Gen Memo 22/12: SEA Project / MCQ Assessment / HIMT / EESO Training / Allianz-SIRC Report / Goldberg Blog / ICSW News

Dear Members,

PLEASE ENSURE THIS GEN MEMO IS WIDELY DISTRIBUTED WITHIN YOUR INSTITUTION

1 SEA Project

Further to the advice in Gen Memo 19/12, the final version of the Sargasso Sea Poster, the first in the Seafarer Environmental Awareness Project, has now had an initial print run. The design and printing of the poster was kindly organised for GlobalMET by member Maritime Training Services (MTS) in Seattle WA, USA. GlobalMET, The Nautical Institute and WWF are very grateful for the strong support provided by MTS.

Orders and expressions of interest have been received for almost 1000 posters. BW Fleet Management has ordered 80 posters and will be the first to place the posters on board its ships. The Sargasso Sea Alliance has ordered 350 posters. Another major ship manager has expressed interest in obtaining 500 posters. Twenty posters are reserved for delivery to members who responded to Gen Memo 19/12 by 25 July and will be delivered in the near future.

The poster is now available at USD 10 per poster, plus packing and postage. A second print run will be conducted upon receipt of firm orders. Please place orders with MTS or with the GlobalMET Secretariat.

There is now need to market the posters widely and get them onto the ships. Marketing already being done on the MTS website - http://www.maritimetraining.com/Product/Sargasso-Sea-Poster - where a copy of the final version of the poster can be viewed. This will also be uploaded on www.globalmet.org in the near future.

2 MCQ Assessment

Captain Denis F. Drown ExC FNI - denis.drown@nl.rogers.com - of Newfoundland has advised that he found the recent - IMLA 20 Conference very interesting, informative and enjoyable. He expresses thanks to the organising efforts, especially by Stephen Cross and Wim van Leunen. Proceedings are on the IMLA website - http://imla.co/news-events/imla-20-successfully-held-miwb.

The paper MULTIPLE CHOICE QUESTION ASSESSMENT: A QUESTION OF CONFIDENCE by Denis and co-authors is attached. Denis advises that their next step is to 'extract some statistical sense from the Preliminary Report data'.

3 Hindustan Institute of Maritime Training

The following has been received from GlobalMET Member HIMT:

Hindustan Institute of Maritime Training (HIMT) ,Chennai offers various Post Sea courses in the City campus at Kilpauk and Presea courses in both Nautical & Engineering disciplines at Kalpakkam (9km from Mamallapuram). By God's grace HIMT has set a benchmark in Maritime Training and have retained its status for over a decade as India's Largest Post Sea Maritime Institute in terms of conducting maximum number of courses approved by D.G.Shipping. The same would not been possible without the support from the Shipping fraternity and the pool of dedicated faculty whose aim has been to gift their knowledge and experience that they have gained from this profession to the next generation.

We have openings on Full Time/Part Time basis for Masters/Chief Engineers/Mates/2nd Engineers/Electrical Officers and Instructors from Nautical and Engineering Disciplines. We also encourage those who are sailing and can commit for atleast 6 months on a rotation basis or Shipping Company superintendents willing to share their valuable expertise for once/month or more between 0730hrs to 1015hrs to the Revalidation course candidates.

We are also looking out for Captain Superintendent / Principal for our Presea campus.

Family Accommodation is available for our faculty at the Presea campus and transport also is available for those who wish to stay at home and travel to the campus.

We certainly offer an attractive package and growth Career in the field of this Noble and respectable profession.The annual package would range between 10 lakhs to 24 lakhs+ .

Interested Professionals may email your resume to ssv@himtmarine.com

4 IMO & WMU to Launch EESO Training

The International Maritime Organization and the World Maritime University, to hold meeting to launch the Energy Efficient Ship Operation training course project on September 3rd, 2012.

The aim of this launching meeting is to gather various experts and stakeholders in order to share knowledge and to make sure the course will be developed encompassing all the issues relevant to this topic. The training package will be designed to support the Energy Efficient Operation of Ships and will highlight its various related aspects.

5 Safety and Shipping 1912-2012:From Titanic to Costa Concordia

One hundred years after the sinking of the Titanic, specialist marine insurer Allianz Global Corporate & Specialty has released a report entitled Safety and Shipping 1912-2012: from Titanic to Costa Concordia. The report, developed with the Seafarers' International Research Centre (SIRC) of Cardiff University in the UK, not only reviews safety developments and trends

over this period – it also looks ahead to emerging shipping risks and future challenges for the marine industry. Key findings include:

Shipping safety has greatly improved, but challenges remain. Key challenges include increased ship sizes, 'human element' factors such training and crewing, and new shipping activity in polar waters. Challenges can be met – but only through open dialogue between all parties. The Executive Summary of the Report is attached.

6 Maritime Training Issues with Murray Goldberg

Murray Goldberg's New Maritime Training Blog Post - *Five Tips for Excellence in Maritime Training, Including the Most Important of All: Passion* - is well worth reading.

http://www.maritimeprofessional.com/Blogs/Maritime-Training-Issues/July-2012/Five-Tips-for-Excellence-in-Maritime-Training,-Inc.aspx

7 New ICSW website

You can now read the stories from ICSW News on the new website - http://www.seafarerswelfare.org

- Main stories in this month's ICSW News include :
- ICSW launches 2012 International Seafarers' Welfare Awards
- SeafarerHelp launches new annual report
- UK Seafarers' Welfare Conference
- Seafarers' welfare drop-in centre in Lagos
- Fair bananas campaign
- China prepares for MLC as Cyprus ratifies
- University launches new China Maritime Centre
- Campaign calls for slave free seas

ICSW requests "If you have any stories about about seafarers' welfare, please send them to icsw@icsw.org.uk for inclusion in future issues of the ICSW News".

Kind regards

Rod Short

Executive Secretary
GlobalMET Limited

MULTIPLE CHOICE QUESTION ASSESSMENT: A QUESTION OF CONFIDENCE

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Abstract

Ships' officers and ratings are required to hold certificates as qualification of competence to perform their duties. Certificates are issued following an examination process. The effectiveness of this process is important, since its purpose is to ensure the certificate holder can complete on-board tasks safely and with the least environmental impact. Over the last six years the authors have researched examination methods, particularly the use of multiple choice questions (MCQ). The authors believe this research is new in maritime education.

Examination methods for certificates of competency vary, with different combinations of written, practical, simulation and interview (oral). For the same examination, one country may require answering MCQ, while another may require a written response. Because MCQ are used to assess both knowledge and competence there are concerns about their effectiveness and reliability, where the authors' studies show that significant scores can be obtained by students with no marine technology knowledge. There are also concerns regarding the place of MCQ in an examination evidencing competence, and concerns that MCQ use is predominantly driven by economics and convenience.

The authors' studies focus on the use of MCQ in examination for STCW certificates of competency, soliciting opinions from maritime lecturers; identifying random elements producing artificial test scores, and comparing the performance of student mariners relative to students with no maritime technology knowledge. The paper reviews previous research; describes the latest study; offers insights into factors influencing MCQ assessment, and suggests the use of variants. The objective is to encourage discussion on the role and reliability of MCQ within maritime examination regimes.

