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Original article

Measuring Safety Culture on Ships Using Safety Climate: A Study among Indian Officers *

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Abstract

Workplace safety continues to be an area of concern in the maritime industry due to the international nature of the operations. The effectiveness of extensive legislation to manage shipboard safety remains in doubt. The focus must therefore shift towards the human element - seafarers and their perceptions of safety. The study aims to understand the alignment that exists between safety culture and safety climate on board ships as perceived by seafarers. The underlying factors of safety climate were identified using factor analysis which isolated seven factors - Support on Safety, Organizational Support, Resource Availability, Work Environment, Job Demands, 'Just' Culture, and Safety Compliance. The perception of safety level of seafarers was found to be low indicating the existence of misalignments between safety culture values and the actual safety climate. The study also reveals that the safety perceptions of officers employed directly by ship owners and those by managers do not differ significantly, nor do they differ between senior and junior officers. A shift in perspective towards how seafarers themselves feel towards safety might provide more effective solutions – instead of relying on regulations - and indeed aid in reducing incidents on board. This paper details practical suggestions on how to identify the factors that contribute towards a better safety climate on board ships.

Keywords: Safety, Culture, Climate, Indian, Support, No blame

I. Introduction

The International Labour Organization (ILO) estimates that worldwide around 340 million occupational accidents and 160 million work related illnesses occur annually. Approximately 2.3 million individuals lose their lives due to work-related accidents or diseases every year which is an astounding 6000 deaths every single day, and costs the global economy a staggering $1.25 trillion or 4% of the world's GDP annually (ILO, 2012). American businesses incurred annual losses to the tune of USD 170 billion (Leigh, 2011), while in the UK, in 2011/12, workplace illnesses cost an estimated £13.8 billion, (HSE, 2013), and in Australia $60.6 billion in the 2008–09 financial year (Safe Work Australia, 2013).

Shipping is one of the most dangerous industries in the world; between 2003–12, the fatal accident rate in shipping was 21 times that of the general British workforce, 4.7 times of that in the construction industry and 13 times of that in manufacturing (Roberts et al, 2014). Kristiansen (2005) found that shipping has a fatality frequency of 1.9 – 2.1 per thousand, against 0.15 for industry, 0.3 for construction and 0.9 – 1.4 for mining.

Ship operators, through the P&I industry, are estimated to deal with third party liability claims for personal injury, illness and death totaling more than $400 million a year (UK P&I, 2013). The Club finds that despite the number of personal injury and illness claims stabilizing, the per capita cost of the individual claims has risen by over 300% in recent years, and individual injury and illness claims now cost more than cargo claims. Between 2005 and 2010 the average cost of Members' claims was about $12,000 per claim. For the Swedish Club (2013), the claim costs for illness and injury made up 8% of all claims between 2009 and 2013, as opposed to 10% for pollution claims, while Skuld (2013) reported that injury claims were second highest after those related to cargo. Data provided by a major P&I Club revealed that in the period between February 2007 to November 2011, there were 3,580 injury claims, resulting in costs of USD 111,622,000. NEPIA (2012) reported that over the past 5 years, crew illness and injury claims accounted for 20% of all of claims, UK Club (2014) reported net notified claims of approximately $50 million in the year 2013, while American Club (2012) reported average cost of injury claims to be at around $28,000 per case. For P&I clubs, the big concern continued to be the "human element", and human error remained the major factor in many claims.

The primary objective of the study was to understand the alignment between safety culture and climate on board ships, and to assess the extent to which the safety climate matches with the espoused values on safety. Safety climate is the construct used to take a 'snap shot' of the safety culture on board ships. By its very nature, safety culture is multidimensional, and factor analysis is the most widely used technique for its analysis (Havold, 2007). Exploratory factor analysis was used to identify and explain the underlying factors, while an analysis of the responses would provide information on the alignment of safety climate and safety culture. Secondary objectives were to determine if the safety perceptions were different between officers working for ship managers' and ship owners, as well as between senior and junior officers.

II. Literature Review

2.1 Safety Culture and Safety Climate

The traditional approach to addressing workplace safety was through statutory means or via physical barriers and similar preventative measures that did not call for any additional care on the part of the individual (Cooper, 2001). Accidents however continued to rise at alarming rates (Cooper, 2001; Reason, 1997), shifting the focus to human factors and the possibility of reducing accidents by providing employees with relevant knowledge and skills. Although research did show that managerial and organizational factors had clear roles in contributing to safety incidents, most practitioners chose to focus almost exclusively on the unsafe acts of workers, building on a prevalent view that certain people were "accident prone" (Heinrich, 1931).

The term "safety culture" was first introduced by the International Atomic Energy Agency (IAEA) after their inquiry into the Chernobyl nuclear power plant disaster in 1986, which concluded that non-compliance with operating procedures significantly contributed to the disaster, indicating a poor culture of safety at the plant (Lee, 1998). The lack of an effective safety culture was also found to have contributed to other major disasters such as the Piper- Alpha oil platform explosion in the North Sea, sinking of the Herald of Free Enterprise ferry etc.

