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Main Contributing Factors to the Stability Accidents in the Spanish Fishing Fleet

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ABSTRACT

Between November 2008 and November 2014 a total of 28 stability accidents affecting to Spanish fishing vessels were investigated by the Spanish Marine Accident and Incident Investigation Standing Commission. A comprehensive review of these accidents allows determining the nature of the main contributing factors behind the high accident rates in the Spanish fishing sector.

Keywords: *fishing vessel, accident investigation, safety policies, training, complacency*

1. INTRODUCTION

The fishing sector ranks high in the list of mortality rates labor sectors. In Spain, figures published by INE (National Statistics Institute, *Instituto Nacional de Estadística*, http://www.ine.es/inebmenu/indice.htm) and various of its bodies (INSHT, 2011) shows the global rate of mortal accidents in 2011 to be 3 deaths for each 100000 workers in Spain (global rate: for all labour sectors). The global rate of severe accidents in Spain in the same year was 25 per 100000 workers. In the fishing sector only, the rate of mortal accidents in that year was of 33 deaths, that is to say, more than ten times the global rate. Similarly, the ratio of severe accidents in the fishing sector rose to 159 per 100000 workers (six times the global rate). According to these data, the fishing and aquiculture labour sector was the third with highest mortality rates in Spain, only behind silviculture1 (51 deaths per 100000 workers) and extractive industries2 (42 deaths per 100000 workers).

Several studies have been conducted studying the relation among fishing safety, research and public policies. Jin and Thunberg (Jin and Thunberg, 2005) established the importance of probability models in development and quantitative assessment of management mechanisms related to safety in the commercial fishing industry. Pérez-Labajos states (Pérez-Labajos, 2008) that the research work on the safety and accidents of commercial fishing vessels can be broken down into three clearly distinct frameworks of analysis: type of damage (personal and material), types of accidents, and accident inequalities applied to the fishing sector.

The present work belongs to the second type of analysis, but a new approach is proposed: instead of focusing in the type of accident of its consequences, proposes to research into the underlying causes which lead to the accidents.

In the fishing sector in Spain, the relation between type of accident and number of casualties (dead or missing person) shows clearly that the stability related accidents are, by far, the most dangerous.

Being clear that the loss of stability is one of the major risks a vessel may face, it is not so

obvious what can be done to prevent accidents due to loss of stability. For policy makers to develop effective policies to reduce the number of accidents is necessary the causes leading to these accidents be known. It is paradigmatic that accidents are due to multiple factors; not being common accidents which respond to a single cause. In any marine casualty is common to find personal factors (lack of training, fatigue ...), social factors (lack of safety culture, economic conditions ...), technical factors (design faults ...), regulatory factors (inadequate regulations …), etc.

Consequently the best policy to prevent stability accidents in the fishing fleet should be based on the incidence that each of the contributing factors has over the accidents rates. A possible way to approach such study is by establishing a maritime accident investigation policy with the following characteristics:

- Comprehensive, in the sense of examining accidents from multiple facets,
- Independent from other investigations. Not intended to establish blame or apportion liability.
- Providing a taxonomy which allows contributing factors to be classified for statistical analysis.

At European level, since 2011 there exists a regulation that harmonizes the investigation procedures and fulfils, in principle, those requirements. Directive 2009/18/EC of the European Parliament and of the Council (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2009.131.01.0114.01.ENG), which entered into force in June 2011, establishes for European countries the obligation to investigate marine accidents and to notify the Commission on marine accidents and the data resulting from safety investigations in the European Marine Casualty Information Platform (EMCIP).

2. EMCIP ACCIDENT ANALYSIS MODEL

The EMCIP is built over a determined investigation analysis method. The accident analysis method lying below EMCIP is the ECFA (Events and Casual Factors Analysis) method, which is extensively described in the scientific literature of accident investigation.

The ECFA method in EMCIP depicts the necessary and sufficient events and causal factors for accident occurrence in a logical sequence (Buys and Clark, 1995). Under the ECFA scheme, behind the accidental events identified leading to the casualty there are contributing factors which must be identified and corrected to prevent the occurrence of similar accidents.

EMCIP provides taxonomy to classify contributing factors identified during an accident. However the EMCIP system has still to prove its value for accident analysis in the fishing sector, due to the following reasons:

- It is relatively recent; therefore it still does not store a significant amount of safety investigations.
- Fishing vessels with length below 15m are not included in the scope of Directive 2009/18/EC; therefore most countries are not notifying EMCIP with accidents in those vessels.
- EMCIP's taxonomy is adapted from existing models used in other transport modes and is oriented towards merchant marine traffic, but its use in the fishing sector is not always straightforward.

