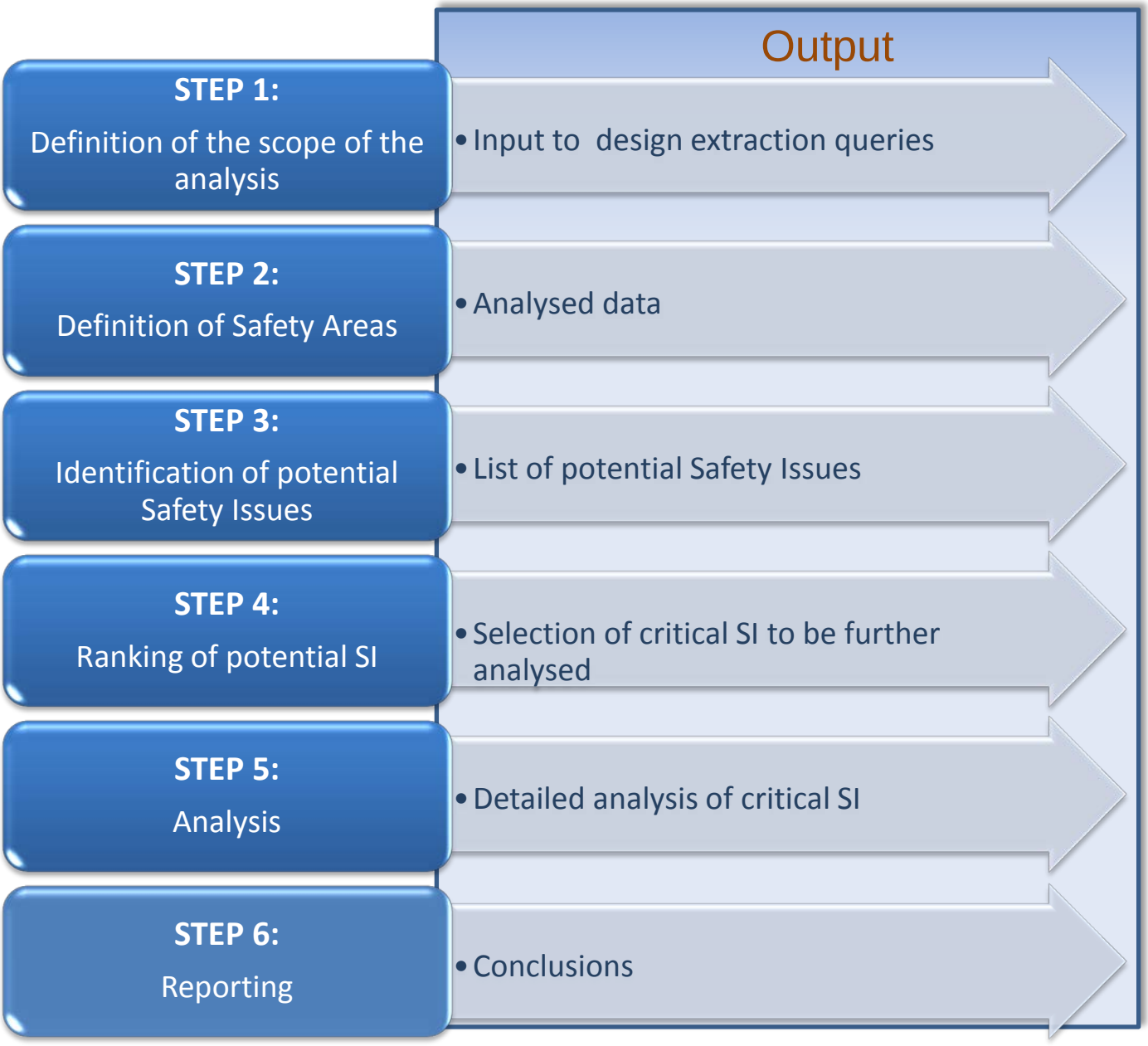

Figure 1 - Analysis scheme

Step 1: Definition of the scope of the analysis

Setting up a clear scope, i.e. the area of interest of the analysis, is pivotal for the overall development of the study, in particular, for designing the relevant EMCIP queries that are instrumental to the extraction of the raw dataset and for the following analysis of data.

Step 2: Definition of Safety Areas (SA)

SA represent areas of concern identified on the basis of the attributes that are available in EMCIP e.g. vessel types or size, events which are the manifestation of the casualty (i.e. “Casualty Event” and “Deviation”), operational modes of the vessel, or any other attribute from the taxonomy provided that enough data is available for analysis.

SA should be derived by combining specific attributes of the taxonomy and have been linked to the potential safety issue (SI) (see next step) to offer more informative value.

Prior to identifying SA, the analyst should:

- Extract the relevant dataset from EMCIP using appropriate extraction queries; and
- Prepare the dataset for the analysis in the interest of data quality.

Step 3: Identification of potential Safety Issues (SI)

The potential Safety Issues (SI) are identified by combining the "Contributing Factors" (CF) and "Accidental Events" (AE) reported in EMCIP within the investigation data.

On an *ad hoc* basis, specific safety reports could be analysed to gather further input on the causes of the marine casualties and incidents scrutinised.

Step 4: Ranking

To optimize resources, the potential SI detected in the previous step should be ranked and the subsequent analysis should be focused on the critical ones.

A semi-quantitative risk assessment encompassing both the frequency of potential safety issues and their consequences could be applied as a workable approach supporting the selection of the substantial issues deserving further assessment.

Step 5: Analysis

Once identified the critical SI, the analyst shoud consider the investigation data reported in EMCIP that contained such SI and, consequently, analyse in detail the information coded in the relevant attributes.

The exercise could also look into the Safety Recommendation proposed by the AIB (and Action Taken) to address the remedial actions and to reinforce the safety barriers.

Step 6: Reporting

The report should provide the conclusions of the data analysis and this could be shared with stakeholders for raising awareness and/or follow-up actions as appropriate (MS, Industry, European Commission, etc.).

Note:

This methodology could be improved in the light of the experience gained.and the feedback from stakeholders..

4. F/V analysis development

This chapter describes how each of the steps of the methodology depicted in the previous chapter has been implemented in the context of the analysis.

The assessment has been conducted at two levels:

- A high level analysis of all the relevant cases, either investigated or not, with a view to define the safety areas and to prepare general statistics and possible trends;
- A more detailed analysis on "Accidental Events", "Contributing Factors" and "Safety recommendations" based on the investigations that have been completed.

In line with the agreed methodology, the analysis has been conducted starting from EMCIP data (bottom-up approach) to end up with the identification of potential SI.

Some statistics relevant to the study are provided in Appendix C.

More detailed statistics concerning the occurrences reported in EMCIP are available in the "Annual Overview of Marine Casualties and Incidents" published by EMSA[1].
Appendix D provides the list of occurrences with finished investigation from which the most of the data relevant for the analysis was taken.

4.1 Step 1: Definition of the scope

The scope of the analysis was the detection of potential safety issues concerning marine casualties and incidents that involved fishing vessels falling within the scope of the AI Directive[2] and that occurred between 17/06/2011 and 01/08/2017.

The selection of this type of vessel has been guided by the following rationales:

- A significant number of occurrences involving fishing vessels is already available in EMCIP;
- F/V were recorded as the type of vessel with most losses within the last EMSA's annual overview of marine casualties and incidents for the period 2011-2016;
- Constructive and operational issues are relatively simpler in comparison with other types of vessels;
- Availability of data (DG MARE's Fleet Register of EU fishing vessels[3] and other sources to obtain figures about the EU fishing vessel population, thus supporting the calculation of safety indicators like "nr. of marine casualties per population").

The following criteria were considered to design the extraction query:

- F/V with "LOA" or "LBP" greater than or equal to 15 metres
- With "Date of Casualty" between 17/06/2011 and 01/08/2017

[1] Available in the EMSA website at http://www.emsa.europa.eu/fc-default-view/tagged/85-annual-overview.html
[2] As per Art.2.2(d) of the AI Directive, this includes the F/V with a length equal or above 15 metres.
[3] Website: http://ec.europa.eu/fisheries/fleet/index.cfm

4.2 Step 2: Definition of Safety Areas

4.2.1 Data extraction

Following the definition of the scope of the analysis, a filter was applied to the attribute "Occurrence Status" in order to purge the "draft" and "deleted" cases.

Eventually, the extraction queries retrieved 2,486 occurrences either investigated or not.

4.2.2 Dataset preparation for analysis

Out of 2,486 occurrences initially obtained, a data check process concluded on a total of 2,404 occurrences that have been considered pertinent for the analysis.

4.2.3 Safety Areas

The most suitable approach was to define SA by grouping specific values of "Casualty Events (CE)" and "Deviation" reported in EMCIP, respectively for "Casualty with a ship" and "Occupational accident"[1].

Defining SA in such a manner had the advantage to ensure a proper categorization in line with the current EMCIP reporting scheme.

Most of the values for the attributes "Casualty Event" and "Deviation" in the EMCIP taxonomy were chosen at "level 1" to create a more compact approach, which allows focusing on a specific area of similar events rather than on a specific event.

The data mapping between the taxonomy values and the SA considered for the study are provided in Appendix B.