The ACSNI Study Group (1993) defines safety culture as: "... the product of individual and group values, attitudes, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organization's health and safety programmes. Organizations with a positive safety culture are characterized by communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy of preventative measures."

Safety culture incorporates all the traditional methods of improving safety and goes beyond it by focusing on the presence of good quality safety management systems (Cooper, 2001); it encompasses the norms, values, and basic assumptions of an entire organization, and refers to the extent to which individuals and groups will commit to personal responsibility for safety, act to preserve, enhance and communicate safety concerns, strive to actively learn, adapt and modify (both individual and organizational) behaviour based on lessons learned from mistakes, and be rewarded in a manner consistent with these values (Wiegmann et al, 2002). Safety culture is thus a broad term that represents all aspects of an organization's values and actions related to safety.

Existing at another level and interchangeably used with safety culture is *safety climate*, coined by Zohar (1980), who defines it as "a summary of molar perceptions that employees share about their work environments". Others support this view with Niskanen (1994) defining it as "a set of attributes that can be perceived about particular work organizations and which may be induced by the policies and practices that organizations impose upon their workers"; Cabrera et al (1997) conceptualize safety climate as organizational members' "shared perceptions about their work environments and organizational safety policies".

Current safety literature finds the concept of safety climate to be the accumulation of beliefs, values, and perceptions about safety that are shared within a specific group (Zohar, 1980; Cooper and Philips, 2004; Guldenmund, 2000), at any given time as manifested by recent or current events. The HSE Report (2005) states that the term safety climate should be used to refer to psychological characteristics of

employees (i.e. "how people feel" as opposed to "what people do"), corresponding to the values, attitudes, and perceptions of employees with regard to safety within an organization. Weigman et al (2002) argue that safety climate is a psychological phenomenon, which is usually defined as the perceptions of the state of safety at a particular time. Safety climate is closely aligned with intangible issues such as situational and environmental factors, and it is a temporal phenomenon, a "snapshot" of safety culture, relatively unstable and subject to change.

Opinion is split on whether safety culture and safety climate are the same construct. Cooper (2000) argues that even though these two terms are similar in concept and inextricably linked, they are distinctly separate entities. In his review, Guldenmund (2000) listed eighteen definitions of safety culture and safety climate, stating that some authors perceived safety climate and culture as the same phenomenon, while many perceive the two as separate constructs - safety climate being the manifestation of safety culture. Some feel that safety climate can be considered to be effectively the same as safety culture (Davies et al, 2001).

Safety culture is derived from a historical context or organizational operations, values, and traditions, and is generally created over a long period of time. The safety culture is the underlying belief that creates a climate. Safety culture is seen as a sub-facet of organizational culture (Cooper, 2000; Weigmann et al, 2002) and exists at a higher level of abstraction than safety climate (Reichers and Schneider, 1990). Safety climate has a narrower focus than safety culture and exists closer to operations, being characterized by day-to-day perceptions towards the working environment, working practices, organizational policies, and management. Thus, safety culture and safety climate appear to operate on different levels. However, due to the inherent stability of safety culture, it is considered to be an antecedent of individual behaviour. Employees may often be driven to action, or inaction, based on their perceptions of reality driven by the safety climate. However, once these changes in perception are removed, the norms of the existing safety culture will be back in place.

2.2 Drivers of safety culture

Safety culture is a subset of the wider organizational culture, and to develop safety culture it must be recognized that safety culture is about people, their organization and interactions (IAEA, 1986). The organizational culture influences human behaviour and human performance at work and can be equally influential on safety outcomes as safety management systems themselves (Cardinus, n.d.). Thus aspects that need to be taken into consideration include the behaviours, perceptions and attitudes of the people involved, the structure of the organization, internal communications, decision making processes, management styles and the like, as these directly affect attitudes, behaviour and the motivations of those who have to do the work.

National culture should also be taken into account when trying to understand safety culture as it is likely to influence the organizational culture itself (IAEA, 1986; Hofstede 1991). Differences between nationalities play an important role, as the value of life, safety standards, and risk perception are known to differ between them (Oltedal, 2011; Havold, 2007, IAEA, 1986). Lardner (2003) finds that although there is some evidence to suggest that safety culture varies significantly due to differences in national cultures, the evidence is limited. He concludes that "the influence of national or regional culture does not

preclude establishing a local site safety culture which differs markedly from other similar local sites. A strong safety culture can override national or regional culture, if this safety culture is actively and consistently promoted".

Guldenmund (2000) views safety culture having three levels, like the layers of an onion. "Basic assumptions" – not safety specific but general - form the core, and refers to those assumptions that are implicit, taken for granted, unconscious and shared throughout the organization. The attitudes of the organizations members - "espoused values" - is the second layer, and are more specific to safety, instead of organizational factors. These are attitudes towards management systems (e.g. safety systems), hardware (e.g. plant design), people (e.g. senior management) and behaviour (e.g. risk taking). The third or outermost layer consists of "artefacts" or the outward expression of the safety culture, such as equipment (e.g. personal protective equipment), behaviours, (e.g. using appropriate safety equipment or managers conducting safety tours), physical signs (e.g. posting number of days since last accident publicly) and safety performance (number of incidents).

