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Traffic Safety
Review
U. D. C.: 656.61:614.86
Accepted: Dec. 20, 01
Approved: Jan. 23, 03.

ANALYSIS OF THE CAUSES OF MARITIME CASUALTIES

ABSTRACT

A survey of total loss accidents in merchant shipping over a period of 30 years shows that these can be arranged in the following order: stranding, fire, water-leaks, gales and collision; other accidents are also taken into consideration. The analysis considers ships over 500 GT of different flags, plying any route of navigation.

Initially, a sample of 500 merchant ships - of different types and tonnage - and under 15 different flags is analyzed to determine age and type of ship, and the causes of accidents.

In the second analysis, the same 15 flags are considered, but now over a wider range on a sample totalling 1,500 merchant ships. The results of both analyses are compared. It is shown that all collisions together with gale amount to 25% of maritime casualty returns -in the total loss lists - while stranding and collision take more than 40% of the toll.

KEY WORDS

analysis, maritime casualty, ship losses, collision, gale, stranding

1. INTRODUCTION

Maritime accidents fall into one of the following groups due to several circumstances: those caused by weather conditions, such as gales, reduced visibility [1], ice, etc; or those due to pilot navigation error, narrow [2] and/or congested [3] waters, collision with unknown objects, ship lying at anchor or moored at buoys with strong currents, manoeuvring at close quarters or with limited space and adverse conditions in port. Cargo-related accidents occur through the carriage of dangerous goods, cargo on deck, heavy cargo, or cases relevant to the ship seaworthiness. Failure in the steering system [4], main engine, different devices, war, terrorism, piracy, collision and misinterpretation in communications at sea, etc. [5, 6] can all lead to accidents.

Accidents by collision have decreased significantly where maritime traffic management service or, at least, Traffic Separation Scheme (TSS) have been implemented. Currently, a worldwide maritime traffic management system is being contemplated [7].

The SOLAS (Safety of Life at Sea) convention rules the safety of navigation in sea trade in shipbuilding and fire-resistant bulkheads, life-saving appliances and facilities, radio communications, grain in bulk and dangerous goods transportation. These international provisions make it compulsory for sea-time training on board merchant vessels, and for fire and abandon-ship drills.

Fire aboard merchant ships is serious, sometimes leading to total loss of the ship and/or her cargo, to gross damage, and to loss of life. In the past, when merchant vessels were built of wood and propulsion was achieved by wind action on the sails, lighting was produced by means of oil or paraffin lanterns; tragic fires happened far too often, due mainly to the ship's rolling and the subsequent falling and breaking of the lanterns. In this day and age, flame lights are not allowed on board, or are prohibited by their inefficiency and danger. Nevertheless, fire still poses a high risk for several other reasons.

The stranding of merchant vessels can result in fire and explosions particularly when large tankers engaged in crude oil trade are involved. Such was the case with the 'Torrey Canyon' in 1967, when a series of explosions and fires after her stranding in the Scilly Isles (Seven Stones, Pollard Rock) caused an all-time record in sea pollution. Probably petroleum products, shipped in bulk, present the highest risk, when errors occur, but we have other substances such as coal, a number of ores, feeding stuff, fertilizers, fish meal, etc. which are apparently harmless - when one is not acquainted with case histories - but which are liable to produce spontaneous combustion.

Accident investigations show that fire leads to serious consequences not only in carriage of dangerous goods, but also poses a risk to other goods which would not be dangerous otherwise and would not present hazard during sea passage - such as sugar, walnuts, cotton, and the like, which can readily be stowed with no apparent fire risk. This kind of cargo burns easily and can become a risk if neighbouring hot work

or a faulty mains line causes fire to break out in the cargo hold. Extinguishing this fire will prove difficult once it has gained hold and it will spread quickly if there is sufficient oxygen.

This work analyzes various maritime accidents during a 30-year period and, with a sample of 500 ships or more, it was found that stranding and fire aboard taken together, amounted to 50 percent of the constructive total losses.

