Fatalities at Sea

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Abstract

There are many problems with the available data relating to seafarer fatalities such as poor recording, limited coverage, and a lack of reliable and robust information on overall seafarer populations. These issues mean that it is often impossible to produce accurate fatality rates using traditional methods, such as fatalities per number of seafarers. This paper therefore presents fatality rates using alternative measures which rely on data which is more readily available in the industry, such as the number of vessels and tonnage.

Introduction

It is often suggested that, relative to other occupations, seafaring is a dangerous profession, and although the overall number of fatalities has dropped compared to levels at the turn of the century, recent studies show that fatality rates are still much higher for seafarers than for those in other occupations (Roberts, 2008; Rodriguez and Formoso, 2007; Roberts, 2002a; Roberts, 2002b; Roberts and Hansen, 2002; Li and Wonham, 2001; Nielsen and Roberts, 1999; Larsson and Lindquist, 1992). For example, Rodriguez and Formoso (2007) reported that fatality rates in the Spanish maritime transport industry were nearly six times higher than for the general population. Similarly, Hansen (1996) found that mortality rates for Danish seafarers were 11 times higher than comparable shore based workers. Others have found even higher rates, with Roberts (2002a) reporting that UK seafarers were 26.2 times more likely to have a fatal accident at work compared to shore based workers in the UK.

All of these studies, however, have limitations. The calculation of fatality rates such as these requires reliable, accurate information about both the number of fatalities and the overall number of seafarers. Although many administrations record generally reliable data on fatalities, because of the serious nature of such incidents, those with smaller fleets and flags of convenience do not always do so (Li and Wonham, 2001; Nielsen and Roberts, 1999; Jepsen, 1991). Some authors have also voiced concern over possible under-reporting of fatalities (Nielsen and Roberts, 1999; Larsson and Lindquist, 1992).

In the calculation of fatality rates the numbers of seafarers in the group from which the fatalities derive is as important in establishing an accurate ‘rate’, as the numbers of fatalities per se. Obtaining accurate information about the overall number of seafarers associated with a register (flag) is, however, highly problematic. Although there are administrations which do consistently record and publish accurate and reliable data about their seafarer population, for example Denmark (see Danish Maritime Authority, 2009), this is very much the exception rather than the rule. More often than not these data are not available at all or, if they are available, there is significant concern about their accuracy (Roberts, 2008). This stems, in particular, from the ways administrations attempt to ‘count’ seafarers. For example, Li and Wonham (2001) suggest that in many cases records of employment or lists of ‘qualified’ seafarers (i.e. lists of certificates for seafarers) are used to provide these data. However, these will include seafarers who are on leave and those that are working ashore (Li and Wonham, 2001), as well as, in some instances, those no longer working in the industry, leading to seafarer numbers being artificially high and not representing those actually working at sea. Artificially high numbers of seafarers will produce artificially low fatality rates for the industry. There are inevitably, as a result, significant doubts over many of (even) the most recently reported seafarer fatality rates.

Partly due to these problems, perhaps, many studies have focused only on individual or a small number of national fleets, and frequently cover different time periods (Li and Wonham, 2001; Nielsen and Roberts, 1999). Only one study has compared fatality rates for different vessel types (see Nielsen, 1999), but this too was limited to a single national fleet. This limited focus and poor coverage, coupled with the widespread problems concerning data on overall seafarer numbers, has made it is impossible to examine and compare rates across the industry as a whole, across administrations, or by vessel types.

There are, however, other ways of presenting accident rates. For example fatality rates can be presented in relation to ‘exposure’, such as kilometres travelled (predominantly used in the non-maritime transport industry), or in terms of years worked. For example, Roberts and Hansen (2002) reported an accident rate of 37.8 per 100,000 seafarer years for British merchant ships. Similarly Hansen, *et al.*, (2008) found an accident rate of 84 accidents per 1,000 years onboard ship in a study of Danish cargo ships (note, this figure includes non-fatal accidents). On the face of it, this is a better unit of measurement as it takes into account how much exposure a person has to the risk of an accident. For example, although there is a high number of accidents in the road transport sector, there is also a high level of mileage covered. However, for the maritime industry such exposure data, for example, hours worked, is frequently not readily available, and where it is, can often be unreliable (Evans, 2003). This has lead to some authors using questionable measures to calculate such information (for example, Roberts and Hansen 2002).

The aim of this paper, therefore, is to try to address some of these difficulties. In addition to trying to collect data on seafarer fatalities from a number of administrations worldwide for all vessel types, the paper focuses on considering alternative ways of calculating fatality rates. Two possibilities are considered: rates by vessel (as opposed to seafarer) numbers, and rates by gross tonnage. The advantage of these approaches over the more traditional rates by seafarer numbers or exposure levels is that they do not rely on 'population' data from administrations which, as we have described, may be collected in varying ways or may not be collected at all. Rather, both these alternative rates are based on reliable and accurate data which are publicly available from the Lloyd's Register *World Fleet Statistics* (Lloyd's Register Fairplay, 2010). The paper also briefly touches on fatality rates by ship type, a measure which, to date, has attracted relatively little attention and has not been looked at for multiple administrations.