3. MARINE ACCIDENTS INVESTIGATED IN SPAIN

3. 1 CIAIM

In Spain the Maritime Accident and Incident Investigations Standing Commission (*Comisión Permanente de Investigación de*

Accidentes e Incidentes Marítimos, CIAIM) is an independent governmental body entrusted with the safety investigation of marine accidents. It acts pursuant to the provisions of Directive 2009/18/EC and the International Maritime Organization (IMO) Casualty Investigation Code. CIAIM was created in September 2008 and since then has received nearly 600 notifications of marine casualties, half of which affect fishing vessels (CIAIM, 2014, 2013, 2012, 2011, 2010, 2009).

3. 2 Stability related accidents of fishing vessels

The author has conducted a study of the stability related accidents of fishing vessels in Spain between September 2008 and December 2014. In this period CIAIM received 305 notifications of fishing vessels casualties, whose distribution according to type of accident and consequences is shown in Table 1.

Type of accident	Number of accidents	Number of dead / missing persons	Number of vessels lost
Capsizing / Listing	**32**	**30**	**28**
Collision	50	8	9
Contact	12	0	5
Damage to equipment	7	0	0
Grounding / Stranding	53	9	22
Fire / explosion	26	3	12
Flooding / foundering	74	8	53
Loss of control	10	1	3
Hull failure	4	0	2
Missing	1	3	1
Non accidental event	3	3	1
Occupational accident	33	27	0
Total	305	92	136

Table 1. Fishing vessel accidents between Sept'08 and Dec'14 in Spain

Definition for types of accidents listed in Table 1 is provided by the European Maritime Safety Agency in the EMCIP taxonomy:

Capsizing/listing: is a casualty where 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. When the ship is tipped over until disabled is called capsizing; when the ship has a permanent heel or angle of loll is called listing.

Collision: a casualty caused by ships striking or being struck by another ship, regardless of whether the ships are underway, anchored or moored. This type of casualty event does not include ships striking underwater wrecks. The collision can be with other ship or with multiple ships or ship not underway.

Contact: a casualty caused by ships striking or being struck by an external object. The objects can be: floating object (cargo, ice, other or unknown); fixed object, but not the sea bottom; or flying object.

Damage to equipment: damage to equipment, system or the ship not covered by any of the other casualty type.

Grounding / stranding: a moving navigating ship, either under command, under power, or not under command, drifting, striking the sea bottom, shore or underwater wrecks.

Fire / explosion: an uncontrolled ignition of flammable chemicals and other materials on board of a ship. Fire is the uncontrolled process of combustion characterized 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 / foundering: is a casualty event when the ship is taking water on board. Foundering will be considered when the vessel has sunk. Foundering should only be regarded as the first casualty event if the details of the flooding which caused the vessel to founder are not known. Flooding refers to a casualty when a vessel takes water on board and can be: Progressive if the water flow is gradually; or Massive if the water flow is considerable.

Loss of control: a total or temporary loss of

the ability to operate or maneuver the ship, failure of electric power, or to contain on board cargo or other substances. Loss of electrical power is the loss of the electrical supply to the ship or facility. Loss of propulsion power is the loss of propulsion because of machinery failure. Loss of directional control is the loss of the ability to steer the ship. Loss of containment is an accidental spill or damage or loss of cargo or other substances carried on board a ship.

Hull failure: a failure affecting the general structural strength of the ship.

Missing: a casualty to a ship whose fate is undetermined with no information having being received on the loss and whereabouts after a reasonable period of time.

Non-accidental events: intentional events as a result of illegal or hostile acts. They are: Acts of war, criminal acts, illegal discharge, and others.

Occupational accident: Occupational accident type means the mode in which a person (crewmember, passenger or other person) was injured or killed, not involving in a ship casualty, which can be: accident, illness, suicide/homicide, or unknown.

It is to be noted the high risk of personal loss and vessel loss in stability related accidents in comparison with other types of accident. Focusing on stability related accidents, 28 out of the 32 accidents were investigated or are currently under investigation. These 28 accidents are listed in Table 2, in the appendix, including the following data:

Internal CIAIM accident code.

Vessel total length (Lt, m).

Indicator of the accident having occurred inside or outside territorial waters -12 miles off the coast (High seas, coast).

Mean wind speed (Vw, knots)

Significant wave height, wind and swell waves (Hs, m).

Primary cause of the accident. In the case of accidents still under investigation, the guessed cause is included.

Number of report published in CIAIM's website www.ciaim.es, in the case the report is published.

3. 3 Underlying causes

Behind the primary causes summarized in the previous table there are several underlying causes. When analysing deeply these 28 accidents the following list of underlying causes has been found.

These underlying causes are listed in Table 3 in the appendix.