For "casualty with a ship" eight SA were defined as per table below. Definitions were taken from the *"Guidelines for notifying marine casualties and incidents in EMCIP"* and adjusted to the specific nature of the project:

SA (Casualties with ships)	Definition
Collision	A casualty caused by ships striking or being struck by another ship, regardless of whether the ships are underway, anchored or moored. This event might involve two or more ships.
Damage to ship / Hull failure	Damage to equipment, system or the ship not covered by any of the other casualty type, including failures affecting the general structural strength of the ship.
Fire/explosion	An uncontrolled ignition of flammable chemicals and other materials on board of a ship. Fire is the uncontrolled process of combustion characterised by heat or smoke or flame or any combination of these. Explosion is an uncontrolled release of energy which causes a pressure discontinuity or blast wave.
Flooding	Event during which the ship is taking water on board. It can be progressive (the water enters gradually) or massive (the water flow is abrupt and considerable).
Foundering	Event during which the ship is taking water on board and eventually sinks.

[1] Definitions on these categories are provided in Annex A.

SA (Casualties with ships)	Definition
Grounding / Contact	Event during which a moving navigating ship, either under command (power), or not under command (drift), strikes the sea bottom, shore or underwater wrecks. Contact is a casualty caused by a ship striking or being struck by an external object, floating, fixed, or flying (the sea bottom is excluded).
Loss of control / containment	A total or temporary loss of the ability to operate or manoeuvre the ship, failure of electric power, or failure to contain on board cargo or other substances. This category includes the following sub-categories: • *Loss of electrical power*: the loss of the electrical supply to the ship or facility • *Loss of propulsion power*: the loss of propulsion because of machinery failure • *Loss of directional control*: the loss of the ability to steer the ship • *Loss of containment*: an accidental spill or damage or loss of cargo or other substances carried on board a ship
Listing/Capsizing	Event during which the ship no longer floats in the right-side-up mode due to: negative initial stability (negative metacentric height), or transversal shift of the centre of gravity, or the impact of external forces. Capsizing refers to a tipped over ship until being disabled, whereas listing concerns a ship with a permanent heel or angle of loll.

Table 1 - Safety Areas for casualty with a ship

The SA for “occupational accident” are listed below:

SA (Occupational accidents)	Definition
Body movement (with or without physical stress)	The effect on the person derives from the movement of the body, either free or under an external stress or pressure. No damage to the ship is implicated. Examples may be: • Walking on a sharp object • Kneeling on, sitting on, leaning against • Being caught or carried away, by something or by momentum • Uncoordinated movements, spurious or untimely actions • Lifting, carrying, standing up • Pushing, pulling • Putting down, bending down • Twisting, turning • Treading badly, twisting leg or ankle, slipping without falling
Breakage, bursting, splitting, slipping, fall, collapse of Material Agent	The effect of the person derives from one or more of the related deviations, however not causing any other damage to the ship. Examples may be: • Breakage of material - at joint, at seams • Breakage, bursting - causing splinters (wood, glass, metal, stone, plastic, others) • Slip, fall, collapse of Material Agent - from above (falling on the victim) • Slip, fall, collapse of Material Agent - from below (dragging the victim down) • Slip, fall, collapse of Material Agent - on the same level
Electrical problems, explosion, fire	The effect on the person derives from some type of electrical problem, explosion or fire which does not affect or cause damage to the ship.

SA (Occupational accidents)	Definition
	Examples may be: • Electrical problem due to equipment failure - leading to indirect contact • Electrical problem - leading to direct contact • Explosion • Fire, flare up
Gas or liquid effects	The effect on the person derives from gas or liquid sources, not causing any damage to the ship. Examples may be: • Solid state - overflowing, overturning • Liquid state - leaking, oozing, flowing, splashing, spraying • Gaseous state - vaporisation, aerosol formation, gas formation • Pulverulent material - smoke generation, dust/particles in suspension/emission
Loss of control	The effect on the person derives from the loss of control of an equipment, material agent, etc. but without any damage to the ship. Examples may be: • Loss of control (total or partial) - of machine (including unwanted start-up) or of the material being worked by the machine • Loss of control (total or partial) - of means of transport or handling equipment, (motorised or not) • Loss of control (total or partial) - of hand-held tool (motorised or not) or of the material being worked by the tool • Loss of control (total or partial) - of object (being carried, moved, handled, etc.) • Loss of control (total or partial) - of animal
Shock, fright, violence, aggression, threat, presence	The effect on the person derives from the relevant deviations, without any damage to the ship. Examples may be: • Shock, fright • Violence, aggression, threat - between company employees subjected to the employer's authority • Violence, aggression, threat - from people external to the company towards victims performing their duties (bank hold-up, bus drivers, etc.) • Aggression, jostle - by animal • Presence of the victim or of a third person in itself creating a danger for oneself and possibly others
Slipping - Stumbling and falling - Fall of persons	The effect on the person derives from slipping, stumbling or falling whether on board or overboard. Examples may be: • Fall of person - to a lower level • Slipping - Stumbling and falling - Fall of person - on the same level • Fall overboard of person
Other	Other types of accidents and deviations, not classified under the rest categories

Table 2: SA for occupational accident

Detailed figures concerning frequency of SA, SA in investigated cases and consequences for the detected SA are provided in Appendix C.

The analysis that followed has been conducted on all SA to give a better understanding of horizontal safety issues that could be common to different SA.

4.3 Step 3: Identification of potential Safety Issues

For each SA as defined in the previous section, Safety Issues (SI) have been identified through the analysis of Contributing Factors (CF) and Accidental Events (AE).

Unlike the previous step, only completed investigations were considered to identify SI[1], since these occurrences have obtained a full mapping and reporting of all identified AE and CF.

The occurrence severity classification is based on the three levels provided by IMO Circ. MSC-MEPC.3/Circ.4/Rev.1:

- **Very Serious (VS) marine casualty**: means a marine casualty involving the total loss of the ship or a death or severe damage to the environment.
- **Marine Casualties other than VS (MC):** means an event, or a sequence of events, that has resulted in any of the following which has occurred directly in connection with the operations of a ship:
    - serious injury to a person;
    - material damage to a ship;
    - the stranding or disabling of a ship, or the involvement of a ship in a collision;
    - material damage to marine infrastructure external to a ship, that could seriously endanger the safety of the ship, another ship or an individual; or
    - the potential for severe damage to the environment, brought about by the damage of a ship or ships.
- **Marine Incident (MI):** means an event, or sequence of events, other than a marine casualty, which has occurred directly in connection with the operations of a ship that endangered, or, if not corrected, would endanger the safety of the ship, its occupants or any other person or the environment.

As per AI Directive, all very serious occurrences – meaning the ones with the most severe consequences – have to be investigated, while for the rest of the occurrences the decision to investigate includes a preliminary assessment by the AIB of their importance in terms of safety; therefore, if investigated, these occurrences have already been assessed as significant.

Out of 2,404 occurrences analysed for the analysis, 196 cases were investigated by AIB (8,15%) with a clear majority (67%) of them being “Very Serious” marine casualties. Moreover, investigations were also conducted on “Marine Casualties other than VS” (32%) and on “Marine Incidents” (1%).

For further details on the investigated cases as per SA, please refer to Appendix C.

4.3.1 Defining Safety Issues

According to its definition[2], a SI encompasses one or more CF and/or other unsafe conditions. To proceed with our analysis, the CFs of the investigations reported in EMCIP have been mapped into homogenous categories to form the SI.

13 categories of SI were identified for the present analysis, based on the description of CF, their codification in EMCIP as well as the professional judgement of the analysts.. When the description was unclear or missing, the CF coding or the AE description were used as complementary items to decide the classification to a SI.

These categories of SI are included in the following table:

[1] Investigation status: “Finished”
[2] Annex to IMO Res.A.1075(28)

SI	Definition
Anthropometric or personal factors	The focus is on issues that have to do with the status (physical or psychological) of a person involved, or dimensions affecting the human decisions, performance or actions. For example the consumption of alcohol that affect the physical and psychological performance of a person will be classified here.
Emergency handling	It concerns the processes or actions made during an emergency status. An example would be the appropriateness of the actions carried out to suppress a fire in the engine room.
Fatigue	It relates to the fatigue of the person(s) involved; this may encompass worktime issues as well as rest duration and periods. For example the limited hours of rest prior to the accident, for a key person involved in the accident.
Legislation, standards and compliance	The subject here has to do with legislative provisions, rules and standards at vessel, company, national or international level; it also includes issues related to inspections, non-compliance, inadequacy or non-existence of the aforementioned provisions. An example would be the inadequate conduction of an inspection or the non-compliance of a vessel with a legislative provision or rule, or even the non-existence of a standard on critical vessel equipment.
Maintenance	It has to do with the processes and actions of maintenance of the vessel, her equipment or mechanical parts. An example would be the poor maintenance of a mechanism that was critical to the accident.
Management factors	It stands directly to the managerial environment of the vessel (owner or management company as per case may be) and the organizational system behind that. Low manning, or insufficient promotion of safety on behalf of the management of the vessel, would be some examples in this category.
Natural environment	It relates to phenomena or conditions of the natural environment. Strong wind or tide effects would be classified here.
Planning and procedures	It relates to the plans and procedures that are kept on board a vessel or a company; it may include non-compliance, inadequacy or non-existence of such plans and procedures. For example voyage planning, or procedures for familiarization or training on board would be attributed to this category.
Safety assessment – review	The main subject has to do with safety or risk assessment, mostly situational, and its conclusions; it may include non-compliance, inadequacy or non-conduction of such an assessment. Leaving port under adverse weather conditions, overloading with fisheries and reducing freeboard or stepping at a specific part of the vessel which does not offer protection against moving fishing gear are examples of poor safety assessment; not implementing guidelines for personal protection by the skipper or the company is another example of not complying with safety review.
Tools and hardware (design or operation)	It relates to the design or operation of the vessel or certain of her equipment or tools used on board. The non-operation of a navigational light, the poor design or ergonomy of a vessel's railings and the wrong tool used for guiding the net's recovery from the sea are examples of this category. (NOTE: the tools and hardware that are related to emergency