2.3 Development of Safety in the Maritime Industry

Since the formation of the IMO, a combination of regulations, advancements in technology and standardized training have been used to enhance maritime safety. A number of very serious accidents occurring in the 80's were shown to be a result of human errors, with management faults also identified as contributing factors. Thus the need was felt for a safety management system, leading to the development and implementation of the International Safety Management Code (ISM) in 1998.

Although the ISM Code is considered to provide a good basis for safety management, the extent of its implementation is a widely held concern with ISM audits and statutory surveys widely perceived to be of very limited benefit in helping to drive forward positive changes in safety management and leadership (MCA, 2004). Lappalainen's (2008) study also found that the direct effect and influence of the ISM Code on maritime safety could not be very well isolated and no quantitative measurement could be found to describe the impacts of the ISM Code on maritime safety.

From a practical perspective, Chen et al (2006) identify three types of culture in shipping companies that define their varying levels of commitment, competence, and compliance with safety. The first is an *Avoidance Culture* where companies avoid compliance by trading only in areas where it is known that such regulations are not adequately enforced or are overlooked for the right price. *Compliance Culture* is the second, with the majority of operators falling under this category, where a minimalist approach to safety compliance is the operative strategy. Companies try to maintain the minimum safety standards required by regulation and ensure compliance in the most economical way possible, regardless of any long term costs and benefits. The last is *Safety Culture* which includes a growing number of ship owners who are generally market leaders in their trade or region and who have genuinely embraced safety management and believe that long term success is dependent on an effective safety culture.

The compliance culture achieves the goal of better safety management without adding to the ship owners' costs. However, the essence of a good safety culture should be to bring about an alignment between the seafarers' values, goals and relevant safety norms. It is only when this alignment is in place that seafarers will feel inspired to implement firm and effective self-regulation and feel encouraged to

take personal ownership of established best practices. Internationally recognized safety principles and the safeguards of best industry practice have to become an integral part of an individual's own standards (MCA, 2010).

ABS (2012) state that "the goal of the ISM Code, and of Safety Management Systems (SMS's) is the attainment of peak safety performance (i.e., no operational incidents, no personal injuries, and no harm to the environment), but the maritime industry is still some way from achieving this goal. These tools undoubtedly aid compliance with regulation, but they do not necessarily improve safety culture". Importantly, they also point out that "there is a general recognition in the industry that encouraging safe working practices does not require more rules, regulations, and procedures. Instead, the industry needs a better understanding of social and organizational factors that foster professionalism in the seafarer in routine and emergency situations".

It is in this context that the relevance of an effective safety culture becomes the key to improving occupational safety on board ships. Commitment from the top management forms the cornerstone of good safety management; they must show commitment by setting company policies, providing resources for improving safety, investing capital and actively communicating on safety issues (IMO, 2008).

2.4 Challenges Faced in Shipping

The shipping industry has certain challenges that must be overcome in order to have an effective safety culture. The MCA (2004) found that there were great barriers to the development of the safety culture in the maritime industry, while Hänninen (2007) opines that there are major defects in its safety culture.

One of the barriers is the distance between the company offices – where the safety management system is developed – and the ships where it is actually implemented. The senior management, who set the tone through the existing organizational culture, is not subject to the actual work place. The implementation is delegated to the senior staff on board, generally the Master. In some cases there is a perception that there is excessive interference from shore staff with limited practical experience, which thereby undermines the authority of the Master as leader, creating a feeling of resentment and low morale (MCA, 2004). Additionally there is widespread concern that managers ashore do not have at-sea experience, and thus lack the knowledge to make key safety decisions which will affect the ship (ibid).

The second challenge is the contractual nature of employment on ships, with different tenures for different ranks. The transient nature of work, high turnover and lack of crew stability are some of the most significant barriers to effective safety cultures (Anderson, 2003; Report ISM, 2008; MCA, 2004; Oltedal, 2011). High turnover of seafarers also has considerable implications on the implementation of the ISM Code and the safety of the vessel, something that certain sectors like the cruise ship industry with average annual turnover rates between 25% and 35%, are grappling with (ITF, n.d.).

Multinational crews are the norm and as a result subcultures, conflicts, ambiguity, stress, and misunderstandings are possible due to the instability of membership, and also because of a lack of shared history of practice (Oltedal, 2011). Nationality differences play an important role, as the value of life, safety standards, and risk perceptions are known to differ between nationalities (Oltedal, 2011; Havold, 2007). Where organizational and national cultures are in harmony, safety

is not influenced; disharmony creates stress and influences safety. There is also widespread concern that in addition to the isolation from land, multinational crews experience isolation among different cultural and national groups on board (MCA, 2004).

The use of crew management companies may also impact safety as Shipowners lose control over the assessment of qualifications, training, and competence of the crew manning their ships. It is questionable as to whether the crew supplied by agents would take the ship owners safety goals and objectives to heart, due to the feeling of lack of ownership and short employment contracts (Oltedal, 2011). Outside of the difficulties to make a positive impact on the organizational culture, there is also the possibility of dilution of safety standards, resulting in senior management not being as committed to safety, had the seafarers also been from their own country. This lack of commitment may trickle down to vessels, creating an ineffective safety climate on board.