2. METHOD AND RESULTS

The method followed in this research on maritime casualties consisted of analyzing total losses of merchant ships under different flags, with gross tonnage of 500 GT or over, throughout 30 years. Data for accidents were taken from "Maritime Casualty 1963 - 1996" [6], which lists disasters alphabetically by the vessel's name. To obtain useful or reliable results for a given flag, it is necessary to consider a group of 100 ships for each flag. To quantify causes, ages, and class-type under different flags, a sample of 500 ships [7] is needed.

Firstly, a total of 500 merchant ship losses under 15 flags was analyzed, to establish the ship's age when lost and the trade she was on (class or type of goods transported). The number of ships, and total gross tonnage per flag were recorded, and the data is presented in Table 1.

The reasons for these accidents have been analyzed and quantified in Table 2, both as numbers and as percentage of the total.

Whilst a sample of 500 accidents is sufficient to establish causes, it is not a large enough sample to discriminate behaviour between different flags. In the next two tables, Table 3, Table 4, the same particulars have been analyzed, but the number of ships has been increased to a total of 1,500.

2.1 Age Estimation

In the analysis of '15 flags - 500 ships' (Table 1), the losses have been separated into four periods of the ship active service - first 0-5 years, second 6-12 years, third 13-20 years, and fourth ages exceeding 21 years. In Table 1, the sum of the losses in the first two periods, 38+72, amount to 110 ships, meaning 22% of the 500 ships analyzed. The losses in the third and fourth periods, 185+205=390 ships, make 78% of the total analyzed. The first particular to consider is that losses in ships over 13 years do outnumber the others, and are 3.5 times more frequent than in new and middle-aged ships; but it is also true, that the over-ageing of the world shipping, in the 30 years under survey, is a trend to be considered. The 205 vessels in the Table aged over 21, amount to 41% of the 500 ships and 15 flags of the sample, and only Japan looms as a younger fleet.

2.2 Trade

Regarding ships classified by trade, those carrying general cargo (break-bulk) make up the majority, making a total of 333 units, meaning 66.6% of the total; dry-bulkers come to 51 ships with 10.2%; tankers number 55 with 11%; and the rest of ships make a total of 61 units, coming to 12.2% of the 500 analyzed. Total gross tonnage amounts to 3,941,360 which divided by the 500 ships, produces a mean of 7,883 GT per ship.

2.3 Cause

Table 2 shows 15 flags and 500 merchant ships entering the nine most frequent circumstances in maritime accidents, resulting in total losses confirmed by ships' classification societies. The results of the Table places "stranding" as the leading maritime casualty - in fine weather, reason unspecified - followed by stranding in heavy weather, a total of 146 being entered with 29.2% of the 500 ships involved in accidents. Ranking second is "fire"; fire in the engine room is the most common cause, with 61 cases forming 55% of the total caused by fire. Total accidents by fire amount to 111 ships and represent 22.2% of the total. The third cause of total loss is attached to "water-leaks" with 72 cases and 14.4% of the total. The fourth are "gales" affecting 70 ships and a share of 14%. The fifth place is held by "collisions" with 48 cases and a 9.6% share.

The remainder of the total losses having lesser frequency impact in this table stand in the following order: explosions, faults in cargo, war, and striking unknown floating objects.

2.4 Ship Losses

In Table 3 the same 15 flags are analyzed, increasing the number of merchant ships - in total loss casualties - to 1,500 of 500 GT and over, the results being entered by age, class of ship and gross tonnage. In the first nine flags with 100 or more ships, ages are analyzed separately, the type of ships involved in the casualties, the mean per flag and the total mean. For the analysis and quantifying of ships the same four periods of Table 1 are maintained.

In considering the first two periods - new and middle-aged ships on one hand, and the two second periods - too long in service and old ships - on the other, if the ratio of the former over the latter is greater than unity, the flag of that merchant fleet can be assumed to be as of new construction. For a valid comparison,

Table 1. Ages and Class of vessels from 15 flags with 500 ships.