Methods

Accident data were originally obtained as part of an earlier study conducted by The Lloyd's Register Educational Trust Research Unit (The LRETRU[1]), Cardiff, which collected data from Maritime Administrations worldwide. Initially the top 30 administrations (as defined by the volume of gross tonnage) were approached and asked if they collected data on accidents involving vessels under their flag and/or occurring in their national waters. Twenty six Administrations responded and of these 25 indicated that they did collect such data. These Administrations were then asked if they would be willing to share these data for the period of 2000 to 2005 with The LRETRU for academic research purposes. After lengthy negotiations, sixteen administrations provided accident data, with seven of the datasets including

[1] The Lloyd's Register Educational Trust (The LRET) is an independent charity working to achieve advances in transportation, science, engineering and technology education, training and research worldwide for the benefit of all.

information on accidents that involved personnel onboard[2]. As part of a separate initiative, these data were updated in 2011 when the seven administrations were again asked to provide accident data, with four administrations providing the information to date. We are still in the process of collecting further data from the other three administrations.

The seven administrations that provided detailed data were additionally asked if they could provide information about the overall number of seafarers employed. Four provided these data for the complete period of study (2000-2010). As anticipated, the sources of this information varied, with one being a national register of employment, whereas another was compiled from the number of articles of agreement signed by national seafarers (i.e. contracts). As noted in the introduction, and in common with other studies, these differences seriously undermine the construction of comparable fatality rates.

Inclusion Criteria

The sampling criteria for the seafarer data were similar to those used by Roberts (2008), Roberts and Hansen (2002) and Nielsen (1999) and included those that worked onboard merchant vessels, including officers, ratings, cadets, and other crew such as stewards and catering staff. Non-crew members, such as passengers, visitors to the vessel, and other non-working individuals, were excluded. Those seafarers that were recorded as missing were included as fatalities, as in the Roberts and Hansen (2002) study.

In terms of vessels, a number of ship types were excluded from the current analysis. These included non-merchant ships such as fishing vessels, non-commercial pleasure craft, and vessels that worked only in port or on inland water networks, such as barges and tugs. A full list of vessel types excluded is shown in Appendix 1.

For each of the Administrations, only vessels flying the national flag were included.

Ship Type Coding

The vessel types which seafarers were sailing upon, as listed in Administrations' datasets, were re-grouped using Lloyd's Register *World Fleet Statistics,* Level 3, ship type definitions (see Appendix 1). There are 24 separate ship types under the Level 3 definitions which have

[2] For full details of methods used to collect accident data from the Maritime Administrations, see Ellis (2007).

been combined into five broad categories: Tankers, Bulk Carriers, Cargo Vessels, Passenger/ General Cargo Vessels, and Other (including offshore industry vessels). For full details of how the vessel types were combined see Appendix 1.

Results

Table 1 shows the range and nature of the data that were provided by each of the administrations. In terms of the factors relating to the key exclusion criteria, only five administrations supplied information about whether the fatalities were crew members or passengers. In addition, although six administrations provided information about the flag of the vessels involved, in one case, this was only partial. Furthermore, only four administrations provided the overall seafarer numbers data needed to calculate fatality rates per number of seafarers.

Looking at the coverage of the datasets in general, only four of the seven Administrations provided data for the full 10 year period. Although they all provided ship type information, two only gave partial data. Very few kept seafarer demographic and job-related information (i.e. age, rank) and only two provided information about the nationality of seafarers. All Administrations did, however, provide details of the type of incident that occurred to the vessel (i.e. collision, sinking).

Table 1: Data Provided by each of the Seven Administrations

	Administration						
	A	*B*	*C*	*D*	*E*	*F*	*G*
Years Covered	2000-2005	2000-2005	2000, 2001, 2003, 2004, 2007, 2008, 2009	2005-2010	2001-2005	2000-2011	2000-2009
Ship Type	✓	✓	✓	Partial	✓	Partial	✓
Flag	✓	✓	✓	×	✓	Partial (2006-2010 only)	✓
Gross tonnage	✓	×	✓	×	✓	✓	✓
Age of Vessel	✓	×	✓	×	✓	✓	✓
Vessel Incident Type	✓	✓	✓	✓	✓	✓	✓
Fatality or Injury	✓	✓	✓	✓	✓	✓	✓
Crew or Passenger	✓	✓	✓	×	×	✓	✓
Seafarer Nationality	✓	×	×	×	×	✓	×
Seafarer Rank	✓	×	×	×	×	✓	✓
Age of Seafarer	×	×	×	×	×	✓	✓
Cause of casualty	✓	×	×	✓	×	×	✓
Overall seafarer numbers (2000-2010)	×	× (2000-2005 only)	✓	✓	× (2000-2005 only)	✓	✓