1. Introduction

1.1 Situation

Maritime administrations have multi-dimensional examination methods in varying combinations of written, practical demonstration, simulation and interview when issuing STCW certificates of competency. Examination effectiveness is critical, since its purpose is to ensure a certificate of competence holder can complete on-board tasks safely and with the least environmental impact. Written examinations may include multiple-choice questions (MCQ), employed more in North America and Asia than in Europe. An examination in one

country requiring a written response may in another country require answering MCQ, reflecting broader differences regarding language, culture and training. MCQ are easy to administer and are popular with administrators and instructors; however, they are harder to construct than open (essay) questions which are quick to set but time-consuming to grade and difficult to assess statistically. MCQ can provide uniformity and fairness, and cover considerable factual matter, but have limited value in assessing knowledge or competence.

1.2 Concerns

MCQ restrict independent thought, measuring recognition rather than understanding. Passing a MCQ test is not equivalent to mastering a real world task. Students with logical (deductive) or argumentative (intuitive) mindsets respond differently, reflecting varying abilities to identify patterns and decode. MCQ are unreliable because of random elements and lack of learning depth (Williams 2006). The maritime community has concerns about the increasing use of MCQ in an examination attesting to competence; concerns about consistency in MCQ use from one country to another; and concerns that use is driven by economics and administrative convenience. These concerns are reflected in the technical press, as evidenced by articles in "Seaways" (Nautical Institute 2007), and mirrored in the general literature, for example criticism of poor design and construction and the over-emphasis on MCQ testing (Paxton 2000). Examinations reflecting influences other than subject knowledge are a concern, particularly where examination is part of a process to determine competence. The differences in MCQ use reflect disparity in international examination methods, a disparity that may be a result of culture, history, research, or the generalised wording of STCW 95 giving scope for national administrations to adapt to their own situations. Concerns about difference, consistency and confidence result in an examination open to question.

1.3 Authors' Research and Objectives

The authors' progressive research (Section 4) is published in proceedings of IMLA 14, IMEC 19, IMEC 21, MHRS 2010 and in 'Seaways' articles (Drown et al., see References). The objectives are to present information and encourage dialogue between maritime educators in the way in which MCQ are developed and utilised, and to offer insights into factors influencing MCQ effectiveness so that such influences may be minimised and assessment be as confident as possible.

2. Background

2.1 Literature Overview

The voluminous literature bears witness to Berk's (1998) observation that MCQ "holds world records in the categories of most popular, most unpopular, most used, most misused, most loved, and most hated". In maritime literature there is little except general advice by the IMO (2000) and the Nautical Institute (1992), advice reflecting many item-writing guidelines, for example by Kehoe (1995), Tarrant (2006) and Campbell (2011). However, studies of MCQ assessment in other disciplines are often relevant to maritime students. An early reference to MCQ is by Giles M. Ruch (Maduas 2001) writing in the 1930s and proposing rules for constructing tests that are essentially the same today (Tileston 2004). Since then controversy surrounds MCQ, with testing perceived as unfair, and simply guessing (McCoubrie 2004), and with uncertainty in deciding knowledge levels, even for those scoring 100%. Some believe standard MCQ are inferior to constructed response

questions (CRQ), testing for facts rather than cognitive skills. The MCQ format usually includes the correct answer among a set of incorrect responses, cueing students to the right choices, facilitating elimination and encouraging guessing (Kuechler 2010). CRQ require creation of a response; allow more than one correct answer; involve higher-order thinking, showing both knowledge and skills. MCQ are held to be more valid and reliable than CRQ, sampling a broader range, differentiating better between performance levels, and providing scoring consistency. Increasing use of MCQ may be driven by accountability translating into comparability, quantification and standardisation; with the passivity of MCQ testing linked to poor writing and thinking skills, implying that language understanding, complexity of thought and articulate writing do not matter (Intintoli 2000). Further, MCQ testing reduces complex conceptual processes to mechanical easy to follow operations, resulting in students increasingly incapable and intolerant of complex thinking (Tumino 2006). MCQ tests may be an inexpensive way to check on factual knowledge, but not for assessing abilities to write, apply knowledge and solve problems (Case 1998). However, Cresswell (2006) believes MCQ tests can be designed to assess both lower and higher level thinking skills.

MCQ are easy to computerise, administer, mark and compile and are popular with instructors and examiners. MCQ can provide uniformity and fairness, and cover considerable factual matter, but have limited value in testing for knowledge or skill, encouraging 'rote standardisation', and discouraging intellectual thinking. CRQ are more reliable than MCQ in assessing knowledge and encouraging intellectual thinking, since answers are more difficult to recall than recognise (Case 1998). CRQ requires students to 'read around' a topic to develop an argument, whereas MCQ are unlikely to generate this kind of approach (Rød 2010). CRQ however, although quick to set, take longer to mark, can be subjective in grading, and are not easy to analyse. However, it is possible to have a balance between 'closed' and 'open' assessment methods using MCQ variants designed to improve reliability and effectiveness (Parsons 1992; Hutchinson 1993). There are many suggestions on MCQ construction, as well as many opinions about effectiveness (Torres 2011). The debate continues, with the Chairman of the UK Independent Schools Council reported as saying MCQ should be used much more in secondary education to raise standards (Hurst 2012).

2.2 STCW and MCQ

In 1980, after STCW 78, Canada revised its examination system and, following the United States, increased use of MCQ. STCW reciprocity requires a proactive approach for common or comparable assessments (Muirhead 2006). MCQ favour information recall, so there are implications when evaluating standards if the pedagogy supports recall rather than comprehension. Assessment is not only about testing mariners for immediate technical job requirements, but is also about their ability to perform complex and demanding jobs requiring broad knowledge and cognitive, communicative and leadership skills (Holder 2007). STCW signalled a move from knowledge-based towards competence-based learning and evaluation, as described by van Leunen (2011).

2.3 The Instructor

It is a college's responsibility to ensure instructors are trained in developing valid and reliable MCQ that are subjected to pre-test and quality assessment review. The authors found that formal training in MCQ item-writing was the exception. Training programs need to emphasise the importance of 'creative' content, levels and range of question types, language, balance, distractors that challenge, and avoidance of item-writing flaws (IWF). A study of

2770 MCQ used in nursing examinations found over 46% had IWF, a result not unusual in teacher-developed examinations in many disciplines (Tarrant 2006). The time-consuming task is in creating unambiguous stems and effective distractors, so that the questions are not as complex as to make them unfair and ineffective. Time is required for validation, ascertaining reliability and standardising. Validity asks if the test is actually testing what it claims to be testing. Reliability asks whether a test will always work in the same way. Standardisation involves collecting and analysing data to determine if test results are distributed normally. MCQ testing must recognise individual learning styles, and personal strengths and weaknesses, noting that MCQ encourage superficial studying and a 'test-wiseness' allowing students to choose the correct answer without knowing it.

2.4 Student Approaches to MCQ Assessment

Students' studies can be a deep approach (meaning and understanding) or a surface approach (recall and reproduction). An approach consists of strategy and motive; for example, a student employing a deep approach might integrate the theoretical and practical components of a course (deep strategy) with the intention to understand and make sense of the material (deep motive). In contrast, a student employing a surface approach might list and drill several discrete pieces of information (surface strategy) for reproduction in examination (surface motive) (Scouller 1998). In a study by Yonker (2011) students scored better on factual MCQ requiring a surface approach than on applied MCQ involving more complex cognitive processing. Students are likely to employ surface learning approaches in MCQ examination and to perceive MCQ as assessing lower levels of intellectual processing. In contrast, students are likely to employ deep learning when preparing for CRQ, perceived as assessing higher levels of cognitive processing. Poorer performance in CRQ is associated with surface strategies, while poorer performance in MCQ examination is associated with deep learning strategies (Scouller 1998). A study of Chinese students' attitudes to MCQ and CRQ found a deep learning approach regardless of format, with memorisation meeting the challenges of assessments in English as a second language (Tait 2010).