GC=General Cargo; BC=Bulk Carrier; TA=Tanker; OB=Ore Bulk Oil; GA=Liquefied Gas; CH=Chemical tanker; RR=Roll on, Roll off; CO=Container vessel; PF=Passenger or Ferry; OT=other vessels

Flags	Years Old				Ships No	Class of Vessels										DWT
	0-5	6-12	13-20	>21		GC	BC	TA	OB	GA	CH	RR	CO	PF	OT	
Greek			2		2	2					2					5,280
Panamanian	1	7	25	33	66	54	4	2			2	1		1	2	338,710
Liberian	7	12	37	29	85	36	21	17	6	1	3		1			1,680,190
Cyprus	1	8	23	32	64	53	4	2		1	1	1	1		1	234,880
UK	4	4	19	16	43	24	3	10	2	2				1	1	379,580
Japanese	6	9	11	1	27	16	2	4		1	1	1		1	1	146,850
Philippine	2	4	16	31	53	42		1					1	9		103,660
Italian	1	8	14	13	36	25	1	5		2	1		1	1		142,550
Spanish	6	6	6	11	29	17	2	6				1		1	2	310,630
Lebanese	1	1	5	17	24	20	2								2	65,750
Norwegian	4	4	8	1	17	11	2	2			1			1		200,470
Brazilian		6	5	6	17	14	3									80,240
US	1	1	4	10	16	5	5	5						1		145,570
W.German	4	1	7	3	15	11	1				1	1	1			53,920
Chilian		1	3	2	6	3	1	1							1	53,080
Total	38	72	185	205	500	333	51	55	8	7	10	5	6	15	10	3,941,360
%	7.6	14.4	37	41	100	66.6	10.2	11	12.2							100

Table 2. Causes of Maritime Casualties of 15 flags with 500 ships.

S=Stranding, fine weather; SGF=Stranding in gale, fog or engine failure; FE=Fire in engine room; F=Fire, unspecified; FC=Fire in cargo; T =TOTAL; L= Leak; G=Gale; SC=Ship's collisions; E=explosion; MF=Machinery failure; T=Terrorism, piracy or war; CU=Collision with unknown subject.

Flags	Strandings			Fire				L	G	SC	E	MF	T	CU	Ships No
	S	SGF	T	FE	F	FC	T								
Greek								1	1						2
Panamanian	15	5	20	5	5	1	11	14	10	2	2	3	2	2	66
Liberian	19	12	31	14	6	3	23	9	2	9	6	1	4		85
Cyprus	11	12	23	8	3	1	12	14	8	3		1	2	1	64
UK	8	4	12	7	2		9	3	8	3	2	1	2	3	43
Japanese	2	4	6					2	7	11	1				27
Philippine	7	6	13	6	5	4	15	7	11	14		3			53
Italian	7	4	11	5	2	2	9	5	5	2	1	1	1	1	36
Spanish	3		3	4	4	1	9	7	5	2	2	1			29
Lebanese	5	2	7	5	1	1	7	2	3	1			2	2	24
Norwegian	2	1	3	4	2		6	1	2	4	1				17
Brazilian	4	2	6	2	1	3	6	3	2						17
US	3		3	1	1	1	3	2	3	3		1	1		16
W.German	2	2	4			1	1	1	2	4		2		1	15
Chilian	4		4					1	1						6
G.Total			146				111	72	70	48	15	14	14	10	500
%			29.2				22.2	14.4	14	9.6	3	2.8	2.8	2	100

there needs to be 100 or more ships per flag in making the estimation.

- Japan has a ratio greater than 2 [(39+50) / (31+7) = 2.342];
- Greece has the lowest ratio, [16/134 = 0.119], indicating the oldest fleet;
- Cyprus [19/131 = 0.145] turns out to be the second oldest flag; following this line Panama with 0.154; Philippines 0.174; Italy 0.244; UK 0.250; Liberia 0.363; and Spain 0.887.

All 15 flags show a mean ratio for the 1,500 ships of (140+251) / (483 + 626) = 0.352. From the total of ships in casualty 9.3% are under 6 years and 41.7% are over 21 years old.

These results do not mean that ships had a casualty for being very old, but rather that the world fleet in the 30 years under survey is quite old, neither does it mean that Japan's casualties occur mainly in her new ships, but rather that her fleet is new.