SI	Definition
	situations and precautions are subject to the next category).
Tools and hardware (emergency)	It encompasses the safety equipment or safety mechanisms that are used during an emergency and may include their operation, design or existence on board a vessel. The absence of a bilge alarm, the poor design or placement of the control panel of a fixed fire extinguishing system, or the insufficient existence of life saving appliances would belong to this group of safety issues.
Training and skills	It relates to the levels of training and skills acquired by the involved persons. Inadequate training or insufficient skills of a key person involved in the accident will be subject to this category.
Work / operation methods	It relates to the processes and the ways they are carried out on board the vessel. The way the bridge is manned when a fishing vessel is operating for many hours or during fishing operations, the storage of the fisheries on board, cleaning of the deck and the use of navigational aids during the voyage are some examples of factors that would be classified here.

Table 3: SI and their definitions

It should be noted that a CF may attributed to more than one SI.This is due to the fact that SI may sometimes even be related among them, or have certain logical links. Such a possibility is dependent especially on the particular characteristics of the vessel type, operation and company/managerial status and policies. For example, a CF that reflects a poor maintenance policy may be directly related with the SI of maintenance, but it may also have relation to the planning and procedures (if maintenance was not properly planned or processed), to the safety assessment or review (if such poor maintenance was not conceived as a risk factor) or even to the management factors (if management did not consider maintenance as an important aspect in its policy).

However, the approach taken for the analysis was to keep the maximum cohesion with the analysis reported in EMCIP by the investigator (with the exception of missing or inconsistent data), therefore, a great effort was put to link **each CF only to one SI** that was more obviously related to, without making assumptions for possible additional SI, unless clearly mentioned in the CF description or coding.

Safety reports were occasionally consulted when data reported in EMCIP was not sufficiently clear to detect the relevant SI. Since each investigation may include more than 1 contributing factor in its analysis, it should be noted that the number of SI is greater than the number of investigations considered for this exercise.

4.4 Step 4: Ranking SI

Frequency alone cannot determine the importance of a SI. Such assessment should also embrace the impact of the SI in terms of significance of risks, to evaluate the necessity of establishing an action plan to deal with enhancing protection barriers against the specific SI.

Therefore, a semi-quantitative risk assessment has been considered to support the ranking of the SI detected, where the level of risk assigned to a hazard is the combination of its frequency of adverse consequences and the severity of those adverse consequences.

EMCIP taxonomy offers a wide characterisation of the consequences associated to marine casualties. For the study, the following categories have been considered particularly significant:

- Lives lost
- People Injured
- Ships sunk
- Pollution (bunkers)

The combination of the SI frequency with the consequences is provided in the following tables. It should be kept in mind that the consequences described are referred to the investigated cases; therefore the outcome of the occurrence could be referred to more SA and SI.

Safety Issues	Safety Areas (investigated cases)									Consequences (investigated cases)			
	Fire/ Explosion	Flooding	Collision	Grounding/ Contact	Foundering	Listing/ Capsizing	Damage to ship/ hull failure	Loss of control/ contain-ment	TOTAL	Lives lost[1]	People injured	Ships sunk	Pollution - bunkers (Tons)
Training and skills	14	6	9	7	5	3	0	2	46	8	5	17	4191
Safety assessment – review	6	4	11	9	2	4	3	1	40	25	7	19	699
Legislation, rules and standards	10	11	3	2	5	2	0	0	33	7	4	16	349
Work / operation methods	5	4	9	0	4	2	2	1	27	5	4	11	223
Maintenance	10	5	0	0	5	0	1	2	23	0	1	13	121
Tools and hardware design or operation	7	3	1	1	3	0	4	2	21	5	1	11	245
Tools and hardware (emergency)	11	6	0	0	3	0	0	0	20	0	1	12	217
Planning and procedures	6	1	2	5	1	0	2	0	17	6	1	9	202
Management factors	2	4	5	3	1	1	1	0	17	10	0	10	10
Anthropometric or personal factors	1	3	3	4	2	1	0	1	15	8	1	9	30
Emergency handling	5	1	1	0	1	4	0	3	15	3	0	8	65
Fatigue	0	1	4	5	0	0	0	0	10	5	1	3	0
Natural environment	0	1	1	1	0	1	0	0	4	0	1	4	28

Table 4: Risk assessment table for casualties with ships

[1] The figures concerning fatalities are higher than “people injured” because most of the investigations concern “Very Serious” marine casuaties

Safety Issues	Safety Areas (investigated cases)						Consequences (investigated cases)	
	Body movement (with or without physical stress)	Breakage, bursting, splitting, slipping, fall, collapse of Material Agent	Gas or liquid effect[1]	Loss of control	Slipping - Stumbling and falling - Fall of persons	TOTAL	Lives lost	People injured
Safety assessment – review	7	2	0	3	7	19	9	4
Work / operation methods	11	1	1	2	4	19	10	3
Tools and hardware design or operation	4	1	0	5	3	13	7	4
Training and skills	4	0	0	2	4	10	4	1
Planning and procedures	4	0	0	2	1	7	4	1
Tools and hardware (emergency)	1	0	2	1	2	6	6	0
Legislation, rules and standards	4	0	0	0	1	5	4	1
Anthropometric or personal factors	2	0	0	1	1	4	3	0
Natural environment	0	3	0	0	1	4	2	1
Maintenance	0	1	1	0	1	3	3	1
Emergency handling	0	0	1	1	1	3	4	0
Management factors	3	0	0	0	0	3	1	0
Fatigue	3	0	0	0	0	3	1	0

Table 5: Risk assessment table for occupational accidents

[1] Includes one occurrence classified under the SA: Electrical problems, explosion, fire

It should be noted that upon the figures of the statistical analysis (frequency of SI and relevant consequences) as well as the professional judgement of the EMSA analysts involved in the study, the prioritisation of the above SI has been conducted on the basis of their reported frequency and consequences.

Considering the semi-quantitative analysis above, the top SI for “Casualty with a ship” are (highlighted in yellow within the previous tables):

1. **Training and skills**
2. **Safety assessment – review**
3. **Legislation, rules and standards**
4. **Work / operation methods**
5. **Maintenance**
6. **Management factors**
7. **Tools and hardware (emergency)** limited to fire/explosion due to the peak in frequency for such a SA**.**

Top SI for “Occupational accident” are:

1. **Safety assessment – review**
2. **Work / operation methods**

5. Step 5: Analysis

The subsequent analysis was focused on the top safety issues and a number of attributes (CF description, CF coding and context of event) were assessed to consolidate the areas of concern.

Two separate analyses were conducted, respectively for casualties with ships and occupational accidents.

5.1 Casualty with a ship

This section focuses on looking more thoroughly into the seven SI prioritized in the previous step for the category "casualty with a ship" (Table 4) after the assessment was carried out in terms of frequency and consequences related to the respective CF.

5.1.1 Training and skills

Training is the most common means for transferring knowledge and acquiring skills, and it plays a key role in keeping fishermen safe. Nevertheless, investigations reported in EMCIP suggest that training often is not effectively provided and drills are not regularly practised.

During the period considered, issues related to training and skills were detected 46 times within 26 safety investigations, thus making this SI the most frequently reported in EMCIP.

Table 4 clearly shows that the SA mainly concerned by this issue are "Fire/Explosion" (14 times) and "Collision" (9 times).

Training issues reported in EMCIP affect mostly the following areas:

- ***Dealing with emergency***: it is the case of lack of knowledge or skills to promptly detect alarms, to assess a dangerous situation particularly during the events of fire (to close fire doors and ventilation) and flooding (to seal the E/R or to close watertight openings), to properly evacuate the ship and to correctly use life-saving equipment.
- ***Knowledge of on board equipment and procedures***: this is about lack of skills and knowledge about essential ship's equipment or procedures. Issues were found in the lack of familiarization with the electrical rudder control system (particularly to switch from electrical to manual and vice versa), with the ventilation systems and with the pitch control devices. Lack of skills was also found to set up effective systems to prevent collisions and to perform radio communications with other ships, particularly due to difficulties to communicate in an international language. Lack of knowledge of the rules to prevent collision (COLREGs) was also reported. Weak nautical skills, particularly to assess the impact of tidal stream and the safe anchoring, were found as well.
- ***Establishment of an effective training programme and implementation of the required training and drills***: this issue is related to the missing or ineffective training provided to the fishermen, particularly in the area of fire-fighting and use of life-saving appliances.
  Another issue that was reported by AIB is about the lack of drills, particularly to cope with flooding and fire-fighting. An inadequate training programme for keeping safe navigation was also reported.