3. Factors Influencing MCQ Test Scores

3.1 Question Structure

MCQ distractors should be plausible for students whose mastery of the content is incomplete or who are making informed guesses (Tileston 2004), but they should not trick knowledgeable students into incorrect responses (Tindal 1990). A MCQ test must be validated to ensure it does what it is meant to do. The more a test is validated, the greater its reliability, where reliability is the degree to which it repeatedly yields scores that reflect test-takers' knowledge and understanding (Bush 2006). Formal errors will reduce validity. A Web application has been developed recognizing and eliminating practices such as negative stem; cueing words; longest item flaw, and stem/item similarities (Brunnquell 2011).

3.2 Testwiseness

Testwiseness is the ability to recognise patterns in the answer options, identify unintentional clues, or use skills unrelated to knowledge or ability (Frey 2005). MCQ testing encourages students to study specimen questions, along with instructor and examiner preferences instead of learning the subject (Dewey 2006). Students can be taught testwise strategies to find the right answer to a MCQ independent of subject knowledge, for example: looking for

grammatical and other clues; mistakes, and key words. Test-wise students who do not know the subject, or understand the question, can still score up to 100% (Runt 2011).

3.3 Language

Language and phrasing of the question stem is important. When the phrasing is unclear students may read more into the MCQ question than the item-writer intended, particularly if the writer is inexperienced or untrained. There may be structural bias including unnecessary linguistic complexity in the stem or options; lack of clarity or consistency in the wording; and errors in grammar, punctuation, and spelling, with excessive formality resulting in convoluted language. A word in the question stem may stimulate an association in a response, which may or may not lead to the correct answer, a concern particularly when instruction is in English as a Second Language (ESL). There are concerns about ESL in classroom and examination. Stupans (2006) found that international students have problematic English-language proficiency, learning styles and attitudes at odds with persons of an English-speaking background, and an incompatibility with knowledge application and recall. Lampe (2010) found ESL students needed more time to complete a MCQ test, with lower scores not reflecting demonstrated classroom knowledge. There are other ESL issues, both for teachers and students, described by Tarrant (2008).

Sihmantepe (2011) observes that over 75% of ships are multilingual with communication failure present in one third of maritime accidents attributable to human factors. The observation is supported by Ziarati (2011), with language difficulties exacerbated by socially and culturally conflictive situations (Safe Trips 2010). The BIMCO 2010 Report shows increases in seafarer supply from China, India and the Philippines, as well as some European countries. Noble (2011) asserts the challenge facing human resource management is in how to harness the strengths of this linguistic diversity.The authors' 1500 MCQ study database was contributed by 22 countries of which three were nominally 'English first language'.

3.4 Chance and Guessing

Chance affects MCQ scores in two ways: first, luck in the selection of questions; second, marks may be obtained by guessing. There is a case for making an educated guess when certain responses can be eliminated (Betts 2009). The chances of guessing correctly can be reduced by having more distractors, although increasing the choice from four to five does not improve test reliability (Burton 2001). Variations of MCQ may reduce or discourage guessing, or it may be better to accept three distractors and allow for this in an overall assessment plan (IMO 2001). Anderson (2011) suggests guessing may be reduced by providing a "don't know" option, which may encourage honesty if not inhibit guessing.

3.5 Gender

Gender differences in MCQ testing are important considering increased female mariner recruitment. MCQ tests promote values of objectivity, factual knowledge, and rapid performance (male socialisation), and devalue subjectivity, reflection, introspection and feelings (female socialisation) (Ramos 1996). Females do less well than males on MCQ tests and better on essay tests (Hellekant 1994), with lower MCQ test scores for females attributed to social and cultural differences (Walstad 1997). Females become less competitive and more risk averse to guessing when educated amongst males (Blair 2009).

3.6 Age, Intuition and Previous MCQ Experience

Intuition is a capacity to utilise the characteristics and formats of the test to receive a high score independent of subject knowledge (Sarnacki 1979). Age is a consideration with persons taking junior and senior STCW certificate examinations, since those older may compensate for their lack of subject knowledge through deductive reasoning (Charness 1985) and general knowledge (Belsky 1990). The authors found that older persons, as well as persons exposed to MCQ since primary education, scored best on MCQ tests.

3.7 Use of Computers and Other Technology

It is assumed that education associated with modern technology enhances the learning experience; however there remains a shortage of proof that this is correct (Beggs 2011). With MCQ the advantage in using computers to score papers is that there are fewer marking errors and more time to answer more MCQ, with the added advantages of security, blind testing, randomising, and less cheating, but the same inherent disadvantages of MCQ remain.

3.8 Wrong Learning and Other Influences

MCQ items expose students to misinformation, and simply reading and repeating a statement increases the probability that the statement will be judged true (Roediger 2005). Other influences described in the literature include lefthandedness (Hook 2000); changing responses (Kruger 2005); cheating (Cizek 2003), and negative experiences (Bowering 1997).

4. Authors' MCQ Research Review

4.1 Research Strengths, Limitations and Participants

Strengths are in originality and encouragement of discussion. Limitations are associated with gathering data privately and without affiliation. There are 1466 Survey and Study Participants from 54 countries (see Appendix). *Mariners* are in at least the second year of a program leading to a first STCW certificate of competency for Deck or Marine Engineer Officers. *Maritime English Teachers* are faculty primarily teaching Maritime English in METS. *Novices* are students educationally comparable to student mariners, without maritime technology knowledge and enrolled in non-maritime programs (Fig. 1).

Business Administration	English Literature	Insurance (1)	Petroleum Engineering
Business Management	English Philology	Insurance (2)	Primary Education
Civil Engineering	Environmental Studies	Legal Studies	Secretarial
Computer Aided Drafting	Hair Stylist	Life Sciences	Therapeutic Recreation
Criminology	Industrial Engineering	Nursing	Trades Technology
English Language	Industrial Manufacturing	Office Administration	Transportation Management

Figure 1: Novice Test Subjects Enrolled in Non-Mariner Programs

4.2 The IMLA 14 Survey

The survey found that use of MCQ in STCW examinations varies from country to country reflecting national differences regarding language, culture and training. The survey indicated variations in examination methods, with wider use of MCQ in North America and Asia than in Europe. The survey showed that MCQ are popular for their convenience but with reservations regarding effectiveness. Survey responders noted that MCQ do not always take into account student strengths, weaknesses, learning styles or cognitive level, as well as

language comprehension. MCQ tests take significant time to develop, being more difficult to ask than to answer, requiring recognition rather than understanding. There is a lack of formal training in MCQ item construction. Specimen questions are popular, with considerable time being spent teaching test-wise techniques. Test-wise students are characterised as having knowledge that is shallow and of little practical application. MCQ tests are considered appropriate for course-work, but not for STCW certificates attesting to competence.

4.3 The IMEC 19 Study

The IMEC 19 study described exploratory research to identify factors that produce artificial test scores. MCQ maritime technology tests were given to 157 novices. The results showed scores attributable to factors other than subject knowledge, with an ability to answer MCQ related to time in school, experience, 'testwiseness', educational level, language skills and general knowledge. The exploratory study demonstrated the feasibility for further research.