3. 4 Contributing factors in the fishing sector

The listed underlying causes may be linked to one or several contributing factors in the EMCIP taxonomy. The individual study of the underlying cause and the specific circumstances of the accident allows for this distribution.

It is not in the scope of the present work to enter in details of the analysis performed in each of the accidents investigated. For the purposes of this study, the results are summarized below.

The results show that most underlying causes are linked to the same type of contributing factors that can be grouped in just six categories according to EMCIP taxonomy:

Type of contributing factor (CF)	Number of CF in CIAIM stability accidents
Lack of training	30
Economic conditions	14
Design error	4
Inadequate regulation	8
Lack of safety awareness	33
Lack of safety culture	20

Table 4. Type of contributing factor in 28 stability related accidents.

Graphically the previous results are presented in Figure 1.

4. ANALYSIS

Most of the contributing factors in the fishing vessel accidents are related to personal economic and social factors: lack of training of crewmembers, economic conditions putting press on the masters to navigate in dangerous areas looking for more abundant catches. Of special relevance is the lack of safety awareness among crew of fishing vessels and the lack of safety culture in fishing companies.

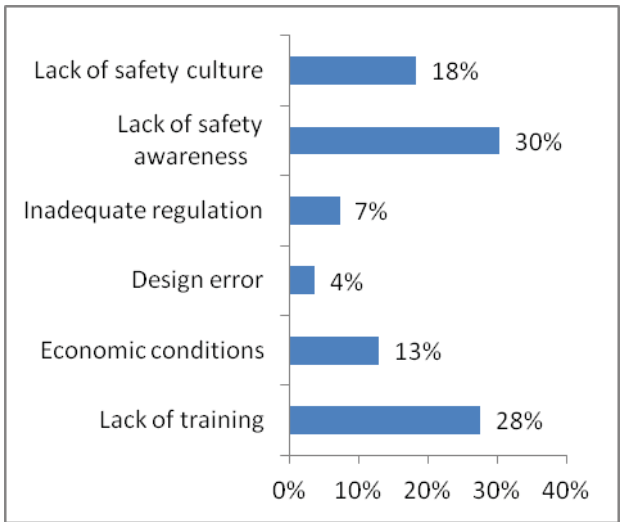

Figure 1 Type of contributing factor (percentage)

It is worth to mention the similarity of these results with those obtained in previous studies by Loughran et al. (Loughran et al, 2002) in their study of fishing vessel safety in the UK: they conclude that fishing industry lacks a safety culture and that more failure data needs to be collected in order to control risks.

Only in four accidents a design error was found to have contributed to the accident.

It is also significant that in 8 accidents the stability regulation has been found inadequate. While the ship fulfilled the stability criteria in force, these were found to be inadequate for correctly managing the stability on board: regulations which did not include any stability, loading or operating information for the master, therefore making impossible to adequately manage stability on board fishing vessels. This was especially true in small fishing vessels, with length below 15 m.

These data may be interpreted in different ways. First, they may indicate the need to design policies which address the basic problems detected: lack of safety awareness and training.

Being this true, the data also show that fishing vessels built and designed according to the approved standards (including safety and stability standards) could be prone to suffer accidents when personal and socio-economic factors are present. For instance, fishing in breaking waves and shoals could be forbidden, or training campaigns to inform about the risks associated to navigating in these areas could be established. Nevertheless it is a fact that fishing vessels will operate where catches can be captured.

This would support the idea of setting more exigent technical standards to fishing vessels, so they are capable to cope with inadequate operation from the crews and fishing companies.

5. CONCLUSIONS

Stability related accidents in Spain in the period September 2008 to December 2014 happened mainly for a combination of personal, social, economic and regulatory factors, being specially relevant the lack of training and lack of safety awareness (complacency) of crews. Marine safety policies in the fishing sector to prevent stability accidents must therefore address these problems.

In addition, the stability standards applicable to fishing vessels, in particular to small fishing vessels, are not capable to deal with the reality of the fishing sector. The maritime authorities should promote the revision of the stability standards applicable to those vessels, so they can bear inadequate operation derived from personal and socio-economic contributing factors present the fishing sector.