III. Research Methodology

3.1 Analytical Methodology

SPSS 20 was used for all analysis. For factor analysis, Varimax orthogonal rotation with Kaiser normalization was used for extraction, which uses a default eigenvalue of 1 as the cutoff. However, 0.9 was taken as the eigenvalue cutoff for extraction as Jolliffe (1972) considers Kaiser's criterion too strict, suggesting retaining all factors with an eigenvalue greater than 0.7. Hair et al (2009) also state that the eigenvalue criterion with less than 20 variables is not reliable as too few factors are extracted, suggesting solutions that explain 60% of the total variance in social sciences. Thus, in order to explain at least maximum variance, and retain a suitable number of factors, an eigenvalue of over 0.9 was considered as the best criterion. Additionally, in order to ensure higher loadings, coefficients less than 0.5 were excluded. This resulted in isolating more factors explaining a larger percentage of variance.

3.2 Questionnaire Design and Survey Respondents

For the purposes of this study, Indian officers were selected, India being the third largest supplier of manpower to the maritime industry, with more than 42,000 officers (Drewry, 2012). The population consisted of licensed and actively sailing Indian Merchant Naval Officers. The survey was carried out at two maritime training colleges in New Delhi and the NCR region where officers attend short term STCW courses. The questionnaire was personally administered over a period of 3 months to officers during regular class room sessions and the responses were collected at the same time, giving a total of 448 completed questionnaires. The three month period accounted for student turnover, allowing new candidates to be surveyed. Care was taken not to include earlier participants. 433 responses were found to be usable, and based on the requirements of Factor Analysis, this sample size was considered to be suitable for analysis.

Safety data was collected using a questionnaire with items generated using the common elements as identified from the literature review. These were reviewed by a panel of five experts spread across academia, shipping, and industry, who all commented on the clarity and relevance of the items, and the comprehensiveness of the questionnaire in covering all relevant aspects. Based on their recommendations,

the final questionnaire consisted of 19 items for the measurement of safety, and eight others to compile demographic data. The Cronbach Alpha was calculated as 0.856, which indicated good internal consistency.

Table 1: Reliability Statistics – Retention Variables

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.856	0.862	19

A Safety scale was developed assisting in categorizing the safety score into High, Medium and Low. Items were weighted from 5 (Strongly Agree) to 1 (Strongly Disagree). Respondents scoring "5" on all items would have a total score of 95. Similarly, if the score on all items was "1", the scores would be 19. Respondents were classified into the "High" if they agreed with each of the 19 items. Thus the "High" category would have a minimum score of 76. Each respondent achieving a safety score of 76 may not have agreed with every single item - they could have disagreed with some and strongly agreed with others. The "Medium" is the segment scoring between 76 and pure neutrality, or 57, while the "Low" category consists of those scoring less than 57.

The profile of respondents was as shown below in Table 2.

Table 2: Survey Respondent Profile

	Deck		Engine		Missing		Total
	No	%age	No	%age	No	%age	
All	337	77.8	94	21.7	2	0.5	433
Senior Officers	69	15.9	33	7.6			102
Junior Officers	268	61.9	61	14.1			329
Age (Av - yrs)	27.4		29.3				27.8
Sea Service (Av - yrs)	4.7		5.8				4.9
Future Career (Av – yrs)	10.45		10.36				10.4

3.3 Assessment Variables

In order to improve safety culture, it is necessary to measure it. The measurement of safety culture provides tangible indicators of existing status and the impact of planned improvements (Health Foundation, 2011). IAEA finds that no composite measure of safety culture exists, and considering that safety culture is multi-faceted, an exact way of measuring it may never be available. They suggest that a single composite measure may not be suitable; identification of a range of indicators that reflect the individual sub-components of culture may be more practicable. It has been recognized that the culture of an organization and staff attitudes can have a tangible impact on safety processes and ultimately outcomes (Murphy, 2006), therefore an assessment of the safety culture assumes greater significance.

Organizations need to consider whether they are interested in assessing safety culture or climate (Health Foundation, 2011). Safety culture being much broader, it is considered easier to measure safety climate as it focuses on employees current perceptions of safety in relation to management support, safety policies and practices, trust and openness, supervision, and risk taking. Safety climate is a

descriptive measure that reflects workers perceptions of the organizational atmosphere (Gonzalez-Roma et al., 1999), and can be regarded as the surface features of the safety culture discerned from the workforce's attitudes and perceptions at a given point in time (Schneider and Gunnarson, 1991; Cox and Flin, 1998; HSE, 1999). It provides a snapshot of the state of safety and is an indicator of the underlying safety culture of a work group, plant or organization (Flin et al, 2000; Weigman, 2002; Guldenmund, 2000). Cox and Flin's (1998) review found that as far as operationalizing the concept into a practical measurement tool, safety climate was the preferred term.