4.4 The IMEC 21 Study

The IMEC 21 study compared the MCQ test results of mariners with novices. It was supposed that novice test scores must reflect factors other than subject knowledge, and that there is a relationship between scores and the characteristics of gender, age, English comprehension and previous MCQ experience. The study used forty-four 20-MCQ tests (deck and engine) randomly selected from a database of 1500 standard English language questions designed to test factual knowledge, contributed by faculty and officials from METS and administrations in 22 countries. The same MCQ tests were given to Deck or Engine mariners and novices, with the first 10 questions basic, and the last 10 advanced. The novices did as well with the advanced questions as they did with the basic, scoring significantly above chance, sometimes exceeding mariner scores, indicating influences other than subject knowledge and suggesting an ability to answer MCQ unrelated to subject knowledge. Figure 2 is an example of the study analysis, with the novices showing the same pattern as mariners.

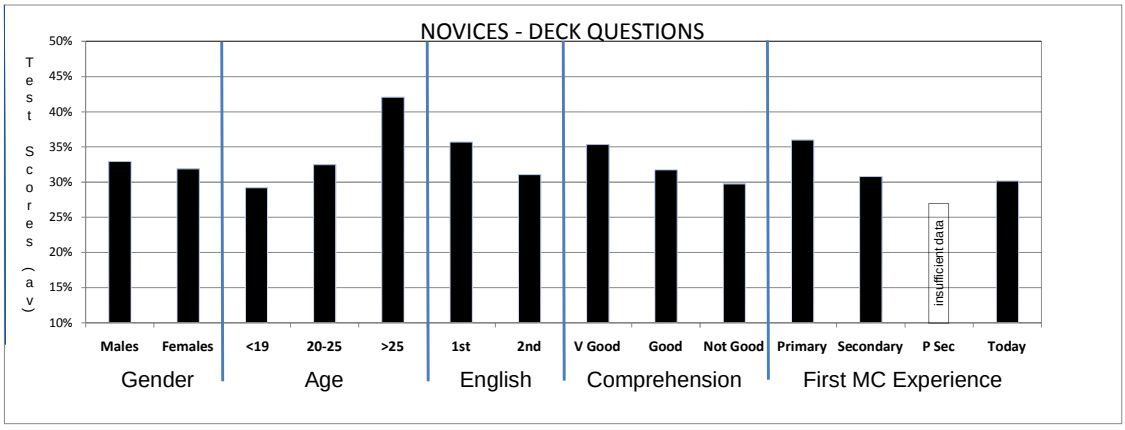

Figure 2: Study Analysis Example

5. New Research 2011-12

5.1 Objective

The IMEC 21 study compared mariner and novice MCQ test scores. Novice scores mirrored and sometimes equalled or exceeded mariner scores. The research seeks explanation by investigating the relative significance of influencing factors, particularly language comprehension, providing insights to evaluation of confidence in MCQ assessment.

5.2 Participants and Study Form

There are 119 English Language Teacher participants addressing MCQ tests on marine technology and analysing the reasons for their responses in terms of factors known to influence MCQ assessment, namely, deduction, word/concept association, language, guessing and intuition. The same MCQ tests as in the IMEC 21 Study are used, with participants additionally asked to complete a Study Form (Figure 3).

THE LANGUAGE OF MULTIPLE CHOICE QUESTIONS: A STUDY
Tick-box the response you think is correct, and give one (only) reason for your response.

	Response				Analysis					
Question	A	B	C	D	1	2	3	4	5	6
1	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
19	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
20	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Analysis Guidelines: The response is:
1 Knowledge
... known because of association with maritime affairs/students.
2 Deduction
... deduced through general knowledge (informed guessing).
3 Word/Concept Association
... prompted by a word or concept in the stem or responses.
4 Language/Grammatical Clues
... indicated by language or grammatical clues.
5 Guessing
... pure (as opposed to informed) guessing.
6 Intuition
... knowing or sensing without rational process.

Figure 3 Study Form

5.3 Preliminary Results

The data collected is explored in three ways: first, determining proportions attributed to factors influencing test scores; second, comparing participant scores with novices and mariners doing the same tests; third, focusing on individual test questions where scores are unexpected. There are four similar groups, A, B, C and D. Each group has eight tabular and graphical representations of the results, using the same MCQ tests completed by mariners and novices in the IMEC 21 Study.

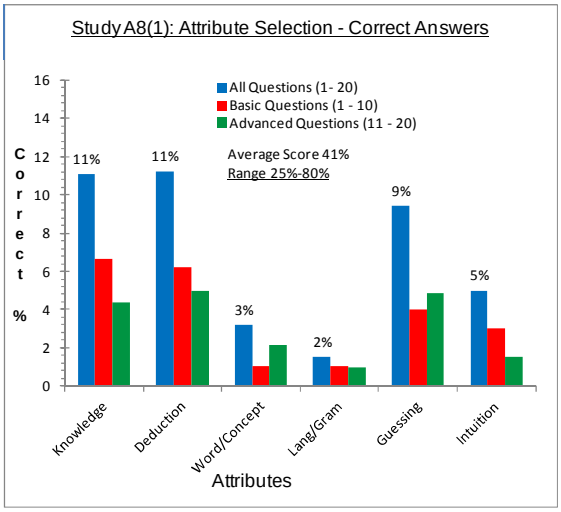

Figure 4

Group	Participants	Average Scores	Range
A	33	41%	25-80%
B	33	52%	35-90%
C	21	49%	20-70%
D	32	38%	5-70%

Figure 5

Figure 4 is Study A8(1) showing the attributes from the analysis (Figure 3) contributing to the participants' average score of 41%, that is, for All Questions, Knowledge (11%), Deduction (11%), Word/Concept (3%), Language/Grammar (2%), Guessing (9%) and

Intuition (5%). As before, the MCQ are sorted so that the first 10 are more basic, and the last 10 more advanced, so that, for example, in the case of Knowledge, correct basic and correct advanced answers contributed 7% and 4% respectively to the total 11%. The pattern in Figure 4 is the same for each group, particulars of which are in Figure 5.

6. Variants

The authors have not studied the extent to which MCQ variants are used in maritime training and education. However, the 1500 MCQ contributed by METS instructors and maritime administrations in the IMEC 21 Study were without exception of the conventional stem and four options type, designed to test factual knowledge. The literature describes the many MCQ variants, for example Alternate-choice; Matching; Multiple true-false; True-false, Context-dependent (Haladyna 2002); 'Thought- provoking' (Parsons 1992) and assertion-reasoning (Williams 2006). Compared to standard MCQ, variants require investment for construction, marking and preserving objectivity, a good investment in a safe transportation industry.

7. Conclusion and Recommendation

Properly constructed and validated MCQ have a place in checking factual knowledge and are effective assessment tools where there is dialogue between instructor and student. In the classroom, the decision on whether to use MCQ must remain within the Maritime Lecturers' areas of responsibility, and will depend on their own experience and understanding of their students, as well as their confidence in the assessment method.

In formal examinations leading to a STCW qualification, standard MCQ should be avoided because they cannot reliably assess subject knowledge, and are not designed to evaluate competence. If used they should be variants and a minor element in a multi-dimensional process favouring competency based assessment, with MCQ effectiveness evaluated during interview.