Fatality rates by administration per 100,000 seafarers

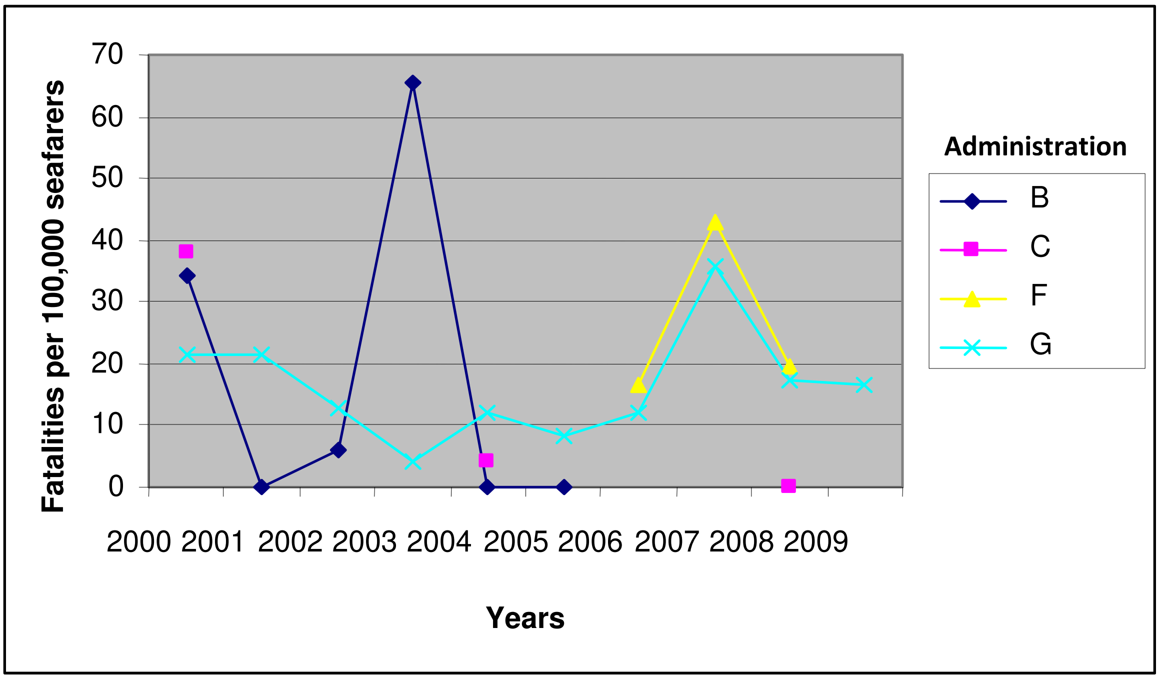
Looking initially at the standard measure of fatality rates (per number of seafarers), it was only possible to calculate these rates for the four Administrations that provided overall numbers of seafarers. Table 2 shows fatality rates per 100,000 seafarers, a similar unit to that used by Roberts (2008) in his study of UK seafarers.

Table 2: Fatality Rates per 100,000 Seafarers Split by Year and Administration

Admin	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	*Mean*
B	34.11	0.00	5.87	65.43	0.00	0.00					*17.57*
C	38.01				4.10				0.00		*14.04*
F							16.75	42.77	19.63		*26.38*
G	21.32	21.58	12.72	3.99	11.95	8.22	11.89	35.81	17.30	16.45	*16.12*
Mean	*31.15*	*10.79*	*9.29*	*34.71*	*5.35*	*4.11*	*14.32*	*39.29*	*12.31*	*16.45*	*17.78*

Mean fatality rates for all Administrations varied between 4.11 seafarer deaths per 100,000 seafarers for 2005 and 39.29 seafarer deaths per 100,000 seafarers for 2007. Mean rates by administration (across years) varied between 14.04 seafarer deaths per 100,000 for Administration C and 26.38 seafarer deaths per 100,000 for Administration F. Rates for each administration by year are shown in Figure 1.

Figure 1: Fatality Rates per 100,000 Seafarers Split by Year and Administration



For Administration B there is a very apparent spike in 2003. This was due to the total loss of a vessel where all crew were killed (n=11). Such cases where there is a total loss are problematic for fatality rates, and some researchers suggest that multiple deaths should be treated as single incidents in order to get more consistent and reliable rates (see O'Connor and O'Connor, 2006).

Looking at the general pattern of rates, although there were a number of years where data were missing for Administration C, where they were present the rate was generally lower than those for Administration F and G, which had similar rates. Figure 1 also seems to suggest that the Administration C fatality rate falls over time. However, the missing years make it impossible to say whether this is a consistent trend, and thus any such claims should be made cautiously.

Fatality rates by administration per 100 vessels

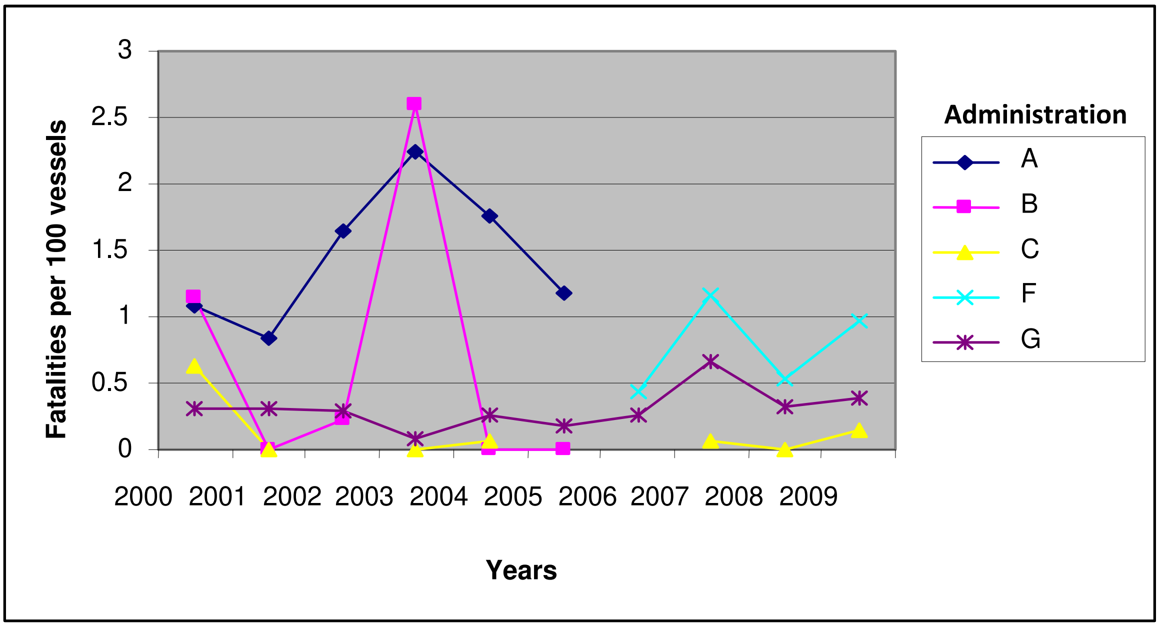
Next, two alternative fatality rates were calculated. This was possible for all five of the Administrations that provided flag and crew/passenger information for their fatality data. Table 3 shows the first of these rates, fatalities per 100 vessels.