Recent years have seen many safety culture/climate tools developed through cross industry collaborations and these have been applied in real working environments (Davies et al, 2001). Many tools are available for the assessment of safety climate, and all of these focus on safety climate rather than safety culture. Some of the more accepted tools are the Health and Safety Climate Survey Tool (HSCST) developed by the HSE in December 1997, the Aberdeen University Offshore Safety Climate Questionnaire, the Loughborough University Safety Climate Assessment Toolkit (LSCAT), and the Safety Climate Questionnaire developed by Quest Evaluations and Databases Ltd (QSCQ). The use of these tools is considered to be an effective method of involving, encouraging and maintaining workers interest in safety in the workplace, as, when their views are solicited it leads to greater involvement in safety practices.

The assessment of safety climate is carried out using a questionnaire survey among employees to measure their perceptions of safety, as their perceptions are central to measuring safety climate (Wadsworth & Smith, 2009; Cardinus, n.d.). Although there are many models and scales for assessing safety climate, there is no universally accepted set of component dimensions or factors (ibid). Havold (2007) reports that in the US most of these tools are focused on the healthcare sector, the offshore oil industry in the UK, and the aviation industry in Australia. There seems to be no specific tool for measurement in the shipping industry. There has been limited research on safety climate in shipping, especially with regard to its measurement. Shea (2005) investigated the impact of organizational culture on leadership on board and accidents, finding that positive behaviour had a positive impact on the safety climate and vice versa, indicating a link between accidents and organizational culture. Lamvik (2002) found that national culture played an important part in safety, while Soma (2005) concluded that safety culture depended on the quality of the ship owner rather than the ships.

To understand the drivers of safety culture, a comparative analysis of the elements that are considered to determine the maturity of safety cultures of organizations was undertaken (IMO, 2003; Davies et al, 2001; IAEA, 1986; ABS, 2012). The most common elements found were:

1. Management commitment and visibility
2. Communication on matters of safety
3. Productivity versus safety
4. Focus on learning from problems rather than allocating blame;
5. Safety resources
6. Participation and involvement in safety matters
7. Shared perceptions about safety
8. Visible mutual trust between stakeholders

9. Industrial relations and job satisfaction
10. Training
11. Empowerment of seafarers
12. Responsiveness of seafarers to comfortably rise to routine job demands

These elements were used to develop the questionnaire to be used to measure safety climate.

IV. Results or Main Findings

4.1 Safety Scores

The safety scores of all respondents were calculated using the methodology specified earlier, and the distribution was within acceptable limits of normality. The safety scores ranged from 40 to 89, the mean calculated as 65.85, with a standard deviation of 8.741, and standard error of 0.420. Categorizing the scores gave 13.4% (n=58) in the High category, 72.3% (n=313) in the Medium category and 14.3% (n=62) in the Low category.

4.2 Identifying Drivers of Safety

Correlations between variables were within acceptable limits, and communalities were higher than 0.5, with 0.648 the average. Sampling adequacy, as measured by KMO and Bartlett's Test gave a test statistic of 0.896. Factor analysis isolated seven factors accounting for 64.810 % of the variability, as shown in Table 3 below.

Table 3: Rotated Component Matrix – Safety Variables

	Component						
	1	2	3	4	5	6	7
Safety Training	0.724						
Participation in safety	0.723						
Safety compliance	0.705						
Adherence to SMS	0.681						
Caring shipboard management	0.506						
Feedback and guidance		0.788					
Valued by company		0.636					
Training		0.622					
Caring company		0.533					
Work resources			0.761				
Safety resources			0.691				
Compromise on quality			0.507				
Near miss reporting				0.715			
Job support				0.685			
Safety conscious crew				0.596			
Workload					0.895		
Adequate rest					0.527		
No blame culture						0.863	
Sacrificing safety							0.902

These factors can be described as follows:

Factor 1: Support on Safety - Safety training, Participation in safety, Safety compliance, Adherence to SMS, Caring shipboard management

Factor 2: Organizational Support - Feedback & guidance, Valued by company, Training, Caring Company

Factor 3: Resource Availability - Work resources, Safety resources, Quality of resources

Factor 4: Work Environment - Near miss reporting, Job support, Safety conscious crew

Factor 5: Job Demands - Work load, Adequate rest

Factor 6: "Just" Culture - No blame culture

Factor 7: Safety Compliance - Sacrificing safety

4.3 Safety and Type of Employer

In order to determine if the safety climate varied with the type of employer – ship owner or ship manager, and if the two groups of officers were statistically different the independent *t*-test was used (Hinton 2004). The summary of the safety scores of both groups are shown below:

Table 4: Summary of Safety Scores

Category	Owner Employed	%age	Manager Employed	%age
High	26	13.6	32	13.40
Medium	164	85.9	203	85.00
Low	1	0.5	3	1.30
Total	191	100	238	100.00

Table 5: Group Statistics

	Type of Company	N	Mean	Std. Deviation	Std. Error Mean
Seafarer Safety Score	Ownership	191	66.52	8.887	0.643
	Management	238	65.39	8.653	0.561

The descriptive statistics above do not indicate any significant difference between the two groups. The standard deviations also indicate that the spread of scores for both groups are similar. To ascertain if the difference in mean safety levels is significant, the Independent Samples Test was used and the results are shown in Table 6 below.