As in Table 1, two letters have been entered at the head of the columns, for readily identifying class of ship, GC = general cargo, BC = bulk carrier (dry--bulkers), etc. Total contribution of GC ships is 1,034 units, a share of 69% of the total. Next column is for dry-bulkers with 121 ships with an 8.1% share, followed by tankers on trades of crude oil or oil products, with 193 tankers and 12.9%. The rest of ships (all columns to the right) entered in the same line (G total) amount to 152 ships, with 10% of the total.

The mean of the gross tonnage of the first four columns with 150 ships per flag is highest for Liberia with 3,524,820 GT/150 = 23,499 GT. This figure, representing fewer GC ships and several in BC and TA ships for the same number of ships means a higher tonnage average. On the contrary, Panama, with a higher number of GC ships and few BC and TA ships, has the lowest tonnage average of the four analyzed with 874,780/150=5,832 GT. Total mean (15 flags) amount to 12,472,710 / 1,500 = 8,315 GT.

Comparing Table 1 and 3, the total tonnage average per ship is only of 8,315-7,883 = 432 GT. Ages in each table keep a similar ratio, and only column 13-20 years shows a difference as high as 4.8%. Regarding types of ships, the highest difference between tables does not surpass 2.4%.

In Table 4 we have arranged the accidents of the 15 flags in 10 columns, for allocating 1,500 ships per flag and their casualties under their corresponding entries and headings. "Stranding" is still the first reason for accidents totalling 455 cases and representing 30.3% of the total.

"Fire" ranks second involving 304 ships with 20.3% of the losses; fire in the engine room has the highest rate in this category, with 165 accidents. Third is "water-leaks", with 202 total losses, 13.4% of the total. The accident in the fourth place is "gales" with 157 ships and 10.5%. In the fifth place is "collisions" with 149 ships and 9.9%. Finally, the remaining five case reasons amount to 233 total losses with 15.6%.

Analyzed individually, the first nine flags in this Table with 100 or more ships in casualty per flag, Greece and Spain come into the highest rate in their total losses because of "fire aboard". On the contrary, Japan is the country with the lowest rate of losses by fire, with only five cases out of the 127 total losses, the most important accidents on record being "collisions".

3. CONCLUSION

Upon analyzing total loss accidents for 15 flags with sample sizes of 500 and 1,500 ships of over 500 GT, over a period of 30 years, the leading circumstances of maritime casualties in the merchant fleet for both sample sizes were in the following order: stranding; fire; water-leaks; gales; and collisions. Other five accident causes were entered, but had little impact. In the reckoning of ships in both models, fire was the second most frequent circumstance in the accidents and, together with stranding, represents more than 50% of maritime casualty returns and, if we include explosions in the column of fire, these latter items (explosion + fire) would add up to 25% of casualties. In considering flags one by one with over 100 ships, Greece and Spain are the flags where the highest number of accidents by fire is to be found, while Japan is the lowest. In this latter flag "collision" is the leading accident eventually ending in casualty.

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POVZETEK

ANALIZA VZROKOV POMORSKIH NESREČ

Pregled celotnih nesreč z izgubami v trgovski mornarici zadnjih 30 let nam pove o razmestitvi št. nesreč, glede na najbolj pogoste vzroke teh tragedij v naslednjem vrstnem redu: nasedanje, požar, prelom trupa, meteorološke razmere, trčenja ter ostali vzroki, ki pa se razvrstijo po naslednjem vrstenem redu: eksplozije, premiki tovora, delovanje teroristov oz. piratov in trčenje z neznanimi objekti. Analiza preučuje ladje nad 500 BT različnih zastav držav, ki plujejo na različnih potovanjih po vseh oceanih.

Uvodoma je analiziran vzorec 500-tih trgovskih ladij-različnih vrst in tonaž – ki plujejo pod 15 različnih zastav z namenom določitve starost in vrsto ladje ter vzroka nesreč.

V naslednji analizi pa je upoštevan isti vzorec, vendar razširjen na 1500 ladij. S pomočjo primerjave rezultatov obeh analiz pridemo do zaključka, da število vseh trčenj skupaj z meteorološkimi razmerami dosega do 25 % vseh pomorskih

Table 3. Ages and Class of Vessels from 15 flags with 1500 ships.