Maritime examinations measure competence for safe and efficient operations. There are no comparative studies of the relative merits of international training and examination regimes. More extensive research encompassing broader aspects of maritime education and examination is recommended, preferably headed by an international institution.

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APPENDIX: Survey and Study Participants by Country

CONFERENCE	IMLA 14		IMEC 19	IMEC 21			Research	
DATE	2006		2007	2009			2011-12	
	Maritime Admin	METS Instructors	Novices	METS Instructors	Mariners	Novices	ME Teachers	Novices & Mariners
Australia	1						1	
Bangladesh	1							
Bulgaria				1	46	26		
Canada	1	1	157	2	37	52	8	21
Chile	1							
China PR		1					25	
Croatia				1	44	26		
Cyprus	1	1					1	
Denmark		1					10	
Denmark (WMU)							1	
Ecuador							4	
Egypt							4	
Finland							1	
France							2	
Georgia							1	
Germany	1	1						
Greece		2					1	
Hong Kong China	1	1						
Iceland	1	1						
India				2	40	40		80
Indonesia	1	1						
Iran							2	
Ireland	1							
Italy	1						1	
Jamaica	1							
Japan	1	1					1	
Korea Republic		1						
Lithuania	1							
Malaysia		1					3	
Malta	1							
Montenegro							1	
Netherlands		2		3	111	39	3	
New Zealand							1	
Nigeria							1	
Panama							2	
Philippines		2		3	177		2	
Poland		1		2	82	78	6	89
Portugal	1							
Romania							3	
Russia							6	
Singapore		1						
Slovenia	1						1	
South Africa	1							
Spain	1	1		1	13	14	7	
Sri Lanka		1		1	20	25	2	
Sweden		2						
Trinidad Tobago		1						
Turkey							3	
Ukraine		1		1	20	20	3	
United Kingdom	1	1					2	
USA	2	1		1		20	5	
Vanuatu		1						
Venezuela		1						
Vietnam		1					5	
SUB-TOTALS	**22**	**30**	**157**	**18**	**590**	**340**	**119**	**190**
					TOTALS			**1466**
					COUNTRIES			**55**

IMEC 21 data used for comparison

Novices completing the ME Teachers study

REFERENCES

Anderson, J. 2011. 'Assessment in Medicine-The Multiple Choice Question Controversy'. Letter to the Editor of Medical Teacher, from the Academic Sub-Dean and Senior Lecturer in Medicine, University of Newcastle.
Beggs, B. 2011. Editorial. Electrical Engineering Education. Glasgow Caledonian University. International Journal of Electrical Engineering Education. V. 48, No. 3.
Belsky, J.K. 1990. 'The psychology of aging theory: Research and Interventions', p 125. Pacific Grove: Brooks/Cole Publishing Co.
Berk, R. A. 1998. 'A humorous account of 10 multiple-choice test-item flaws that clue testwise students'. Electronic Journal on Excellence in College Teaching. V. 9, No 2.
Betts, L.R., Elder, T.J., Hartley, J. & Trueman, M. 2009. 'Does correction for guessing reduce students' performance on multiple-choice examinations? Yes? No? Sometimes?'. Assessment & Evaluation in Higher Education, V. 34, No. 1, February, pp. 1–15.
BIMCO. 2010. `Manpower 2010 Update: The Worldwide Demand for and Supply of Seafarers – Highlights`. Baltic and International Maritime Council, Denmark.
Blair, A. 2009. 'Girls take greater risks in single-sex classes'. Times Online July 31 2009.
Bowering, E.R., & Wetmore A.A. 1997. 'Success on Multiple Choice Examinations: Model and Workshop Intervention'. Canadian Journal of Counseling, V. 31, p. 297, and p.303.
Brunnquell, A., Degirmenci,U., Kreil, S., Kornhuber, J. & Weih, M. 2011. 'Web-Based Application to Eliminate Five Contraindicated Multiple-Choice Question Practices'. The Health Professions, V. 34(2), pp 226-238.
Burton, R.F. 2001. 'Quantifying the Effects of Chance in Multiple Choice and True/False Tests: Question selection and guessing of answers'. Assessment & Evaluation in Higher Education, V. 26, No. 1, pp 41- 50.
Bush, M.E. 2006. 'Quality assurance of multiple-choice tests'. Quality Assurance in Education V. 14 No. 4, p 398.
Campbell, D.E. 2011. 'How to write good multiple-choice questions'. Journal of Paediatrics and Child Health V.47, 2011, pp 322–325.
Case, S.M., & Swanson, D.B. 1998. 'Constructing Written Test Questions for the Basic and Clinical Sciences'. Journal of Research in Science Teaching, V. 35, No. 3, pp 265-296.
Charness, N. 1985. Adult Development & Ageing, 5th Ed., Hoyer W. J. and Roodin P. A. on 'Limits of Expertise'
Cizek, G.J. 2003. 'Detecting and Preventing Classroom Cheating; Promoting Integrity in Assessment'. Corwin Press, California, published 21 March 2003, p 44.
Cresswell, M. 2006. 'Multiple choice is not a dumb option'. The Times Educational Supplement, 23 June.
Dewey, R.A. 2006. 'Writing Multiple Choice Items which Require Comprehension'. In Psych Web! From <http://www.psywww.com/selfquiz/aboutq.htm> (Accessed 8 May 2012).
Drown, D.F., R. Mercer & G. Jeffery. 2006. 'One, All or None of the Above - Multiple-choice question techniques and usage in education and examination for marine certification'. In Proceedings of IMLA-14 , Marseille, October.
Drown, D.F., R. Mercer & G. Jeffery. 2007. 'STCW Competence: Disparate exam methods, does it matter?' In "Seaways", the Journal of the Nautical Institute, London, January.
Drown, D.F., R. Mercer & G. Jeffery. 2007. 'The Influence of Language and Question Structure on Multiple-Choice Test Scores: An Exploratory Study'. In Proceedings of IMEC-19, Rotterdam, October.
Drown, D.F., R. Mercer, G. Jeffery & S. Cross. 2009. 'Language and Effectiveness of Multiple-Choice Questions in Maritime Education and Certification: A Study'. In Proceedings of IMEC-21 , Szczecin, October.
Drown, D.F., R. Mercer, G. Jeffery & S. Cross. 2010. 'Disparate Measures in Examinations for STCW Certificates of Competency: The Use and Effectiveness of Multiple Choice Questions'. In Proceedings of the 4th International Conference "Maritime Human Resource Solutions" by the Company of Master Mariners of Canada & Petroleum Human Resources Council of Canada, St. John's, September.
Drown, D.F., R. Mercer, G. Jeffery & S. Cross. 2011. 'Matters of Difference (on Multi-National Ships)'. In "Seaways", the Journal of the Nautical Institute, London, July.
Frey, B.B., Petersen, S., Edwards, L.M., Pedrotti, J.T. & Peyton, V. 2005. 'Item-writing rules: Collective wisdom'. Teaching and Teacher Education V. 21 pp 357-364.
Haladyna, T.M., Downing, M. & Rodriguez, M.C. 2002. 'A Review of Multiple-Choice Item-Writing Guidelines for Classroom Assessment'. Applied Measurement in Education, V. 15, No. 3, pp 309–334.
Hellekant, J. 1994. 'Are Multiple-choice Tests Unfair to Girls?'. System, V. 22, No. 3, pp 349-352.
Holder, L. 2007. 'Getting it right: The importance of assessments'. Seaways, Nautical Institute, p 25.
Hook, S. 2000. 'Sinister bias of multi-choice test'. The (London) Times Educational Supplement, 10 March.
Hurst, G. 2012. Education Editor: 'Multiple choice is key to raising exam standards, says leading head.' The London Times 2 January 2012.