Levene's test is found to be insignificant as $p = 0.840$, indicating the variances are approximately equal and the Equal variances assumed column is used (Field, 2009). The independent t-test results calculate the *t*-statistic as 1.330, and the significance or two tailed value of p is 0.184 (> 0.05). Since the p-value is greater than alpha, it can be concluded that there is no statistically significant difference between the two samples - officers employed by ship owners and by ship managers have similar safety levels.

Table 6: Independent samples Test

		Levene's Test for Equality of Variances		t-test for Equality of						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Seafarer Safety Score	Equal variances assumed	0.041	0.840	1.330	427	0.184	1.132	0.851	-0.541	2.804
	Equal variances not assumed			1.326	402.378	0.185	1.132	0.853	-0.546	2.809

4.4 Safety and Rank.

The independent *t*-test was used to determine if safety scores varied with rank – senior and junior officers. The summary of the safety scores and group statistics is shown below:

Table 7: Summary of Safety Scores – Senior vs. Junior Officers

Category	Senior Officers	%age	Junior Officers	%age
High	13	12.7	44	13.40
Medium	76	74.6	236	71.70
Low	13	12.7	49	14.90
Total	191	100	238	100.00

Table 8: Group Statistics

	Type of Company	N	Mean	Std. Deviation	Std. Error Mean
Seafarer Safety Score	Senior	102	66.25	8.263	0.898
	Junior	329	65.75	8.909	0.491

Here too the descriptive statistics do not indicate any significant difference between the two groups. The standard deviations indicate that the spread of scores for both groups are similar.

Table 9: Independent samples Test

		Levene's Test for Equality of Variances		t-test for Equality of						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Seafarer Safety Score	Equal variances assumed	1.026	0.312	0.508	429	0.612	0.504	0.993	-1.447	2.456
	Equal variances not assumed			0.528	179.745	0.598	0.504	0.954	-1.379	2.387

Levene's test is found to be insignificant as $p = 0.312$. The independent *t*-test results calculate the *t*-statistic as 1.026, and the significance or two tailed value of p is 0.612 (> 0.05). It can thus be concluded that the differences between the two groups are not statistically significant, and that the safety perceptions of senior and junior officers are similar.

4.5 Analysis of Responses

The summary of responses (Appendix) indicates that there are many areas where officers feel positively about the aspects of safety culture on board. A majority of officers (86%) felt they were actively encouraged to improve shipboard safety, with high priority placed on safety training (78%) and the availability of essential personal protective equipment (PPE). Most considered their co-workers safety conscious (69%), felt free to ask for guidance (88%) and to report unsafe acts or incidents (75%), while 61% found the safety training provided to be useful. On safety management, again a majority (70%) agreed that they were not encouraged to break procedures to achieve targets, although this number drops to 56% on whether safety was compromised to meet schedules. On board ship, 56% found the shipboard management genuinely caring about safety and wellbeing, and 45% reported satisfaction with their performance feedback.

On the organizational front, just about half (52%) considered the company to be sincerely concerned about wellbeing, health and safety, while 43% did not feel they were considered an important part of the organization. Nearly a third felt that the organization compromised on quality at the cost of safety, and did not have necessary resources to do the job well. On work and rest issues, 42% did not find their workload excessive, a similar percentage stated that they got adequate rest, 40% agreed to taking short cuts on safety to complete jobs faster, while only 18% attested to the existence of a 'no blame' culture prevailing.

V. Discussion

The mean Safety Score was calculated as 65.85, with 13.4% officers who perceive high safety standards on board ships, while a similar number (14.3%) had a low safety perception. The majority (72.3%) falls into the "Medium" category and do not perceive safety standards or the safety culture to be high. This would indicate that the espoused values of safety culture are not trickling down to team members on board.

Factor analysis identified seven factors responsible for 64.810% of the variability. The strongest driver predictive of safety was Support on Safety, that is, the support provided by employers in safety matters. This factor includes elements such as the concern for safety demonstrated by shipboard management, compliance with SMS's, safety training, and participation in safety issues. On most of these elements, the responses are favourable with the majority agreeing that participation in safety issues is encouraged, while high priority is given to safety training and adherence to laid down procedures. On the safety – schedules relationship, even though more than half (56.4%) agreed that there was no pressure; nearly half the officers may feel pressure in some form or the other. Again just more than half (56%) had a positive

impression of shipboard management's genuine interest in safety and wellbeing, something that could be attributed to the short tenures on board and a lack of permeation of organizational culture to the ships senior staff.

The second driver is organizational support which represents the mutual trust that exists between employer and employee, the feeling of worth felt by the seafarer evidenced by the resources spent on training, and providing feedback and guidance. Just about half the respondents (51%) felt that their employers showed a genuine interest in their safety and wellbeing, and these numbers must increase to demonstrate mutual trust. This is not helped by only 42% feeling a valuable part of the organization. The organizations interest can be seen through the usefulness of training provided where 60% agreed to its usefulness, but this was qualified by 45% who did not get proper feedback and guidance on their performance. Organizations need to demonstrate more interest by ensuring proper evaluations and providing necessary training accordingly, instead of unilateral training programs. Training and performance review go hand in hand as there is an intrinsic relationship between training, competence and procedures; training someone to do something does not mean they are automatically competent (IMO, 2003). Very often procedures are mistakenly viewed as a way of bridging the gap between training and competence; however, procedures can never replace the understanding and awareness that are innate to competence.