Table 3: Fatality Rates per 100 Vessels Split by Year and Administration

Admin	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	*Mean*
A	1.09	0.84	1.64	2.25	1.76	1.18					*1.46*
B	1.15	0.00	0.22	2.60	0.00	0.00					*0.66*
C	0.63	0.00		0.00	0.07			0.07	0.00	0.14	*0.13*
F							0.44	1.16	0.53	0.96	*0.77*
G	0.31	0.31	0.29	0.09	0.26	0.18	0.26	0.66	0.32	0.38	*0.31*
Mean	*0.79*	*0.29*	*0.72*	*1.23*	*0.52*	*0.45*	*0.35*	*0.63*	*0.29*	*0.49*	*0.67*

Overall mean rates for all Administrations varied from 0.29 seafarer deaths per 100 vessels in 2001 and 2008 to 1.23 seafarer deaths per 100 vessels in 2003. The mean rates by Administration (across years) varied from 0.13 seafarer deaths per 100 vessels in Administration C to 1.46 seafarer deaths per 100 vessels in the Administration A. These rates are shown in Figure 2.

Figure 2: Fatality Rates per 100 Vessels Split by Year and Administration



Although only covering the period 2000-2005, the fatality rate for Administration A can be seen to be much higher those than for other Administrations (except in 2003 where a spike in the rate for Administration B can be seen again). Administration C, as before, has the lowest fatality rate, with Administration F and G showing slightly higher levels.

Fatality rates by administration per 1,000,000 gross tonnes

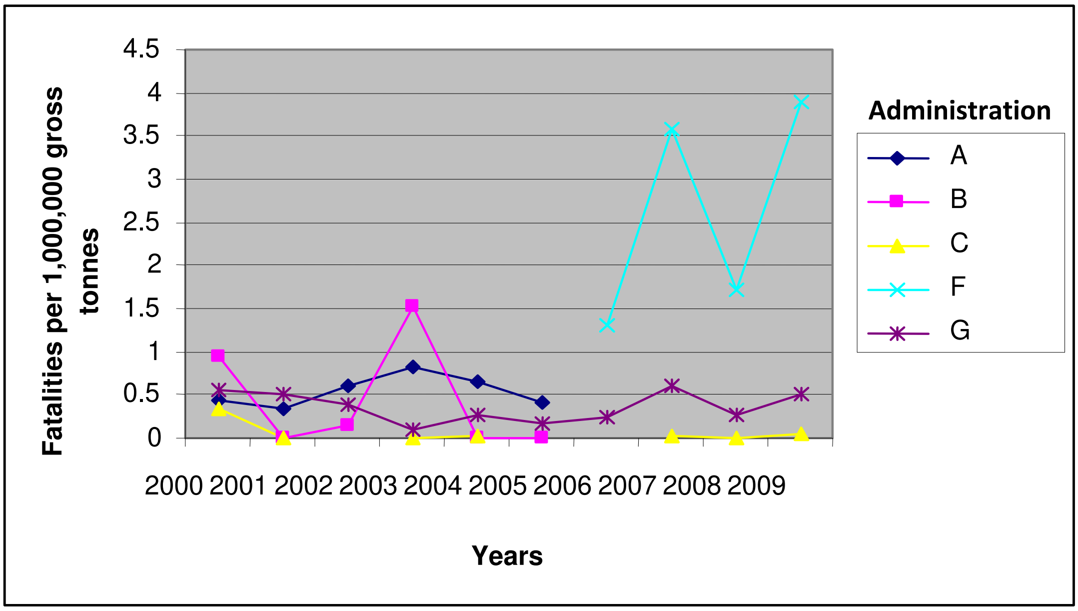
An alternative method for calculating seafarer fatality rates could rely on gross tonnage. We therefore calculated the mean fatality rates for the different Administrations using gross tonnage as the ‘denominator’ (see Table 4).

Table 4: Fatality Rates per 1,000,000 GT Split by Year and Administration

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	*Mean*
A	0.45	0.33	0.61	0.83	0.65	0.42					*0.55*
B	0.94	0.00	0.14	1.52	0.00	0.00					*0.43*
C	0.34	0.00		0.00	0.03			0.03	0.00	0.05	*0.06*
F							1.32	3.57	1.73	3.89	*2.63*
G	0.56	0.51	0.38	0.09	0.27	0.18	0.25	0.60	0.27	0.50	*0.36*
Mean	*0.57*	*0.21*	*0.38*	*0.61*	*0.24*	*0.20*	*0.78*	*1.40*	*0.66*	*1.48*	*0.81*

In terms of gross tonnage, overall mean rates for all Administrations varied between 0.20 seafarer deaths per 1,000,000 gt in 2005 and 1.48 seafarer deaths per 1,000,000 gt in 2009. The mean rates by Administration were again lowest for Administration C (0.06 per 1,000,000 GT) and, in this case, highest for Administration F (2.63 per 1,000,000 GT). Rates in terms of gross tonnage are shown in Figure 3.