GC=General Cargo; BC=Bulk Carrier; TA=Tanker; OB=Ore Bulk Oil; GA=Liquefied Gas; CH=Chemical tanker; RR=Roll on, Roll off; CO=Container vessel; PF=Passenger or Ferry; OT=other vessels

Flags	Years Old				Ships No	Class of Vessels										DWT
	0-5	6-12	13-20	>21		GC	BC	TA	OB	GA	CH	RR	CO	PF	OT	
Greek	4	12	63	71	150	104	13	24	2	1		1		4	1	1,608,720
Panamanian	2	18	53	77	150	117	14	7	1		2	1		2	6	874,780
Liberian	10	30	62	48	150	59	32	45	8	1	3		2			3,524,820
Cyprus	2	17	51	80	150	123	8	9	1	1	3	1	2	1	1	1,214,260
UK	11	14	50	50	125	71	9	22	4	2		5	1	5	6	1,013,070
Japanese	39	50	31	7	127	100	4	12		4	2	1		1	3	495,140
Philippine	3	13	33	59	108	79		8		3			1	17		285,280
Italian	7	13	35	47	102	67	5	18	1	2	3	1	1	3	1	597,010
Spanish	21	26	16	37	100	76	6	9			1	1	2	1	4	687,820
Lebanese	1	2	18	57	78	71	5								2	262,020
Norwegian	16	18	23	11	68	43	5	15		1	2			2		697,470
Brazilian	3	15	15	25	58	48	4	1	1	2				1	1	259,140
US	2	3	13	40	58	18	12	20		1		1	2	2	2	608,510
W.German	19	17	14	7	57	45	1	2			1	3	1		4	188,690
Chilian		3	6	10	19	13	3	1	1						1	155,980
Total	140	251	483	626	1,500	1,034	121	193	19	18	17	15	12	39	32	12,472,710
%	9.3	16.8	32.2	41.7	100	69	8.1	12.9	10							100

Table 4. Causes of Maritime Casualties of 15 flags with 1500 ships.

S=Stranding, fine weather; SGF=Stranding in gale, fog or engine failure; FE=Fire in engine room; F=Fire, unspecified; FC=Fire in cargo; T =TOTAL; L= Leak; G=Gale; SC=Ship's collision; E=explosion; MF=Machinery failure; T=Terrorism, piracy or war; CU=Collision with unknown subject.

Flags	Strandings			Fire				L	G	SC	E	MF	T	CU	OT	Ships No
	S	SGF	T	FE	F	FC	T									
Greek	29	18	47	32	12	9	53	20	6	5	5	2	5	4	3	150
Panamanian	28	14	42	14	11	8	33	28	17	5	4	7	6	3	5	150
Liberian	29	19	48	21	11	4	36	17	8	15	10	2	9		5	150
Cyprus	26	20	46	23	9	4	36	30	12	5		3	12	1	5	150
UK	25	17	42	10	7	3	20	10	15	11	5	6	5	5	6	125
Japanese	14	17	31		2	3	5	16	26	38	7	4				127
Philippine	16	19	35	11	7	4	22	12	20	6	5	5	1	1	1	108
Italian	21	13	34	10	4	7	21	16	7	9	5	4	1	2	3	102
Spanish	11	9	20	9	10	4	23	15	10	14	4	9	2	2	1	100
Lebanese	22	12	34	10	1	2	13	9	6	3	2	3	4	2	2	78
Norwegian	7	6	13	9	6		15	7	7	12	5	6		1	2	68
Brazilian	14	11	25	3	1	5	9	9	3	6	2				4	58
US	11	4	15	7	1	1	9	6	7	6	8	3	3		1	58
W.German	9	5	14	5	1	1	7	5	9	14	1	5		2		57
Chilian	8	1	9	1	1		2	2	4		1			1		19
G.Total			455	61	32	18	304	202	157	149	64	59	48	24	38	1,500
%			30.3				20.3	13.4	10.5	9.9	4.3	3.9	3.2	1.6	2.6	100

nesreč. Medtem ko, trčenje in nasedanje predstavljata več kot 40%.

KLJUČNE RIJEČI

analiza, pomorska nesreča, izguba ladje, trčenje, nevihta, nasedanje

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