The third factor identified is the availability of adequate resources to do any task well. Resources refer to both work and safety related materials, as well as the quality of these resources. IMO (2003) states that "the success of any safety culture will be dependent upon the resources made available to support, nurture and develop it. Safety has to be seen at the centre of all decision making and not just as an aside that needs considering once all other decisions are made". The majority (79%) have the necessary safety resources in terms of PPE, but this drops to 47% who are satisfied with work resources, be it spares/stores or manpower. Unfortunately, only 28% find that quality is not compromised over safety, which may reflect on the quality of resources provided. It has been recognized that improved safety has brought improved productivity leading to greater profitability; this relationship is now so widely recognized that the economic arguments for not promoting safety management i.e., it will cost too much, cannot be justified (IMO, 2003).

The fourth factor refers to the workplace environment on board in terms of on the job guidance, safety conscious co-workers and the encouragement received to report near misses and incidents. A stable work force is essential to an effective safety culture as workers are familiar with safety practices, with each other and in turn feel confident in asking for assistance wherever required. On this factor, the majority of officers responded positively indicating that at least on board ship, the ships' crew manages safety well.

The fifth factor relates to job demands in the form of workloads and the availability of adequate and quality rest periods. On work being excessive, 41% disagreed, while on rest periods, 42% were satisfied with the availability of adequate rest. Work and rest impact safety as the crew should be responsive to the demands of the job, including unexpected events and emergencies; they should get adequate rest between shifts to maximize their alertness and readiness to respond during their work periods (ABS, 2012). The issues of reduced manning, increased workload and

resulting fatigue have continued to play a major role in many maritime accidents to the present day. The Cardiff surveys (Smith et al., 2006) have also shown that fatigue is a major problem and that about 30% of seafarers report that they are very fatigued, about 25% reported fatigue while on watch, and many reported that they had fallen asleep while on watch (Smith, n.d.).

The existing culture on blame forms the sixth factor and indicates the perceptions of seafarers regarding the existence of a no-blame culture on board. Organizational learning is an essential part of safety culture effectiveness, and refers to the ability of all affected by safety to learn from past mistakes and improve themselves and the systems that support their activities. This state can only be fully reached when there is a 'No Blame Culture' (IMO, 2003). There appears to be a huge gap here as only 18% agreed that their employers followed a no-blame culture, while 53.6% disagreed.

The last factor – safety compliance - represents the success of the safety culture in that seafarers are still forced by circumstances to take short cuts on safety matters to complete jobs within schedules. Even though three quarters (75%) of respondents disclosed that they report all unsafe acts and conditions without hesitation, one third (33.2%) stated they had taken short cuts in safety matters. This could partly be due to selective reporting in the absence of a 'no blame' culture, pressure to adhere to schedules, or simple fatigue due inadequate rest.

5.1 Safety Perceptions

5.1.1 Ship Owners vs. Ship Managers

It has been stated that the popularity of ship management companies could be a deterrent in achieving an effective safety culture, and it can be argued that Shipowners being larger stakeholders have more to gain from an effective safety culture. The results of the comparison of safety perceptions between officers employed by each do not show any statistically significant differences between the two groups of officers. However, on an individual element basis, there were some differences as can be seen in the Appendix. Owners employing officers had a better record on elements such as encouragement to improve safety, putting schedules above safety, safety conscious crew, and the availability of adequate rest. Surprisingly, managers scored better on their emphasis on safety training. Generally speaking, however, the pattern of responses from both groups were similar with no significant differences, leading to the conclusion that safety climate can be considered independent of the type of employer.

5.1.1 Ship Owners vs. Ship Managers

The safety culture, as well as the organizational culture, of the shipping company is implemented on board through the senior officers, in particular by the Master, who acts as the Owners representative. The senior shipboard management's attitudes on safety have a deep impact on the way safety is managed on ships as it reflects the safety values the company stands for and the emphasis it places on safe operations. If the senior management does not have positive perceptions of the safety values espoused by the employers, it may result in dilution of the safety culture, leading to unsafe operating environments on board. The results indicate that the safety

perceptions of both Senior and Junior Officers were not different, reinforced by the similarities between the categories of safety scores.

VI. Conclusions and Practical Implications

The study provides insights into the safety environment on board and whether it is driven by a genuine belief in safety and wellbeing or is in fact a means of acquiring regulatory acceptance. It captures the safety climate on board which through the misalignments measured can be seen as different from the effective safety culture envisaged by the IMO and the ISM Code.

The study also found many misalignments between safety culture and the safety climate. As it is there are many barriers to an effective safety culture as discussed earlier; additionally shipping companies must address the negative perceptions of seafarers in order to bring about alignment. Foremost among these is the lack of a 'no blame culture'. The presence of a culture which places blame on an individual following an accident or near miss has clear implications for the other indicators of a positive safety culture; it inhibits reporting, prevents the thorough examination of incidents, prevents learning, and has a negative effect on staff motivation (HSC, 2001). Employees have confidence that a just system exists where honest errors can be reported without fear of reprisals (ABS, 2012). If ship owners are genuinely interested in an effective safety culture, it is imperative that they ensure and demonstrate a visible blame free atmosphere which allows reporting of honest errors and consequent learning. In the absence of this, there can never be an effective safety culture and safety will amount to little more than a paperwork exercise.