Figure 3: Fatality Rates per 1,000,000 GT Split by Year and Administration

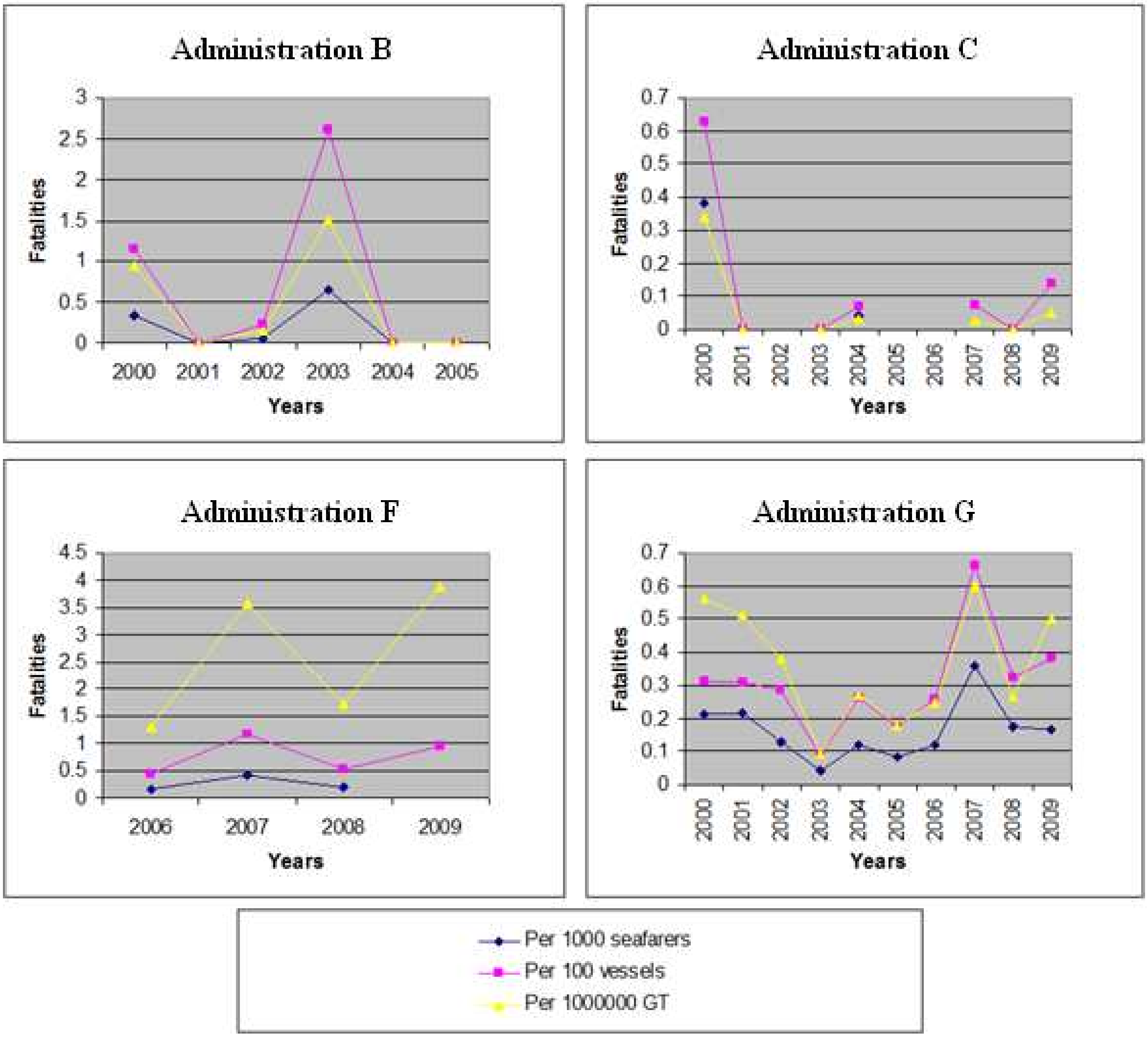


Looking at fatality rates in terms of tonnage it is clear that although data are only present for 2006 onwards, the fatality rate for Administration F is considerably higher than those for the other Administrations.

Comparing fatality rates

In order to compare the three types of fatality rates, Figure 4 presents the rates together for each Administration[3].

Figure 4: Fatality Rates Using the Three Different Measures



[3] The four Administrations where it was possible to calculate all three rates are presented here; the other, where only two rates were possible, is in Appendix 2.

Looking at the four Administrations for which all three rates could be calculated, the alternative rates (i.e. fatalities by vessel number or tonnage) follow a similar pattern to that of the standard fatality rate (per number of seafarers) for all of the Administrations. In addition, the Administration with the lowest mean overall rate per number of seafarers, Administration C, also has the lowest mean overall rates by both vessel numbers and gross tonnage. Administration F, the Administration with the highest overall rate per number of seafarers also showed the highest rates for the two alternative measures, particularly that per 1,000,000 GT. These consistencies, both in terms of patterns over time and relative levels between Administrations, suggest that the alternative rates presented here are viable ways of considering fatality rates.

However, there are some specific issues which require further consideration in relation to any future development of this 'measure'. In our sample of five Administrations, four had similar numbers of vessels on their register (an average of 1,526 vessels per fleet). One had approximately one third of this number of ships registered with it however. When it came to tonnage the variation was far greater with just two of the Administrations registering similar volumes of tonnage and with the largest register (by tonnage) having 24 times more registered tonnage than the smallest. These variations inevitably impact upon the calculation of fatality rates. We are currently in the very early stages of considering ways this might be dealt with, for example by using the information available about vessel numbers and tonnage together with details of crew sizes. Refining the approach in this way might allow it to be of greater use in making cross-register comparisons.