Hutchinson, T.P. 1993. 'Ability, Partial Information, Guessing: Statistical Modeling Applied to Multiple-choice Tests'. Psychometrica, V. 58, No. 3.
IMO. 2001. IMO Model Course; 6.09: Training course for instructors. IMO London.
IMO. 2000. IMO Model Course; 3.12. Examination and certification of seafarers. IMO London.
Intintoli, M.J. 2000. 'One way to improve education: Ban multiple-choice questions'. Christian Science Monitor, V. 92, Issue 38, January 2000.
Kehoe, J. 1995. 'Writing multiple-choice test items'. Practical Assessment, Research & Evaluation, V. 4, No. 9. From http://pareonline.net/getvn.asp?v=4&n=9 (Accessed 8 May 2012).
Kruger, J., Wirtz, D., & Miller, D.T. 2005. 'Counterfactual Thinking and the First Instinct Fallacy'. Journal of Personality and Social Psychology, V. 88, No. 5, pp 725-735.
Kuechler, W.L. & Simkin, M.G. 2010. 'Why Is Performance on Multiple-Choice Tests and Constructed-Response Tests Not More Closely Related? Theory and an Empirical Test'. Decision Sciences Journal of Innovative Education, Volume 8 Number 1, January.
Lampe, S. & Tsaouse, B. 2010. 'Linguistic Bias in Multiple-Choice Test Questions'. Creative Nursing, V.16.
Maduas, G. 2001. Ruch Proposal for Consumers' Research Bureau on Tests, in A Brief History of Attempts to Monitor Testing. From <http://www.bc.edu/research/nbetpp/publications/v2n2.html> (Accessed 8 May 2012).
McCoubrie, P. 2004. 'Improving the fairness of multiple-choice questions: A literature review', Medical Teacher, V. 26, No. 8, 2004, pp 709-71
Muirhead, P.M.P. 2006. 'STCW and Assessment of Competence by Simulator: Ten Years On – Why No Global Acceptance of the Practice?'. In Proceedings of the International Conference on Maritime Simulation and Ship Manoeuvrability (MARSIM 2006). The Maritime Institute, Terschelling, Netherlands, June.
Nautical Institute 'Seaways'. 2007. Drown, D.F. "Disparate exam methods: Does it matter?" (January), L. Holder, "Getting it right" (May), and P. Smith "Multiple Choice Questions" (July). Nautical Institute, London.
Nautical Institute. 1992. Maritime education and training; a practical guide. The Nautical Institute, London.
Noble, A., Langehuchten, L. & van Parys, W. 2011. 'Intercultural Competence and Effective Communication At Sea: An Invitation to Celebrate Diversity On Board'. In Proceedings of IMEC-23 , Constanta, Romania.
Parsons, J. 1992. 'Creating Thought-Provoking Multiple-Choice Questions for Social Studies Exams' Perspectives'. The Journal of the Saskatchewan Council of Social Sciences, Vol 24, No 2, 1992, pp 17-18.
Rød, J.K., Eiksund, S. & Fjær, O. 2010. 'Assessment based on exercise work and multiple-choice tests'. Journal of Geography in Higher Education, V. 34, No. 1, p. 151, February.
Rodrigues,S., Taylor, N., Cameron, M. & Syme, L. 2010. 'Questioning Chemistry: The role of level, familiarity, language and taxonomy'. Science Education International, V.21, No.1, March, pp 31– 46.
Runt, R. 2011. 'Tips for Taking Multiple Choice Tests`. Faculty of Education, University of Lethbridge, Canada. From http://www.kvhigh.com/learning/testtips.html (Accessed 8 May 2012).
Safe Trips. 2010. WMU Dissertation, Consultora Fluvial Maritima, Argentina, from: http://www.safe-trip.com.ar/ (Accessed 22 Mar 2010: full text available).
Sihmantepe, A., Sernikli, S. & Ziarati, R. 2011. 'Building Maritime English by Event Simulation'. In Proceedings of IMEC-23 , Constanta, Romania.
Tait, C. 2010. 'Chinese Students' Perceptions of the Effects of Western University Examination Formats on their Learning'. Higher Education Quarterly, Volume 64, No. 3, July, pp 261–275.
Tarrant, M., Knierim, A., Hayes, S.S.K. & Ware, J. 2006. 'The frequency of item writing flaws in multiple-choice questions used in high stakes nursing assessments'. Nurse Education Today, v. 26 no. 8, pp. 662-671.
Tarrant, M. & Ware, J. 2008. 'Impact of item-writing flaws in multiple-choice questions on student achievement in high-stakes nursing assessments'. Medical Education, V. 42, pp 198–206.
Torres, C., Lopes, A.P., Babo, L. & Azevedo, J. 2011. 'Improving Multiple-Choice Questions'. US-China Education Review, B 1 (2011) 1-11.
van Leunen, W. 2011. 'The Maritime Simulator: An Instrument for MET Assessment?'. In Proceedings of IMEC-23 , Constanta, Romania.
Williams, J.B. 2006. 'Assertion-reason multiple-choice testing as a tool for deep learning: a qualitative analysis'. Assessment & Evaluation in Higher Education, V. 31, No. 3, June 2006, pp. 287–301.
Yonker, J. 2011. 'The relationship of deep and surface study approaches on factual and applied test-bank multiple-choice question performance'. Assessment & Evaluation in Higher Education, V. 36, No. 6, pp 673–686.
Zeifrid, O. 2011. 'Portfolios, Checklists and Rubrics as Forms of Performance Assessment'. In Proceedings of IMEC-23 , Constanta, Romania.
Ziarati, M., Ziarati, R., Bigland, O. & Acar, U. 2011. 'Communication And Practical Training Applied In Nautical Studies'. In Proceedings of IMEC-23 , Constanta Maritime University, Romania.

Executive Summary

March 2012

Allianz Global Corporate & Specialty www.agcs.allianz.com

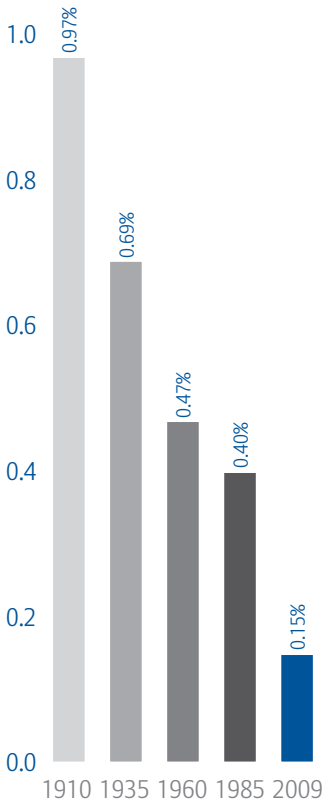
Safety and Shipping 1912-2012: From Titanic to Costa Concordia

An insurer's perspective from Allianz Global Corporate & Specialty

This Executive Summary highlights key findings from a detailed report prepared by Allianz Global Corporate & Specialty (AGCS), in conjunction with the Seafarers International Research Centre of Cardiff University. For a copy of the full report please visit www.agcs.allianz.com

Maritime safety affects everyone, from blue collar factory workers and school children, to journalists and company chief executives. The global population depends on a safe and efficient shipping trade network for modern day living to continue unchecked. In the 100 years since the loss of the *RMS Titanic*, the maritime industry has worked steadily to improve safety performance so that the 23 million tonnes of cargo and 55,000 cruise passengers that travel by ship every day do so safely and efficiently in the vast majority of cases.