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APPENDIX

CIAIM accident code	Lt (m)		Vw (kt)	Hs (m)	Primary cause (summarized)	Report number
014/2008	27,85	High sea	25	2,7	Water ingress on main deck	A-05/2010
020/2008	34,5	High sea	25	6,5	Fishing gear stuck	A-15/2010
031/2009	39,3	High sea	20	3	Water ingress on main deck	S-28/2011
033/2009	9,6	Coast	30	1,5	Excessive weather conditions	S-41/2011
035/2009	17,7	High sea	5	1	Water ingress on main deck	A-06/2009
044/2009	10,53	Coast	12	0,25	Cargo shifting	S-20/2011
002/2010	27	High sea	35	3,5	Water ingress on main deck	A-10/2011
007/2010	37,35	High sea	17	4	Water ingress on main deck	S-27/2011
056/2010	7,18	Coast	12	0,25	Fishing gear stuck	S-14/2012
062/2010	24	High sea	20	1,25	Water ingress on main deck	A-01/2013
067/2010	28	High sea	30	4	Water ingress on main deck	A-10/2012
055/2011	14,83	High sea	22	3,5	Excessive weather conditions	A-08/2012
074/2011	5,76	Coast	19	1,4	Excessive weather conditions	S-26/2012
056/2012	15,5	High sea	11	1	Cargo shifting	S-23/2013
003/2013	7,2	Coast	5	1	Green seas	R-27/2013
008/2013	6,37	Coast	23	4,6	Excessive weather conditions	S-24/2013
039/2013	12,5	Coast	27	4,25	Excessive weather conditions	11/2014
047/2013	9,5	Coast	10	2	Green seas	S-42/2013
056/2013	8,45	Coast	11	2	Green seas	R-39/2013
016/2014	9,45	Coast	13	2	Fishing gear stuck	Investigation ongoing
028/2014	32	High sea	5	0,75	Cargo shifting	Investigation ongoing
056/2014	8,64	High sea	22	2	Water ingress on main deck	Investigation ongoing
057/2014	14,48	High sea	17	2	Water ingress on main deck	Investigation ongoing
079/2014	8,7	Coast	20	1	Green seas	Investigation ongoing
072/2014	11,85	Coast	n/a	2	Green seas	Investigation ongoing
088/2014	17,5	High sea	20	2	Water ingress on main deck	Investigation ongoing
089/2014	8,5	Coast	n/a	n/a	Green seas	Investigation ongoing
095/2014	18,6	Coast	20	1,25	Excessive weather conditions	Investigation ongoing

Table 2. Stability related accidents

CIAIM accident code	Contributing factor	CIAIM accident code	Contributing factor
035/2009	Freeing ports sealed	008/2013	Crew inexperienced
035/2009	Overloading: excess of fishing gear	008/2013	Inadequate stability regulation
035/2009	Non authorised modifications to vessel structure	008/2013	Excessive weather conditions
035/2009	Inadequate stability management on-board	003/2013	Loss of propulsion (dead ship)
014/2008	Overloading	003/2013	Fishing close to wave surf or shoal
014/2008	Watertight openings not closed	056/2013	Excessive weather conditions
020/2008	Watertight openings not closed	056/2013	Fishing close to wave surf or shoal
020/2008	Inadequate fishing winch operation	047/2013	Vessel undermanned
020/2008	Inaccessible fishing winch operation post	047/2013	Fishing close to wave surf or shoal
002/2010	Inadequate watertight opening design	047/2013	Excessive weather conditions
002/2010	Watertight openings not closed	039/2013	Excessive weather conditions
044/2009	Inadequate cargo lashing to deck and cargo shifting	039/2013	Fishing gear and catches shifting
044/2009	Overloading	039/2013	Freeing ports sealed
007/2010	Overloading	039/2013	Overloading
007/2010	Watertight openings not closed	016/2014	Excessive weather conditions
031/2009	Overloading	028/2014	Inadequate stability management on-board
031/2009	Watertight openings not closed	028/2014	Overloading
033/2009	Non authorised modifications to vessel structure	056/2014	Inadequate stability management on-board
033/2009	Overloading	056/2014	Inadequate stability regulation
033/2009	Inadequate stability regulation	056/2014	Navigating out of authorised area
055/2011	Inadequate stability regulation	057/2014	Excessive weather conditions
067/2010	Watertight openings not closed	057/2014	Inadequate stability regulation
067/2010	Gear hauling with stern seas	079/2014	Excessive weather conditions
067/2010	Bad watertight opening design	079/2014	Inadequate stability regulation
056/2010	Vessel undermanned	079/2014	Fishing close to wave surf or shoal
056/2010	Fishing winch lack of safety stop system	072/2014	Fishing close to wave surf or shoal
074/2011	Inadequate cargo lashing to deck	072/2014	Inadequate stability regulation
074/2011	Inadequate stability regulation	088/2014	Overloading
062/2010	Watertight openings not closed	088/2014	Bad watertight openings maintenance
062/2010	Navigating in quarter or stern waves	095/2014	Navigating out of authorised area
062/2010	Inadequate stability management on-board: excessive trim	095/2014	Inadequate cargo lashing to deck and cargo shifting
056/2012	Inadequate stowing and cargo shifting	089/2014	Fishing close to wave surf or shoal
056/2012	Inadequate stability management on-board		

Table 3. Underlying causes to 28 stability related accidents.