Unsurprisingly, within the overall patterns there are a number of Administration-specific differences. For example, the Administration F's rate by tonnage is markedly higher than the rates presented by vessel or seafarer numbers, reflecting the composition of the fleet which contains a large number of mainly low tonnage vessels. However, for Administration G's fatality rates in terms of both tonnage and the number of vessels are higher than fatalities per number of seafarers. For Administration B and C the three rates are generally similar, although for Administration B the spike in 2003 is apparent in all three measures, with per vessel measure highest and the per seafarers measure lowest

Fatality rates by ship type

Previous research has paid little attention to differences in fatality rates by ship type. Although this is very much a work in progress for this project, Table 5 shows ship type fatality rates per 100 vessels for all five of the Administrations in combination.

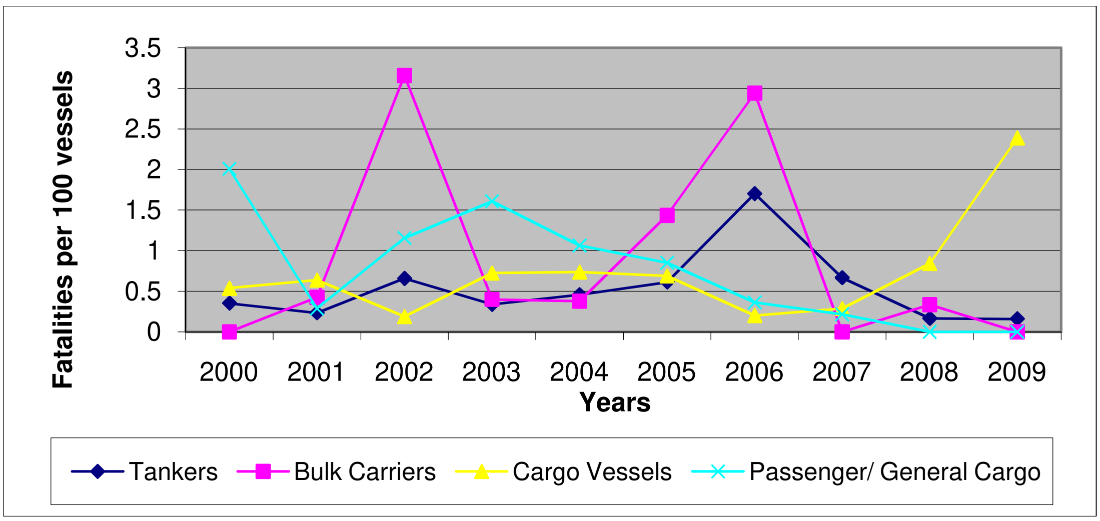
Table 5: Fatality Rates Per 100 Vessels by Ship Type Split by Year

	Tankers	Bulk Carriers	Cargo Vessels	Passenger/ General Cargo	Other (Inc Offshore Industry Vessels)
2000	0.35	0.00	0.54	2.01	0.11
2001	0.23	0.42	0.64	0.29	0.00
2002	0.66	3.16	0.19	1.16	1.27
2003	0.34	0.40	0.72	1.61	1.58
2004	0.46	0.38	0.74	1.06	0.43
2005	0.61	1.43	0.69	0.85	0.13
2006	1.70	2.94	0.20	0.36	0.00
2007	0.67	0.00	0.29	0.22	1.06
2008	0.16	0.33	0.84	0.00	0.09
2009	0.16	0.00	2.39	0.00	0.09
Mean	*0.53*	*0.91*	*0.72*	*0.76*	*0.48*

Looking at fatality rates across the years, we find fairly similar rates across all the vessel types. However, excluding the other category (as being too heterogeneous to compare), bulk carriers have the highest mean rate of fatalities (0.91) and with tankers the lowest (0.53).

Fatality rates per 100 vessels by ship type (excluding others) are shown in Figure 5.

Figure 5: Fatality rates per 100 vessels by ship type split by year



Looking at the fatality rates for each of the ship types across the years, no particular vessel type has a consistently higher rate of fatalities although average fatality rates per ship type do vary. There are a number of years where the accident rate for a particular ship type rises dramatically. For example, bulk carriers in 2002 and 2006, where the accident rates are 3.16 and 2.94 fatalities per 100 vessels respectively. However, both of these spikes may be seen as anomalous: while there were only one and three fatalities for those years respectively, there were also particularly low numbers of vessels (total number of bulk carriers registered) in those years. Considering rates such as these over a longer period of time and for a greater number of registers would allow us a better insight into the overall patterns of fatality by ship type potentially 'ironing out' some of the effects of anomalous years/data.

Discussion

An important criticism of many previous studies of fatality rates in the maritime industry is that they often present rates calculated using questionable (and variable) baseline data on overall numbers of seafarers. The aim of this paper has been to try to suggestive alternative ways of dealing with these issues by: first, collecting data from a number of Administrations worldwide; and second considering alternative ways of calculating fatality rates. Although, as anticipated, we have encountered a number of difficulties in terms of the availability and content of the Administration data, we have nevertheless presented three different measures of fatality rates across a number of Administrations in the hope of stimulating discussion and a greater awareness of the issue across the sector.

It should, of course, be stressed that the lack of usable data was not the result of any unwillingness to cooperate on the part of the maritime Administrations. Rather the issue is one of what Administrations record and how they record it. For example, many of the Administrations' datasets which we examined (10 of the 16 provided) did not include information about accidents occurring to individuals, instead focussing on vessels alone. Where details about accidents involving those onboard were included, these were often sparse. For instance, two datasets had to be excluded from this study because, although the number of fatalities that occurred per incident was recorded, there was no indication of whether these were to crew or to passengers onboard the vessel. Similarly the flag of the vessel that the fatality occurred on was only recorded in 5 of the 7 cases. This information is crucial to the accuracy, reliability and comparability of the rates. Unless the issue of poor recording is addressed by Administrations worldwide it will continue to hamper efforts to produce global fatality rates. However, the impetus for Administrations to do this will need to come from the international legislative bodies such as the International Maritime Organisation (IMO) and the International Labour Organisation (ILO), so that global standards can be agreed upon.