In investigation reports, where the "training and skills" SI has been identified, the relevant recommendations that address this issue, deal mostly with training and acquirement of skills on proper watch-keeping, especially concerning COLREG and emergency situations (conduction of drills). Other issues addressed by the issuance of safety recommendations have to do with the familiarization with the vessel's safety equipment and the swimming skills that the fishermen should possess.

5.1.2 Safety assessment – review

Safety and risk assessment and reviews of tasks, methods, procedures or processes based on such assessment are important tools that are part of the safety culture on board all types of vessels. Unlike other highly "procedurized" industries, such as nuclear energy production, in the maritime industry decision making of key persons within the different types of operations appears as an important factor and it has a great impact on the results of the relevant actions taken. Thus, if not preceded by at least a basic safety assessment it may lead to unexpected and unwanted events, especially in sub-sectors like the fishing vessel operations, which in principle lack in most cases of strict pre-defined procedures and processes in terms of safety or quality management systems.

As it appears from the data analysis from the EMCIP, the group of issues under Safety assessment – review are quite prominent in significance. In fact, this specific SI has the highest consequence risk grade, in all the considered areas (lives lost, people injured, vessels sunk) apart from pollution. It can be characterised as the most "fatal" in terms of casualties with ship(s)[1], topping the list of fatalities per SI, with a toll of 25 lives lost, as well as the list of injured persons with a total of 7. It has also led to the highest figure of fishing vessels sunk, with a total of 19 vessels.

A total of 32 investigation reports comprise contributing factors that have been classified under safety assessment – review, with 40 different CF classified as such. It is notable that the dispersion of this SI covers all the SA identified. However, the SA where safety assessment – review is more prominent is Collision (11 relevant CF) followed by Grounding / Contact (9 relevant CF), in which it is also the most frequent SI of all.

The particular areas that are mostly discerned concerning this SI, as reported in the EMCIP are the following:

- ***Safety assessment on the wheelhouse***: the assessment of collision or grounding risks by the skipper or crewmember on the wheel and the lack or inadequacy of actions taken to mitigate such risks are frequently reported as contributing factors to accidents. Whether it has to do with proper look out, the interaction and confrontation with other vessels or avoidance of navigational dangers, it appears from the reported data that the person(s) in charge of navigating the vessel lacks the efficiency or effectiveness of safety assessment which hinders timely decision making and acting and may in turn lead to critical situations. Also, not correctly assessing the vessel's limitations (concerning areas of navigation and adverse weather conditions) has been reported to have contributed to listing/capsizing and foundering consequences.
  Finally, the inadequate or improper use of navigational aids for situational assessment, such as radar, AIS or even communication systems, has been mentioned as contributing factor especially in collisions.
- ***Safety assessment on water ingress***: the improper assessment on closure of watertight or weathertight openings during operation and the poor assessment of water ingress in cases of flooding has been reported to have led to critical situations for fishing vessels being flooded, capsized or foundered.
- ***Assessment of tools' and aids' status*****:** the status of equipment on board that may in turn assist in the proper safety assessment, especially in critical and emergency situations, is significant for the vessel's safety. Fire alarms and bilge water level alarms have been reported either not working or malfunctioning. This suggests that had their operational status been assessed and troubleshot, problems would have been solved and critical input for unsafe situations (timely fire or water high level detection) might have been provided.

[1] Casualties that include damage to the vessel or her equipment and infrastructure (for further details see Appendix A)

In terms of relevant safety recommendations addressing this SI, it is suggested that specific measures should be taken on the promotion of safe practices on watch-keeping and look-out as well as the use of navigational equipment and aids, along with the respective training and the closing of watertight and weathertight openings during operation.

Other issues coped with safety recommendations are the assessment and compliance with the vessel's operational limitations and the scheduling of maintenance cycles according to the manufacturer's instructions.

5.1.3 Legislation, standards and compliance

This SI is synthesized by the combination of lack or inadequacy of any legislation and rules, the level of safety standards followed on board the vessel and the compliance to the aforementioned; it also has to do with the quality of inspection carried out on board. The consequences related with contributing factors classified under this SI count mostly for the sinking of fishing vessels (16 vessels sunk) while 7 lives were lost and 4 injuries have been reported related to this SI.

The total of 33 CF that have been classified under this safety issue exist in 23 different safety investigations. The main SA where the SI is related is Flooding (11 CF) followed by Fire/Explosion (10 CF), while the dispersion of the SI is extending to most of the rest SA as well.

The areas that are mainly identified under this SI are:

- ***Inspection and compliance with safety provisions for fishing vessels***: the compliance of fishing levels to the provisions of safety legislation is an area of concern. Occurrences in which the standards of safety were inadequate due to poor inspection by the crew, the repair yard or the certification inspectors have been recorded. Poor hull integrity and water tightness or leakage checks, inadequate inspection of the operational status of seawater pumps, undetected lube-oil pipework leaks, lack of AIS installation, statutory surveys not carried out are some characteristic examples in this domain. Moreover, there are occurrences where compliance with some legislative provisions was not achieved in operational modes, like STCW-F standards on recruiting crewmembers, COLREG rules for safe navigation, or sailing outside the approved navigational areas.
- ***Applicable standards for fishing vessels***: a series of safety provisions, deriving from international safety legislation are not applicable for fishing vessels (due to vessel type exclusion); however this has been reported in some cases as a CF for inadequate safety standards. Cases reported in EMCIP have to do mostly with fire-detecting and fire-fighting equipment and relevant national provisions for fishing vessels, which are not up to the standards set by the SOLAS Convention.

The safety recommendations that are related to this SI focus mostly on studying and revising the provisions for safety equipment F/V, especially on fire detection and protection, reminding that provisions should be followed, focusing on permission of navigating to the areas respective of the vessel's certification and operation and suggesting tips for improving the inspections and surveys carried out on board F/V. Also training on legislative provisions, mostly on COLREG and watch-keeping are recommended, in order to improve the efficient compliance with such provisions.

5.1.4 Work / operation methods

The methods used for the various tasks on board the fishing vessels are quite often deriving from mere incorporation of practical experience and casual needs in daily routines of the crewmembers. Thus, such methods may sometimes contain latent factors that threaten or pose a risk to safety and may create the ground of casualties. 22 reported cases contain 27 contributing factors that have been classified under the SI of work operation methods. Their dispersion covers almost all the SA, however

the most prominent SA is collision (9 times). 5 lives lost, 4 injuries and 11 sunk fishing vessels are connected with this SI.

The particular areas of concern under this SI are:

- ***Watch-keeping on the bridge:*** the manning of the bridge as well as the practice of watch-keeping itself is quite important, especially in cases of collision. Some casualties have been reported with no one on the bridge; in some others the efficiency of the only person on the bridge to follow or apply basic navigational rules or to keep a proper look-out, was questionable or deemed inadequate. More important is that poor practices related to watch-keeping have been reported by the investigators as recurrent issues on board fishing vessels involved in accidents, which means that they did not happen occasionally.
- ***Operating around the limit of "unsafe":*** in some occurrences the various operations of the skipper or the crew on board do not seem to follow a "safety" priority. This may be due to working time restrictions, or the general operative and economic pressure which often characterises the fishing profession. Leaving hatch openings open after loading operations had finished, not securing mooring lines, sailing with the AIS switched off, not checking the fuel flow of a flexible pipe which was rolled near a hot exhaust pipe and sailing further than the vessel's certification allowed are some examples in this area.

A look into the SR that are related to investigations where work / operation methods was identified as a SI, provides mostly for remedial actions through training and skills on vessel navigation, collision avoidance and safe manning of the bridge. Moreover, the safety promotion or awareness campaign (on behalf mostly of F/V operators as well as authorities) on operational methods and practices, including navigating within the specified sea areas in terms of construction specifications and certification, VHF communication with VTS and other ships, use of AIS has been the subject of recommendations on this SI.

5.1.5 Maintenance

Fishing vessels are a special category of vessel type in relation to their construction, their size and the conditions of their operation. For example, unlike other common ship types, the open deck of a fishing vessel is constantly washed by sea water, since their freeboard is relatively low and the product or the tools of their operation are primarily collected or stored on this deck directly from the sea. Moreover, adverse weather conditions may have significant impact on fishing vessels, rather than other types of larger commercial vessels. Such impact may be cumulative and not obvious; therefore the conduction of proper maintenance appears to be of major importance in terms of safety status.

Factors which have been classified as maintenance issues have been reported 23 times in a total of 16 investigation reports. The majority of these concerns maintenance issues against fire (10 times), flooding (5 times) and foundering (5 times). The impact of the "maintenance" SI has consequences in terms of the 13 vessels that have sunk, while 1 injury has been reported in occurrences where maintenance was identified as SI.