IMO (2003) states that a good relationship between employer and employee results in employees being more proactive in both understanding and adopting any proposed safety measures; negative perceptions will result in employees mistrusting the motives of the employer. Job satisfaction and the feeling of worth are additional areas of improvement with nearly half the respondents not feeling part of the organization. Seafarers must be seen as integral to the system and not as a cost. Ship owners would be better served if their commitment was visibly demonstrated through their actions.

On the issue of resources, a shortage of work materials and equipment on one hand and sufficient manpower on the other are barriers. Lack of materials leads to shortcuts and eventually impacts workplace safety. The other major and unaddressed issue is that of excessive workload and availability of quality rest. Excessive workload compounded by inadequate rest gives rise to fatigue and burnout whereby mental and physical energy is depleted and manifests itself in negative employee well-being, which includes worker anxiety, health, and depression, and work-related stress (Nahrgang, 2010).

The productivity – safety relationship also appears skewed with costs playing a major role in decision making. As suggested by IMO (2003) "quality shipowners know that attention to quality and safety pays unseen dividends as accidents do cost money. This again supports the need for greater accountability and transparency so that those that benefit from the risk-taking pay reasonable costs for mitigating those risks". Financial constraints are always present, especially in

depressed markets of today, but compromising on quality can result in more losses and a practicable balance has to be maintained.

There is also a word of caution for shipowners who directly employ their crew. Ship owning companies are generally preferred by seafarers due to the belief that being larger stakeholders, they will be more committed to their crew. The results do not prove this and ship owners should not be lulled into a false sense of security. Ship managers, with all their alleged faults, appear to be just as effective in dealing with shipboard safety.

The pattern of responses shows a picture where a positive attitude is reported for sub factors that are within the ship and its control, such as, encouragement in participation, safety training, ease in reporting near misses, asking for guidance and safe co-workers. The dissatisfaction is apparent where support is expected from shore offices on issues such as organizational support, productivity-safety relationship, resources and manpower, and organizational learning through a no-blame culture. This also indicates the misalignment in that the ships staff is doing its best to effectively manage safety on board, without adequate support from shore.

In conclusion, despite the implementation of the ISM Code, there appears to be a significant gap between espoused safety values and those actually found on board - a gap that needs to be filled in order to have an *effective* safety culture.

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Appendix - Analysis of Response

Item	Statement	Overall			Owners			Managers		
		Disagree	Neutral	Agree	Disagree	Neutral	Agree	Disagree	Neutral	Agree
1	Encouraged to improve safety	2.1	11.3	86.6	2.6	8.9	88.5	4.6	16.8	78.6
2	High priority on safety training	4.9	16.9	78.2	5.2	16.8	78	1.7	13.4	84.8
3	Schedules never above safety	14.3	29.3	56.4	14.1	23.6	62.3	13.9	34	52.1
4	Breaking rules to achieve targets	9.3	21.5	70.2	8.9	20.9	70.1	8	21.8	70.1
5	Ship's management cares about safety and well being	13.6	30.3	56.1	11.1	29.3	58.7	14.7	30.7	54.6
6	Regular feedback and guidance on performance	18.7	36.5	44.8	18.3	34.6	47.1	18.4	37.8	43.7
7	Considered an important part of the company	15	42.7	42.3	12	45	43	17.2	41.2	41.6
8	Training given by the Company very useful	10	29.3	60.7	11	32.5	56.5	9.2	26.5	59.2
9	Company cares about wellbeing, health and safety	14.8	33.7	51.5	12.5	37.2	50.2	16.8	30.7	52.5
10	Spares/stores available	20.3	32.3	47.4	19.3	31.9	48.7	21.5	32.8	45.8
11	Availability of personal protective equipment (PPE)	4.2	17.1	78.7	2.6	16.8	80.6	5.5	17.2	77.3
12	Quality not compromised over costs	36.3	35.6	28.1	34	35.1	30.9	37.8	35.7	26.5
13	Freely report all unsafe acts or conditions	4.7	20.3	75	5.2	20.4	74.4	3.8	20.6	75.6
14	Comfortable asking for guidance	1.8	9.9	88.3	1.6	8.4	90	2.1	11.3	86.5
15	Safety conscious co-workers	4.6	26.6	68.8	2.1	22.5	75.4	6.3	29.8	63.9
16	Excessive work load	40.6	42.3	17.1	39.8	46.1	14.2	40.7	39.9	19.4
17	Adequate rest provided	28.4	29.8	41.8	22	28.8	49.2	32.7	30.7	36.6
18	Existence of 'no blame' culture	53.6	28.4	18	46.6	34	19.4	58.4	24.4	17.2
19	Bypassing safety to finish jobs quickly	33.2	26.8	40	36.1	29.3	34.5	31.5	24.4	44.2