The calculation of reliable fatality rates, however, is not solely dependent on what is recorded within accident data. As discussed earlier, the present study also found that for most Administrations there was a lack of available data relating to total numbers of seafarers (the information which is also required to calculate standard fatality rates). Even where these data were available, their source was often questionable in terms of its reliability and comparability across Administrations. For example, while one Administration provided data from official employment statistics, another's source was records of certification. Furthermore, most sources raise the additional issue of whether a seafarer is 'active', i.e. working at sea, or not.

To address this the study looked at alternative ways by which fatality rates could potentially be calculated using data which is much more consistent and readily available in the maritime industry, i.e. statistics on the world fleet. Rates were presented by number of vessels and by gross tonnage. Although this approach has yet to be refined a comparison of these rates with the traditional measure suggested that measuring fatality rates in these ways could conceivably provide an alternative and viable approach that allows for the inclusion of more Administrations worldwide.

The paper also briefly considered differences in fatality rates across vessel types. These data are preliminary. However, they represent a first step in an exercise which would provide insight into the types of vessel where safety could usefully be improved.

We suggested at the outset that seafaring has always been, and continues today to be, a relatively dangerous occupation. This study has highlighted the current difficulties in calculating reliable and globally comparable fatality rates in the industry. However, if a "gold standard" minimum data set could be internationally agreed, this would allow not only for the calculation of accurate fatality rates, but also for the targeting of interventions to improve safety where they are needed most. This would significantly improve the industry's ability to reduce the relative danger of seafaring. However, until the time when such standardised recording practices are agreed upon the alternative measures presented here do seem to suggest a potentially viable alternative to traditional seafarer population-based fatality rates.

Acknowledgements

We gratefully acknowledge the role of The Lloyd's Register Educational Trust (The LRET) in supporting this work, and for allowing us to use data collected as part of a previous project funded by them.

The Lloyd's Register Educational Trust (The LRET) is an independent charity working to achieve advances in transportation, science, engineering and technology education, training and research worldwide for the benefit of all.

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Appendix 1

Lloyd’s Register World Fleet Statistics Ship Types (WFS, 2009) –Vessel Types Coding Including Combined Categories

Level 5	Level 4	Level 3 *(As used for initial coding of vessel type)*	SIRC Ship Type Codings
LNG Tanker CNG Tanker	LNG Tanker	Liquefied Gas	Tankers
LPG Tanker LPG/ Chemical Tanker LPG Barge, propelled	LPG Tanker		
CO2 Tanker	C02 Tanker		
Molten Sulphur Tanker Chemical Tanker Parcels Tanker Chemical Tanker Barge, propelled	Chemical Tanker	Chemical	
Chemical/ Products Tanker Chemical/ Products Tanker Barge, propelled	Chemical/ Oil Products Tanker		
Wine Tanker	Wine Tanker		
Vegetable Oil Tanker	Vegetable Oil Tanker		
Edible Oil Tanker	Edible Oil Tanker		
Beer Tanker	Beer Tanker		
Latex Tanker	Latex Tanker		
Fruit Juice Tanker	Fruit Juice Tanker		
Shuttle Tanker Crude Oil Tanker Crude/Oil Products Tanker	Crude Oil Tanker	Oil	
Products Tanker Tanker (unspecified) Products Tanker Barge, propelled	Oil Products Tanker		
Asphalt/Bitumen Tanker	Bitumen Tanker		
Coal /Oil Mixture Tanker	Coal /Oil Mixture Tanker		
Water Tanker Water Tanker Barge, propelled	Water Tanker	Other Liquids	
Molasses Tanker	Molasses Tanker		
Glue Tanker	Glue Tanker		
Alcohol Tanker	Alcohol Tanker		
Caprolactam Tanker	Caprolactam Tanker		
Bulk Carrier Bulk Carrier, Laker Only Bulk Carrier (with Vehicle Decks) Bulk Barge, propelled	Bulk Carrier	Bulk Dry	Bulk Carriers
Ore Carrier	Ore Carrier		
Bulk/Oil Carrier (OBO) Ore/Bulk/Products Carrier	Bulk/Oil Carrier	Bulk Dry/Oil	
Ore/Oil Carrier	Ore/Oil Carrier		
Bulk Cargo Carrier, self discharging Bulk Cargo Carrier, self discharging, Laker Bulk Cargo Barge, self discharging, propelled	Self Discharging Bulk Carrier	Self Discharging Bulk Dry	
Cement Carrier Bulk Cement Barge, propelled	Cement Carrier	Other Bulk Dry	
Wood Chips Carrier, self unloading	Wood Chips Carrier		
Urea Carrier	Urea Carrier		
Aggregates Carrier	Aggregates Carrier		
Limestone Carrier	Limestone Carrier		
Refined Sugar Carrier	Refined Sugar Carrier		
Powder Carrier	Powder Carrier		
General Cargo Ship (with Ro-Ro facility) Open Hatch Cargo Ship General Cargo/ tanker (Container/oil/bulk - COB ship) General Cargo /tanker	General Cargo Ship	General Cargo	Cargo Vessels