The main areas of concern under maintenance have been consolidated as below:

- ***Prioritization and standards of maintenance:*** occurrences were reported in which there was mere absence of maintenance or maintenance system on board the vessel. There were also cases in which despite maintenance was carried out (by the crew or external technicians), lack of skills or poor techniques used resulted in the outcome failing to ensure safety and quality standards, e.g. against water tightness of the hull or piping systems (cooling water or fuel), or insulation and protection against heat, or even the securing of the cable of the gear transition system from the bridge. In other cases it was also identified that the maintenance instructions provided by the manufacturers were not followed or maintenance was carried out reactively (after an occurrence or breakdown).

- ***Inspection and testing of equipment (for maintenance reasons):*** effects from physical fatigue, vibration or heat were reported on various parts of the vessel, especially concerning insulation of pipes against heat or water ingress and leaks from seawater cooling pipes or fuel pipes. However, the poor status of this equipment could be sometimes identified by proper inspection from the crew and subsequent maintenance actions might have prevented the occurrence. Also, equipment and mechanisms that exist for emergency safety reasons on board a fishing vessel should be tested for their operation before emergencies occur. Bilge pumps and alarms as well as fire detectors were reported not to be functioning, when the situation necessitated due to maintenance reasons.

Safety recommendations in reports that include maintenance as SI, relate to the establishment of effective monitoring of maintenance and inspection of equipment, verification of proper repair and maintenance works as well as of proper operation of water level detectors.

5.1.6 Management factors

Management of fishing vessels is quite peculiar in comparison to other types of vessels. The small company or fleet size (sometimes down to only one vessel), the relation that often appears between the owner/manager and the skipper (sometimes is the same person or member of the same family), as well as the non-existence of obligatory international provisions for the safe management (ISM) of F/V, might renders the management of such vessels not as prominent in terms of safety, as in other types of vessels. In fact, it is an exceptional SI that was regarded in our further analysis not due to its frequency in terms of reported and respectively classified CF (17 CF in a total of 14 investigated occurrences), but mainly due to its impact in terms of consequences in the accidents that such a SI was identified. A total toll of 10 lives lost and 10 vessels sunk, renders this SI quite important and its relative influence quite significant.

The main areas that comprise this SI are:

- ***Manning of fishing vessels:*** the low number of crew members on board is the most common issue that is directly linked with the management of the fishing vessels. This is in particular related to the person(s) qualified and in charge of the navigation of the vessel (skipper) which is usually one and may also participate in the fishing activities. In combination with the extended working schedules, such a multiple role is often influencing the skipper's alertness and performance in general as well as the prioritization of tasks, affecting the safety standards on board. Also, quality and skills of the crew in relation with the selection policy appeared as a contributing factor, as well as the fact that the registered number of persons on board the vessel might be different than the actual one.
- ***Promotion of safety:*** the policy of the management on board fishing vessels, in terms of inadequate safety standards is identified under this SI as well. This area consists of reference to various other SI from the point of management: operational and safety fitness of the vessel in terms of proper maintenance, pressure for improving the catch, lack of procedures for safety are some of the factors that were reported by the investigators in this context.

The relevant recommendations here aim mostly at ensuring that proper manning of the bridge and safe navigation will be carried out on board the F/V managed by a company. Also focus was on the assessment of safety hazards on board by the crew and the processes and procedures followed to ensure safety of navigation, in terms of skills and manning of the bridge, keeping watertight openings closed as well as operating within areas of navigation in accordance with vessel limitations.

5.1.7 Fire/explosion and tools and hardware (emergency)

This particular SI is noticed as a peak in terms of frequency of CF reported in connection with the SA "fire/explosion". Consisting of 11 CF reported in 5 investigations, in which the consequences counted for 4 vessels sunk and 1 injury to person, the main area of concern on this SI is:

- ***Design and operation of systems in place in case of fire:*** design of systems in place for fire fighting purposes has been reported to be ineffective in a case of fire in the engine room, since all the controls for activation of the fixed fire fighting system as well as the system to cut the ventilation were placed only in the engine room, thus they were not accessible. In another case, a system to cut the fuel supply to the engines did not exist, neither a fixed fire extinguishing system (vessel LOA=23.00m), while non-operation of fire detectors and inability to hear the fire alarm outside the wheel house were also reported as CF in other accidents.

Relevant recommendations were made, to install controls of the fixed fire fighting system outside the engine room or to install a remote release system in the wheelhouse.

5.2 Occupational accident

This section details the analysis carried out on the 2 high priority SI for "occupational accident".

5.2.1 Safety assessment – review

"Fishing at sea is probably the most dangerous occupation in the world"[1]. Life on board a fishing vessel, especially due to the peculiar layout of the vessel as well as to the nature of the fishing profession conceals a number of risks, on a daily basis. Risk or safety assessment may be run on two levels: the management level and personal level, depending on the nature of the task or action assessed. If however, a proper assessment is not carried out previous to any actions on board, the risks may evolve to dangers and eventually to casualties.

"Safety assessment – review" is a SI which has been identified in 13 investigations, with a total of 19 CF that have been reported in respect. The consequences in investigated occurrences where safety assessment – review is a SI are 9 deaths and 4 injuries to persons in total. Most of these occupational accidents were codified relating to body movement (7 times) and slipping, stumbling and falling of a person (7 times).

The main areas identified within this SI are:

- ***Keeping unsafe position on board:*** the position of crew members tasked in fishing operations is often risky, especially when it has to do with proximity to mechanical equipment or fishing tools that are mechanically driven (trawls, nets, etc.). Also cases of unsafe positioning in which the crewmember was affected by weather / sea conditions were reported. Therefore, the assessment of the dangers of positioning on board appears to be prominent within the safety investigations reported in the EMCIP.
- ***Use of lifejackets:*** the use of lifejackets during operations on board the vessel, especially under adverse weather / sea conditions, is a practice that usually derives from a proper safety assessment. It has been reported that crewmembers that were swept overboard due to rough seas were not wearing lifejackets either during unmooring operations or during normal passage and fishing operations.

[1] FAO Safety for fishermen website (http://www.fao.org/fishery/safety-for-fishermen/en/)

Safety recommendations made in reports that include CF classified under the safety assessment and review SI refer mostly in assessing risks and hazards connected to tasks on board, taking steps to promote the safe operation as well as the use of safety equipment and carry out emergency drills, focusing on MOB drills. Also the separation by physical means of the dangerous zones on board a F/V has been recommended.

5.2.2 Work / operation methods

Procedures on board fishing vessels are usually limited and most operative actions are carried out based on skills, techniques and experience on the job. Therefore, the methods followed are quite prone to performance variability, leaving grounds for unsafe practices and latent risks.

19 CF, reported in 13 investigations have been classified under the SI of Work / operation methods. Most of them had to do with occupational accidents that were reported in relation with body movement (11 times). The consequences of these accidents rated to 10 deaths and 3 injuries to persons.

The main areas of concern under this SI are:

- ***Poor supervision or communication:*** tasks carried out on board a fishing vessel may include dangers if loose supervision is applied. Stepping outside the safety rails or on a net that is being hauled in, moving or positioning oneself in a dangerous spot, not applying the normal safety precautions during the cleaning of a conveyor belt without being instructed or warned are examples of poor supervision; miscommunication or no communication at all before performing some tasks like hauling in a net, trying to release a snagged net or repairing a manhole are some reported examples of poor communication on board fishing vessels.
- ***Operating around the limit of "unsafe":*** fishing vessels are mainly operating under a catch maximization focus. This may result in operating under pressure and without considering certain specifications or limitations of the vessel or the tools used, creating dangerous situations for the persons on board. Relevant occurrences that have been reported in this scope have to do with sailing or working on deck under adverse weather / sea conditions, overloading of equipment (rope stopper) and an unsafe attempt to remark a trawl warp in order to save time.

For safety recommendations in reports that contain issues within the group of work / operation methods' SI, the focus is mostly on assessing hazards and creating procedures as well as communicating them to the crew. While being mostly generic on that, some of the recommendations specify the object or area of remedial action, such as the installation of alternate means control of a winch, the removal of materials from the deck that may create tripping dangers, installation of a camera overlooking the aft part of a vessel which is not visible from the wheelhouse or highlight the places on board a seiner where access is not allowed during fishing operations.