Total losses - % of world fleet



Source: Calculated from Lloyd's Register World Casualty Statistics 1900-2010

At the turn of the twentieth century, one of the most renowned shipping tragedies of all time occurred in the midst of the Atlantic Ocean. In April 1912, the *RMS Titanic*, the pride and joy of White Star Line, sank on her maiden voyage from Southampton, UK to New York, USA. *Titanic*, at the time the world's largest passenger steamship, struck an iceberg four days into the crossing and sank to the ocean bed taking 1,513 lives. Since that human tragedy, the maritime industry has actively endeavored to improve safety records and it is no understatement to say that shipping in 2012 is a far safer form of transport for passengers, cargo, seafarers and ships. However, notwithstanding these advances, significant challenges remain as the recent *Costa Concordia* and *Rabaul Queen* disasters have demonstrated.

No one separate development can be singled-out for this progress: today's safer shipping environment is the culmination of a number of initiatives, research, regulations, and innovations. The full report outlines some of the major areas where the shipping industry has benefitted from improvements, explains how shipping in the twenty-first century is now safer than ever, and reviews current and future challenges to maritime safety. Perhaps of most interest are the emerging challenges facing the industry. Key findings about future challenges are listed overleaf.

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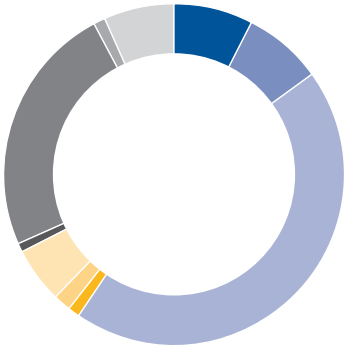
Total losses by ship type: 2000-2010
(number of losses)



Tankers	121	7.6%
Bulk Carriers	120	7.6%
Cargo Vessels	706	44.5%
Containers	17	1.1%
Reefers	24	1.5%
Passengers/General Cargo	83	5.2%
Passenger Cruise	17	1.1%
Fishing	375	23.6%
Offshore Industry	20	1.3%
Other	103	6.5%

Source: Lloyd's Register Fairplay, World Fleet Statistics 2000-2010

- **Ship sizes** have increased significantly, dwarfing the *Titanic* in comparison. The largest modern container ships, such as Maersk's new Triple-E class, pose challenges for insurers due to their sheer scale and value. Other ships are pushing the design envelope, breaking new ground in terms of design challenges which has led to concerns about structural integrity.

- **Cruise ships:** Despite the strong passenger safety record of the cruise industry, the modern trend towards ultra-large cruise ships, carrying over 6,000 passengers, poses new challenges, especially in terms of evacuation and rescue in remote environments. The International Maritime Organisation (IMO) has introduced regulations addressing such risks, including proactive risk management with improved fire safety systems and a focus on the need for such vessels to be their 'own best lifeboat' so that, in the event of a casualty, persons can stay safely on board, as the ship proceeds to port.

- **Training and labor:** with increased cost pressure, many ship-owners look to source crews from emerging economies due to lower wage demands. Despite IMO attention through international standards, training regimes and assessment are not consistent and may lead to variations in crew and officer competence.

- **Crewing levels** in a competitive industry continue to pose risks, despite the greatly improved efficiency of modern vessels, and may compromise margins of safety. Some commentators regard minimum crewing levels as too low, and point out they do not allow for the inevitable extra tasks that 24 hour operations require – with 'human factor' risks such as fatigue being significant causes of accidents.

- **Inadequate risk management** is identified as a key challenge which can be addressed through improved safety management systems and processes.

- **Piracy** continues to threaten shipping, especially off Somalia and the Horn of Africa where 28 ships were attacked in 2011, with attacks also being seen in other regions (such as West Africa). The economic impact of piracy was estimated to be around $7 billion in 2011.

- **Language barriers** are also cited as potential risks, given the dependence on English as the 'language of the seas'. With increasingly multi-national crews, concern has been raised about communication in an emergency, or even misunderstandings in routine operations.

- **Arctic and Polar waters:** climate change is opening up access to previously impassable seaways, but the development of new routes, such as the North East Passage, pose great challenges in terms of ice navigation, environmental concerns, and design and construction demands, as well as emergency procedures in extremely hostile environments.

- **Poor enforcement & coordination:** with a complex regulatory environment, coordination of such regulations needs to be improved. Despite an alignment of objectives, individual enforcement bodies do not always coordinate actions, nor is it easy to enforce responsibility in the event of an incident.

- **Bureaucracy** is cited as a pressure on crews and officers, diverting them from other tasks and potentially compromising safety. This is compounded by minimum crewing levels which place further burdens on already hard-pressed crews. Allocating responsibility for such matters, perhaps via a 'purser' role, could address this challenge.

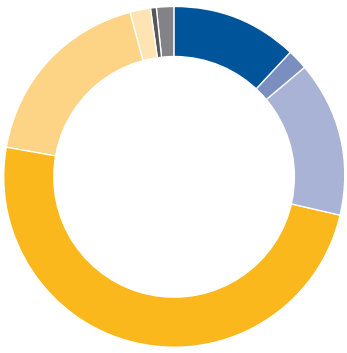
- **Fire** remains a major on-board risk especially in 'Ro-Ro' ferries (with relatively open decking) and also on passenger ships with increased 'hotel' services and large passenger numbers.

While these emerging safety risks need to be addressed to further improve incident records going forward, in its review of safety improvements since the *Titanic* accident, the report finds that much progress has been already made in attending to safety issues.

Key facts and figures

- Despite a trebling of the world fleet to over 100,000 ships in 2010, and a total fleet tonnage now approaching 1 billion gross tonnes, shipping losses have decreased significantly from 1 ship per 100 per year (1912) to 1 ship per 670 per year in 2009.
- World seaborne trade continues to grow rapidly, driven by globalization and supported by containerization, having trebled since 1970 to over 8.4 billion tonnes of cargo loaded per annum.
- Marine transport can be regarded as one of the safest means of passenger transport overall: in Europe, it is ranked after rail, air and bus/coach as the fourth safest means, with far lower fatal accident rates than car, motorcycle, bicycle or walking.
- However, seafaring remains dangerous as a profession. While professional seafarer fatality rates have fallen – for example, in the UK per 100,000 seafarer-years, from 358 (in 1919) to 11 in 1996-2005 – this fatality rate is still twelve times higher than in the general workforce. Despite inconsistent data, other country statistics appear to be considerably higher: for example Hong Kong recorded 96 per 100,000 seafarers per annum for 1996-2005, and Poland a rate of 84 per 100,000 seafarers per annum for the same period.
- Most losses can be attributed to 'human error' – a broad category estimated to be responsible for between 75%-96% of marine casualties. Pressures of competition (often shore-based) and fatigue are frequently cited as significant causes – a particular matter of concern in busy shipping areas such as the Baltic where crews may have little time to rest between periods of duty.
- The most common primary causes of shipping losses are foundering (49% of losses), wrecking/stranding (18%) and fire/explosion (15%) while hull or machinery failure only accounts for around 2% of losses.
- Dry (bulk) cargo vessels have higher than average loss rates (44% of losses, despite representing 20% of the world fleet by number). Conversely, tankers, container vessels and offshore industry ships have relatively low loss rates.
- Shipping is highly concentrated into modern sea-lanes as vessels navigate between major ports to optimize efficiency. This results in clustering of losses in certain key regions. Accident 'black spots' include South China, Indo-China, Indonesia and Philippines (17% of losses in 2001-2011), followed by East Mediterranean and Black Sea (13%), and Japan, Korea and North China (12%). The seas around the British Isles also show relatively high loss concentrations (8%).