General Cargo Ship			
General Cargo Barge, propelled			
Palletised Cargo Ship	Palletised Cargo Ship		
Deck Cargo Ship	Deck Cargo Ship		
General Cargo/Passenger Ship	Passenger/General Cargo Ship	Passenger/General Cargo	Passenger/ General Cargo
Container Ship (Fully Cellular) Container Ship (Fully Cellular with Ro-Ro Facility)	Container Ship	Container	
Container Barge, propelled			
Passenger/Container Ship	Passenger/Container Ship		
Refrigerated Cargo Ship	Refrigerated Cargo Ship	Refrigerated Cargo	
Ro-Ro Cargo Ship Rail Vehicles Carrier	Ro-Ro Cargo Ship	Ro-Ro Cargo	
Car Carrier Vehicles Carrier	Vehicles Carrier		
Container/Ro-Ro Cargo Ship	Container/Ro-Ro Cargo Ship		
Landing Craft	Landing Craft		Cargo Vessels
Passenger/Ro-Ro Ship (Vehicles) Passenger/Ro-Ro Ship (Vehicles/Rail)	Passenger/Ro-Ro Cargo Ship	Passenger/Ro-Ro Cargo	
Passenger/Landing Craft	Passenger/Landing Craft		
Passenger/Cruise	Passenger (Cruise) Ship	Passenger	
Passenger Ship	Passenger Ship		Passenger/ General Cargo
Livestock Carrier	Livestock Carrier	Other Dry Cargo	
Barge Carrier Barge Carrier, semi submersible	Barge Carrier		
Heavy Load Carrier Heavy Load Carrier, semi submersible Yacht Carrier, semi submersible	Heavy Load Carrier		
Nuclear Fuel Carrier Nuclear Fuel Carrier (with Ro-Ro facility)	Nuclear Fuel Carrier		
Pulp Carrier	Pulp Carrier		Cargo Vessels
Factory Stem Trawler Stem Trawler Trawler	Trawler	Fish Catching	REMOVED FROM ANALYSIS
Fishing Vessel	Fishing Vessel		
Fish Factory Ship	Fish Factory Ship	Other Fishing	
Fish Carrier	Fish Carrier		
Live Fish Carrier (Well Boat)	Live Fish Carrier		
Fish Farm Support Vessel Fishery Patrol Vessel Fishery Research Vessel Fishery Support Vessel	Fishing Support Vessel		
Seal Catcher	Seal Catcher		
Whale Catcher	Whale Catcher		
Kelp Dredger	Kelp Dredger		
Pearl Shells Carrier	Pearl Shells Carrier		
Crew/Supply Vessel Pipe Carrier Platform Supply Ship	Platform Supply Ship	Offshore Supply	Others (Inc offshore industry vessels)
Anchor Handling Tug Supply Offshore Tug/Supply Ship	Offshore Tug/Supply Ship		
Offshore Support Vessel	Offshore Support Vessel	Other Offshore	
Diving Support Vessel Accommodation Ship			
Drilling Ship	Drilling Ship		
Pipe Layer Crane Vessel Pipe Layer	Pipe Layer		
Production Testing Vessel	Production Testing Vessel		
FPSO, Oil FPSO, Gas	FPSO		
Well Stimulation Vessel	Well Stimulation Vessel		
Standby Safety Vessel	Standby Safety Vessel		
FSO, Oil FSO, Gas	FSO (Floating, Storage, Offloading)		
Trenching Support Vessel	Trenching Support Vessel		
Pipe Burying Vessel	Pipe Burying Vessel		
Research Survey Vessel	Research Vessel	Research	

Tug Pusher Tug	Tug	Towing/Pushing	
Bucket Dredger Cutter Suction Dredger Grab Dredger Suction Dredger Dredger (unspecified) Water Jet Dredger	Dredger	Dredging	
Hopper/Bucket Dredger Hopper/Grab Dredger Hopper/Suction Dredger Hopper/Dredger (unspecified)	Hopper Dredger		
Hopper, Motor Stone Carrier	Motor Hopper	Other Activities	
Crane Ship Pile Driving Vessel	Crane Ship		
Icebreaker Icebreaker/ Research	Icebreaker		
Cable Repair Ship Cable Layer	Cable Layer		
Incinerator Waste Disposal Vessel Effluent carrier	Waste Disposal Vessel		
Fire Fighting Vessel	Fire Fighting Vessel		
Pollution Control Vessel	Pollution Control Vessel		
Patrol Vessel	Patrol Vessel		
Crew Boat	Crew Boat		
Training Ship	Training Ship		
Utility Vessel	Utility Vessel		
Search & Rescue Vessel	Search & Rescue Vessel		
Pilot Vessel	Pilot Vessel		
Salvage Ship	Salvage Ship		
Buoy Tender Buoy & Lighthouse Tender Lighthouse Tender	Buoy/Lighthouse Vessel		
Supply Tender	Supply Tender		
Mooring Vessel	Mooring Vessel		
Work/Repair Vessel	Work/Repair Vessel		
Hospital Vessel	Hospital Vessel		
Tank Cleaning Vessel	Tank Cleaning Vessel		
Trans Shipment Vessel	Trans Shipment Vessel		
Anchor handling Vessel	Anchor Hoy		
Rocket Launch Support Ship	Rocket Launch Support Ship		
Log Tipping Ship	Log Tipping Ship		
Exhibition Vessel Theatre Vessel Mission Ship	Leisure Vessels		
Bulk Dry Storage Ship Bulk Cement Storage Ship	Dry Storage		
Mining Vessel	Mining Vessel		
Wind Turbine Vessel Wind Turbine Installation Vessel Wind Turbine Installation Vessel (semi sub)	Wind Turbine Vessel		
Bunkering Tanker	Bunkering Tanker		
Vessel (function unknown)	Vessel (function unknown)		
Sailing Vessel	Sailing Vessel		

Appendix 2

Fatality Rates For Administration A Using Two Different Measures (Per 100 Vessel, and Per 1,000,000 GT)