6. Conclusions

This study has focused on analysing the data of safety investigation as reported in EMCIP, in search of identification of categories of SI and more specific areas of concern within each SI. The consolidated result of this exercise is summarized in the following table:

Nature of occurrence	SI	Area of concern	Main SR
Casualty with ship	Training and skills	Dealing with emergency	SR addressing this issue deal mostly with training and acquirement of skills on proper watch-keeping, especially concerning COLREG and emergency situations (conduction of drills). Other SR focused on the familiarization with the vessel's safety equipment and the swimming skills that the fishermen should possess.
		Knowledge of on board equipment and procedures	
		Establishment of an effective training programme and implementation of the required training and drills	
	Safety assessment – review	Safety assessment on the wheelhouse	SR addressing this issue suggested that specific measures should be taken on the promotion of safe practices on watch-keeping and look-out as well as the use of navigational equipment and aids, along with the respective training and the closing of watertight and weathertight openings during operation. Other issues tackled by SR are the assessment and compliance with the vessel's operational limitations and the scheduling of maintenance cycles according to the manufacturer's instructions.
		Safety assessment on water ingress	
		Assessment of tools' and aids' status	
	Legislation, standards and compliance	Inspection and compliance with safety provisions for fishing vessels	SR related to this SI focus mostly on studying and revising the provisions for safety equipment F/V, especially on fire detection and protection, reminding that provisions should be followed, focusing on permission of navigating to the areas respective of the vessel's certification and operation and suggesting tips for improving the inspections and surveys carried out on board F/V. Also training on legislative provisions, mostly on COLREG and watch-keeping are recommended, in order to improve the efficient compliance with such provisions
		Applicable standards for fishing vessels	

Casualty with ship (cont.)	**Work / operation methods**	Watch-keeping on the bridge	SR related to this SI provided mostly for remedial actions through training and skills on vessel navigation, collision avoidance and safe manning of the bridge. Moreover, the safety promotion or awareness campaign (on behalf mostly of F/V operators as well as authorities) on operational methods and practices, including navigating within the specified sea areas in terms of construction specifications and certification, VHF communication with VTS and other ships, use of AIS has been the subject of recommendations on this SI.
		Operating around the limit of "unsafe"	
	Maintenance	Prioritization and standards of maintenance	SR relate to the establishment of effective monitoring of maintenance and inspection of equipment, verification of proper repair and maintenance works as well as of proper operation of water level detectors
		Inspection and testing of equipment (for maintenance reasons)	
	Management factors	Manning of fishing vessels	SR aim mostly at ensuring that proper manning of the bridge and safe navigation will be carried out on board the F/V managed by a company. Also focus was on the assessment of safety hazards on board by the crew and the processes and procedures followed to ensure safety of navigation, in terms of skills and manning of the bridge, keeping watertight openings closed as well as operating within areas of navigation in accordance with vessel limitations
		Promotion of safety	
	Fire / explosion and tools and hardware	Design and operation of systems in place in case of fire	Relevant SR were made to install controls of the fixed fire fighting system outside the engine room or to install a remote release system in the wheelhouse.
Occupational accident	**Safety assessment / review**	Unsafe positioning on board	SR refer mostly in assessing risks and hazards connected to tasks on board, taking steps to promote the safe operation as well as the use of safety equipment and carry out emergency drills, focusing on MOB drills. Also the separation by physical means of the dangerous zones on board a F/V has been recommended.
		Use of lifejackets	
	Work / operation methods	Poor supervision or communication	SR focus mostly on assessing hazards and creating procedures as well as communicating them to the crew. Some SR specify the object or area of remedial action, such as the installation of alternate means control of a winch, the removal of materials from the deck that may create tripping dangers, installation of a camera overlooking the aft part of a vessel which is not visible from the wheelhouse or highlight the places on board a seiner where access is not allowed during fishing operations
		Operating around the limit of "unsafe"	

Table 6 - Consolidation of SI and areas of concern

The outcome of the data analysis from the reported occurrences in EMCIP could be the starting point to a process of a more formal and detailed approach on each of the areas of concern in the appropriate instances.

Appendix A EMCIP system: an overview

EMCIP was established based on the provisions of article 17 of the European Directive 2009/18/EC, to serve the Member States and the Commission as an electronic database to store and provide data for analysis and interface amongst them. Thus, EMCIP can be accessed by the Commission and EMSA as well as the Member States' (and EFTA) investigative bodies and entitled authorities.

EU and EFTA Member States have an obligation to store all data on marine casualties and incidents in EMCIP. To achieve this, a number of specific information has to be inserted in the platform1.

The minimum data stored on EMCIP per occurrence, provide the requested information according to the mandatory notification data requested in Annex II of the AI Directive and the definitions provided by Resolution MSC.255 (84) of the IMO, Resolution A.1075(28) and MSC-MEPC.3 Circular 3, as amended. Moreover, a complementary taxonomy of data has been created by EMSA to facilitate the reporting and the layout presentation of each occurrence inserted in the platform. The taxonomy comprises a series of attributes that provide a certain standard of details available for use and analysis, in terms of safety investigations and safety reports or case studies, based on the input of the investigative bodies or other entitled authorities of the Member States involved in the reporting of marine casualties.

It should be also mentioned here, that EMCIP in its current version divides the occurrences in 2 main categories since the context and the codification of these categories is quite particular and deserves separate analysis:

- "**casualty with a ship**": the casualty includes damage to the vessel or her equipment and infrastructure. The characteristic attribute of this category for the sake of this study is the "casualty event", which may take values such as flooding, foundering, fire, damage to ship, etc.

- "**occupational accident**" : the casualty is a sole manifestation of a human action (deviation) with consequences only for persons. The characteristic attribute of this category is the "deviation". Deviation is defined in turn as the categorization of the last event differing from the normal and leading to the accident. If there is a chain of events leading to the accident, the last 'Deviation' must be recorded (the 'Deviation' closest in time to the point at which the accident occurred). Deviation may take values such as slipping, falling, loss of control, etc.

For the purpose of this study it was deemed as appropriate to separate the events under analysis in these two categories; however it should be noted that the used nomenclature does not exist within the revised taxonomy (in production with the new EMCIP). The new nomenclature stands for the respective categories "occurrences with ship(s)" for "**casualties with a ship**" and "occurrences with person(s)" for "**occupational accident**".

The analysis carried out within the investigation should be reported in EMCIP in line with the ECFA model. This is an organised approach aiming at assisting the verification of causal chains and event sequences leading to a casualty, and providing a structure for integrating investigation findings.

The ECFA model links in a logical and consistent way casualty events, accidental events and contributing factors as defined by the IMO Res.A.1075(28) "Guidelines to assist investigators in the implementation of the casualty Investigation Code":

[1] Data reported in EMCIP can be amended, at any time, by the relevant data providers.

Casualty Event	The marine casualty or marine incident, or one of a number of connected marine casualties and/or marine incidents forming the overall occurrence (e.g. a fire leading to a loss of propulsion leading to a grounding).
Accident Event	An event that is assessed to be inappropriate and significant in the sequence of events that led to the marine casualty or marine incident (e.g. human erroneous action, equipment failure).
Contributing factor	A condition that may have contributed to an accident event or worsened its consequence (e.g. man/machine interaction, inadequate illumination).

The following diagram summarises an application of the ECFA model to the analysis of an occurrence where a ship ran aground as a consequence of an engine failure (1 ship involved):

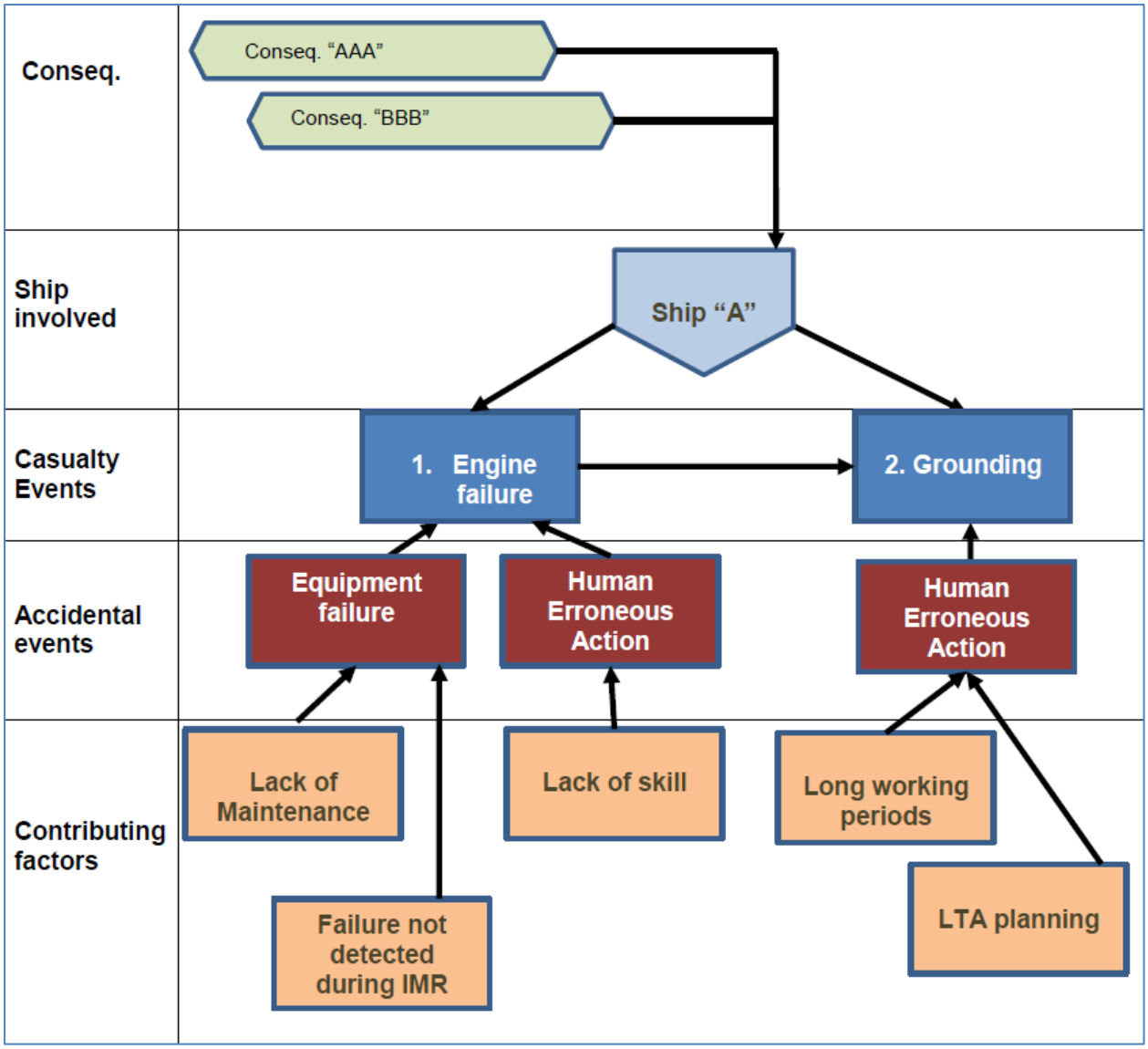

Figure 2 - ECFA diagram (1 ship involved)

In the taxonomy, Accidental Events have been classified as follows:

- Environmental effect

  Factors like wind, waves and current may have a significant effect on the behaviour of the vessel. These factors may not necessarily show extreme strength in order to feature in the casualty or accident sequence.