Causes of total loss (2000-2010)
(number of losses)



Collision	190	12.0%
Contact	34	2.1%
Fire/Explosion	233	14.7%
Foundering	778	49.1%
Wrecked/Stranded	286	18.0%
Hull/Machinery	33	2.1%
Missing	6	0.4%
Other	26	1.6%

Source: Lloyd's Register Fairplay, World Fleet Statistics 2000-2010.

Driving safety

Safety has improved through a combination of technology, cultural and training improvements, and regulations, as well as through new construction and design techniques.

Additionally, past experience demonstrates that major accidents have often been the catalysts for key changes: for example, the International Convention for the Safety of Life at Sea (SOLAS) of 1914 was spurred on by the loss of the *Titanic*. A similar impact can be expected from the *Costa Concordia* incident – just as we have previously seen with the *Herald of Free Enterprise* (1987), the *Exxon Valdez* (1989), and the *Estonia* (1994) losses, which drove the creation of Safety Management Systems under the ISM Code.

Technology & design in focus

Technology has been a key driver of safety, from the introduction of gyrocompasses and the first use of aviation to spot icebergs in 1914 to the mandatory use of Electronic Chart Display & Information Systems (ECDIS) in 2012.

Military innovations drove improvements in the mid-20th century - for example, in Radar and in wireless communications - while later technologies such as Automatic Radar Plotting Aid (ARPA), Global Positioning Systems (GPS) and Automatic Identification System (AIS), have reduced accidents through greatly improving 'situational awareness' via increased access to real time information.

In addition, search and rescue efforts are greatly assisted by modern (satellite-assisted) location-finding technologies such as radar transponders and distress beacons.

However, experts warn of dependence on single technologies, citing examples where reliance on technology has led to major incidents.

Improvements have also stemmed from changes in construction and design processes. Ship building techniques such as pre-fabrication and welding have improved quality and structural integrity, while computer aided design has radically speeded up the design process, allowing modeling to replace physical trial and error.

Training & Culture

Over the past one hundred years, training has moved from being localized and unregulated to a global footing and is now subject to close international scrutiny. The Standards of Training Certification and Watch-keeping for Seafarers Convention (STCW) in 1978 established international benchmarks in this area – and has since been enforced by the IMO through publishing its 'White List' of countries which comply with these standards. Safety Management Systems have also driven an increased safety culture, in part arising from the failures of the previous piecemeal approach highlighted in the aftermath of the *Herald of Free Enterprise* disaster in 1987. Spurred by this accident, the International Safety Management Code (ISM Code), which the IMO adopted in 1993, has driven best practice to be more widely accepted and institutionalized in the industry.

However, inadequate risk management remains a challenge – with one survey attributing this as a main or contributing factor in nearly 40% of accidents.

Regulation

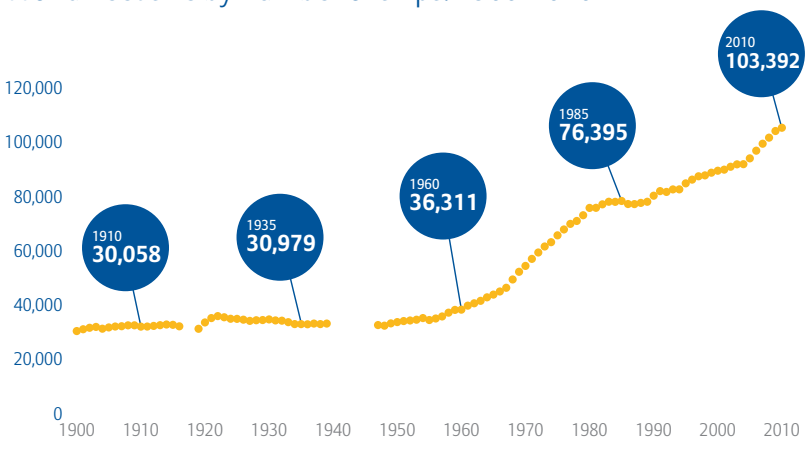
The maritime industry is now highly regulated, with a large number of organizations responsible for different facets of safety. However, it is the primary body, the IMO, formed in 1948, as a United Nations agency, which has driven much international regulation.

Prior to the IMO's formation, the first SOLAS convention was driven by the loss of the *Titanic*, and on being adopted by its international signatories in 1914 formed a landmark treaty on marine safety. Subsequent revisions, combined with other key IMO conventions such as the International Regulations for Preventing Collisions at Sea (COLREG) and the International Convention on Loadlines, have further tightened safety rules.

Such regulations have not simply reduced the risk of accidents; they have also addressed the challenges of responding to an accident with, for example, the Global Maritime Distress and Safety System (1999) establishing improved global procedures for search and rescue.

The industry itself has also played an active part in self-regulating to improve standards: for example, oil tanker owners have set higher standards since environmental disasters such as the *Exxon Valdez* by tightening risk management procedures and establishing vetting systems, forcing others to adopt similar safety standards.

World fleet size by number of ships: 1900-2010



Source: Lloyd's Register Fairplay, World Fleet Statistics 1900-2010

Quality control and enforcement

Working with the IMO, Members States check operational safety at ports around the world through the Port State Control (PSC) system.

Established under the STCW convention in 1978, national PSC can inspect and detain shipping when necessary to enforce standards. The results of inspections are published freely online, creating considerable transparency in this process.

While the number of inspections has increased with increased trade, detentions have notably decreased: in the Asia Pacific region, inspections increased by 48% from 2001-2010, but detentions dropped by 5%.

Flag States further support the global enforcement of IMO legislation. Flag states are those under whose national flag a ship sails, and on whose register of shipping each vessel is recorded.

However, "open registries" or "Flags of Convenience" have also emerged since the 1950s, and some have attracted criticism for a perceived relaxation of regulatory control, either through non-ratification of legislation, or non-enforcement of ratified legislation.

Classification Societies offer another important element to maintaining safety standards. These independent bodies develop and apply technical standards to ship design and construction. They have, however, been subject to criticism for failing on occasion to spot potential technical weaknesses in advance and, more recently, when some Societies have started to enter into ship design services – a move that has raised concerns in respect of conflicts of interest when the Societies may classify the very ships they have themselves designed. However, other commentators refer to the improvements in ship safety that have been achieved through the design contributions of some Societies.

Marine insurers such as AGCS should also contribute through transparent underwriting and dialogue with ship-owners, supported by proactive risk consulting to reduce risk in advance. Insurers can encourage best practice in marine operations, recognizing the efforts of leading ship-owners to reduce risk – for the benefit of all parties.

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