- Equipment failure

  A system module (subsystem) or component that does not function as intended due to some sort of breakdown. Loss of function may also be the result of operating outside the specified performance criteria (eg. overload, overcapacity).

- Hazardous material

  Critical events associated with the presence of explosive, flammable or toxic material, where the main sources are cargo and fuel.

- Human erroneous action

  Operator performs in conflict with intended procedures or in a less than adequate way. Main forms are omission, commission, wrong timing or wrong sequence.

- External agent or ship

  This group should apply to external influences; for example, lack of, or inadequate, support from other ships, agents or infrastructure.

Appendix B Data consolidation

1. Consolidation of "Casualty Events" values into Safety Areas

Values for "Casualty Events" from EMCIP taxonomy	SAFETY AREAS (Casualty Events)
(Collision) With other ship (Collision)Ship not underway (Collision)With multiple ships Collision	Collision
Damage to ship or equipment Hull failure	Damage to ship or equipment
Fire Explosion Fire/Explosion	Fire/Explosion
(Flooding) Progressive (Flooding) Massive Flooding	Flooding
(Grounding) Power (Grounding)Drift Grounding/stranding (Contact) Fixed object (Contact)Other (Contact)Unknown (Contact)Floating object (Contact)Flying object (Contact)Ice	Grounding/Contact
Capsizing Listing	Listing/Capsizing
Loss of electrical power Loss of propulsion power Loss of directional control Loss of containment Loss of control	Loss of control/containment
Foundering Flooding/Foundering Missing	Vessel foundered

Table 7 - Mapping "Casualty Event" values from EMCIP into safety areas

2. Consolidation of "Deviation" values into Safety Areas

Values for "Deviation" from EMCIP taxonomy (level 1)	SAFETY AREAS (Deviation)
Slipping - Stumbling and falling - Fall of persons	Slipping - Stumbling and falling - Fall of persons
Breakage, bursting, splitting, slipping, fall, collapse of Material Agent	Breakage, bursting, splitting, slipping, fall, collapse of Material Agent
Loss of control (total or partial) of machine, means of transport or handling equipment, handheld tool, object, animal	Loss of control
Body movement under or with physical stress (generally leading to an internal injury) Body movement without any physical stress (generally leading to an external injury)	Body movement (with or without physical stress)
Deviation by overflow, overturn, leak, flow, vaporisation, emission	Gas or liquid effects
Deviation due to electrical problems, explosion, fire	Electrical problems, explosion, fire
Shock, fright, violence, aggression, threat, presence	Shock, fright, violence, aggression, threat, presence
Other No information	Other

Table 8 - Mapping "Deviation" values from EMCIP into safety areas

3. Consolidation of "Occurrence Severity" values

Values for "Occurrence Severity" from EMCIP	Adjusted Severity
Very Serious	VS
Serious Less Serious	OMC
Marine Incident	MI

Table 9 - Mapping "Occurrence Severity" values from EMCIP into adjusted Severity

Appendix C Statistics

1. Occurrence severity and investigations per SA

The tables below show, for each SA, the frequency of the occurrences per severity and the number of SA that were investigated following a marine casualty or incident.

A comparison between the columns "Total" and "SA Investigated" allows appreciating what are the most critical areas of concern.

To give an example, the SA "Vessel Foundered" is only seventh out of eight SA in terms of frequency (column "Total"); however, this SA has been investigated 38 times since in most of the cases it brings to very serious consequences for the vessels (sinking or loss).

SA (Casualty with ship(s))	VS	MC	MI	Total	SA Investigated
Vessel foundered	40	7	0	47	38
Collision	19	175	74	268	37
Flooding	30	85	13	128	33
Grounding / Contact	18	212	24	254	31
Fire/Explosion	19	85	17	121	27
Listing/Capsizing	14	5	3	22	14
Loss of control / Containment	11	537	35	583	14
Damage to ship / Hull failure	6	65	24	95	10

Table 10 – Investigated SA and SA frequency (Casualty with ships)

SA (Occupational accidents)	VS	MC	MI	Total	SA Investigated
Slipping - Stumbling and falling - Fall of persons	19	227	13	259	21
Body movement (with or without physical stress)	8	252	4	264	14
Loss of control	11	210	4	225	9
Breakage, bursting, splitting, slipping, fall, collapse of Material Agent	4	99	1	104	7
Gas or liquid effects	3	25	0	28	4
Electrical problems, explosion, fire	0	6	0	6	1
Other	2	60	2	64	0
Shock, fright, violence, aggression, threat, presence	0	6	0	6	0

Table 11 – Investigated SA and SA frequency (Occupational accidents)

It should be understood that occurrences might include more than one SA, particularly when an investigation is undertaken.

For instance, a single occurrence might involve a fishing vessel that experiences a flooding as a consequence of a contact with a floating object and, ultimately, it sinks. As a consequence, one crew

member is lost and two are injured. Following the methodology adopted for the analysis, this marine casualty is analysed against three different SA: (i) Collision/contact; (ii) Flooding, and (iii) Foundering.

Therefore it should be made clear that the figures of consequences of the various SA are not cumulative but only comparative among the various SA. Additional information on the EMCIP model is available in Appendix A.

The tables below follow the same "comparative" approach between SA and show the consequences of the marine casualties to the SA in the scrutinised period.

SA (Casualty with ships)	Lives lost	Injured people	Ship sunk	Pollution (bunker)
Collision	46	17	21	4
Listing/Capsizing	45	10	14	4
Vessel foundered	39	9	44	6
Grounding / Contact	16	20	17	13
Flooding	9	2	31	11
Loss of control / Containment	8	12	10	17
Damage to ship / Hull failure	3	16	3	2
Fire/Explosion	3	19	15	5

Table 12 - Consequences per SA (Casualty with ships)

SA (Occupational accidents)	Lives lost	Injured people
Slipping - Stumbling and falling - Fall of persons	20	227
Shock, fright, violence, aggression, threat, presence	0	6
Other	2	64
Loss of control	10	209
Gas or liquid effects	5	34
Electrical problems, explosion, fire	0	5
Breakage, bursting, splitting, slipping, fall, collapse of Material Agent	4	99
Body movement (with or without physical stress)	8	250

Table 13 - Consequences per SA (Occupational accidents)

When reading the tables 12 and 13 it should be considered that in EMCIP reporting scheme the consequences are not directly linked to one specific event but to the occurrence itself (the number of fatalities and injuries) and to the ships involved (the consequences to ships and pollution).

Therefore, the outcome for a given occurrence (e.g. one fatality and two injured people) where 3 SA are quoted would be attached to each SA.

2. Events vs. time of accident

The following tables provide the frequency of events per time of casualty (in local time) respectively for casualty with ships and occupational accidents.

	Time of casualty (LT)							
Event	**00:00-03:00**	**03:00-06:00**	**06:00-09:00**	**09:00-12:00**	**12:00-15:00**	**15:00-18:00**	**18:00-21:00**	**21:00-24:00**
Collision	49	45	51	48	44	39	35	53
Damage to ship or equipment	13	7	13	15	14	11	10	6
Fire/Explosion	4	14	11	20	22	20	13	20
Grounding	33	38	29	17	15	16	25	32
Hull failure	1	1	0	2	2	3	0	1
Loss of control/containment	49	50	77	96	87	94	74	57
Vessel foundered	19	19	31	26	19	22	12	18
Contact	5	5	8	7	12	8	7	4
Listing/Capsizing	4	1	1	5	5	1	2	4

Table 14- Events per time of casualty (Casualty with ships)

	Time of casualty (LT)							
Event	**00:00-03:00**	**03:00-06:00**	**06:00-09:00**	**09:00-12:00**	**12:00-15:00**	**15:00-18:00**	**18:00-21:00**	**21:00-24:00**
Body movement (with or without physical stress)	12	24	36	43	63	43	29	18
Breakage, bursting, splitting, slipping, fall, collapse of Material Agent	5	10	16	15	19	18	8	13
Electrical problems, explosion, fire	1	0	0	1	2	0	2	0
Gas or liquid effects	0	1	4	6	6	7	1	3
Loss of control	13	15	32	40	48	34	25	22
Other	4	9	7	10	10	8	10	6
Shock, fright, violence, aggression, threat, presence	0	0	2	0	1	1	2	0
Slipping - Stumbling and falling - Fall of persons	22	24	35	42	46	35	32	24

Table 15 - Events per time of casualty (Occupational accidents)

Both the tables show that mostly of events occur during daytime, particularly in the time interval between 09:00 and 15:00. This particular outcome is made more evident in the following chart showing the frequency of the events per time of casualty:

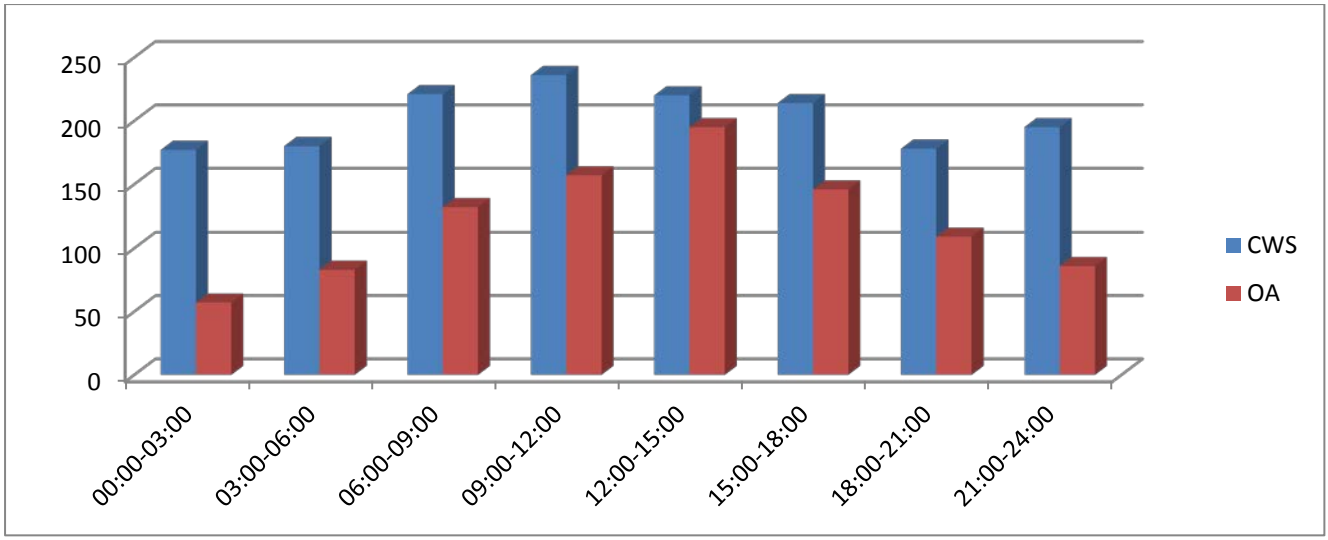

Figure 3 - Event frequency per time of casualty (Casualty with ships and Occupational Accidents)

3. Events vs. Occurrence location

The tables below show the frequency of events per Occurrence Location, respectively for Casualty with ships and Occupational accidents

	Occurrence location							
	inland waters	internal waters			Coastal waters <= 12 nm	Open sea		
Events		Port area	Channel, river	Arch. fairway		N.A.	Within EEZ	Outside EEZ
Collision	2	92	6	3	151	25	73	12
Contact	0	22	0	0	23	1	9	1
Damage to ship or equipment	0	18	3	0	45	1	18	4
Fire/Explosion	0	42	1	0	38	3	31	8
Grounding	3	47	10	15	124	0	3	1
Hull failure	0	0	0	0	2	1	5	1
Listing/Capsizing	1	5	0	0	2	0	14	1
Loss of control/containment	1	39	4	1	352	21	152	12
Vessel foundered	0	35	2	0	60	7	47	15

Table 16 - Events per Occurrence location (casualty with ships)

	Occurrence location								
	inland waters	Repair yard	Internal waters			Coastal waters <= 12 nm	Open sea		
Events			Port area	Channel, river	Arch. fairway		N.A.	Within EEZ	Outside EEZ
Body movement (with or without physical stress)	0	1	27	1	1	80	52	85	19
Breakage, bursting, splitting, slipping,	0	0	13	0	0	32	26	28	4
Electrical problems, explosion, fire	0	0	2	0	0	1	1	2	0
Gas or liquid effects	0	0	10	0	0	5	4	4	4
Loss of control	1	2	25	2	0	63	31	89	14
Other	0	0	5	0	0	18	8	26	6
Shock, fright, violence, aggression, threat, presence	0	0	0	0	0	1	1	4	0
Slipping - Stumbling and falling	2	1	69	0	0	73	26	78	8

Table 17 - Events per Occurrence location (Occupational accidents)

Mostly of the events related to casualties with ships occur within coastal waters (≤12nm), particularly for the event “Loss of control/containment”.

Concerning occupational events, events appear to be concentrated around coastal waters and within ZEE.

4. EU fishing vessels vs. Length overall (LOA)

The following table provides an example of an index about the number of occurrence concerning casualties occurrend in 2016 that involved EU flagged vessels (both Casualties with ships and Occupational Accidents).

For this calculation, data for the active EU fleet size has been extracted from the EU Fleet Database managed by DG MARE. Since the database does not include data from Norway and Iceland, figures concerning events for such flags have been discarded for consistency purposes.

In the table below, these figures have been structured per length overall.

2016	LOA				
	15≤24	24≤50	50≤100	>100	TOT
F/V fleet size	5,187	2,526	187	25	7,925
Occurrences	271	128	13	1	413
RATIO	**5.22%**	**5.07%**	**6.95%**	**4.00%**	**5.21%**

Table 18 – Occurrences involving EU F/V vs. Fleet size

Appendix D List of occurrences with finished investigations

The following table provides the list of the occurrences with finished investigations reported in EMCIP from which the most of the data relevant for the analysis was taken. Such occurrences can be consulted in the EMCIP portal at: https://emcipportal.jrc.ec.europa.eu/index.php?id=44

Casualty Report Nr.	Casualty Report Nr.	Casualty Report Nr.	Casualty Report Nr.	Casualty Report Nr.
388/2011	139/2013	1904/2013	2527/2014	3282/2015
397/2011	145/2013	1977/2013	3120/2014	3311/2015
490/2011	184/2013	1993/2013	3131/2014	3366/2015
817/2011	200/2013	2052/2013	3136/2014	3368/2015
1083/2011	244/2013	2072/2013	3225/2014	3711/2015
1370/2011	315/2013	2142/2013	3305/2014	3737/2015
107/2012	318/2013	2149/2013	14/0085/MAIBUK	3933/2015
144/2012	368/2013	2150/2013	14/0459/MAIBUK	3998/2015
311/2012	404/2013	2241/2013	96/2015	219/2016
388/2012	527/2013	2262/2013	97/2015	287/2016
728/2012	528/2013	13/0055/MAIBUK	228/2015	429/2016
818/2012	543/2013	13/0096/MAIBUK	273/2015	526/2016
823/2012	544/2013	13/0890/MAIBUK	280/2015	909/2016
995/2012	545/2013	13/1299/MAIBUK	293/2015	1207/2016
1002/2012	568/2013	13/1337/MAIBUK	385/2015	1294/2016
1227/2012	610/2013	235/2014	632/2015	1376/2016
1249/2012	638/2013	343/2014	684/2015	1454/2016
1274/2012	763/2013	354/2014	707/2015	1507/2016
1288/2012	775/2013	440/2014	756/2015	1543/2016
1294/2012	899/2013	441/2014	769/2015	1602/2016
1317/2012	1140/2013	481/2014	770/2015	1852/2016
1534/2012	1229/2013	616/2014	1145/2015	2015/2016
1615/2012	1246/2013	626/2014	1366/2015	2298/2016
1828/2012	1253/2013	806/2014	1593/2015	2578/2016
1844/2012	1260/2013	922/2014	1888/2015	2634/2016
1854/2012	1322/2013	946/2014	2063/2015	3137/2016
1902/2012	1394/2013	1103/2014	2566/2015	3476/2016
1917/2012	1494/2013	1107/2014	2651/2015	2395/2017
1955/2012	1519/2013	1132/2014	2657/2015	2610/2017
12/0314/MAIBUK	1569/2013	1624/2014	2717/2015	2624/2017
12/0482/MAIBUK	1610/2013	1787/2014	2721/2015	
12/0603/MAIBUK	1625/2013	2007/2014	2814/2015	
60/2013	1700/2013	2256/2014	2882/2015	
103/2013	1899/2013	2347/2014	2916/2015	

Table 19 - List of occurrences with finished investigation

ABOUT THE EUROPEAN MARITIME SAFETY AGENCY

The European Maritime Safety Agency is one of the European Union's decentralised agencies. Based in Lisbon, the Agency's mission is to ensure a high level of maritime safety, maritime security, prevention of and response to pollution from ships, as well as response to marine pollution from oil and gas installations. The overall purpose is to promote a safe, clean and economically viable maritime sector in the EU.

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