

# Crew Resource Management: The Role of Human Factors and Bridge Resource Management in Reducing Maritime Casualties

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**ABSTRACT:** This paper presents the Crew Resource Management which has now been in the existence for more than two decades as a foundation of maritime transport in order to improve the operational efficiency of shipping. The impact of human errors on collisions and grounding of ocean going vessels have been taken place due to the human or team errors which need to be analyzed by various maritime casualties in depth. The first section of this article is devoted to investigate the role of Human Resource Management, Crew Resource Management and Maritime Crew Resource Management; it is because of minimizing ship accidents at sea. The next part of this paper is designated to evaluate the Bridge Resource Management, Bridge Team Management and Human factors in depth. It should be noted that the necessary techniques in bridge team management should be clarified based on the consideration of the issues that why bridge team management is arranged. The next segment of this paper is dedicated to consider the ways of minimizing ship accidents by offering optimum training methods for the future seafarers. The last part of this paper is designated to assess the qualification of maritime lecturers based on STCW95 Convention and the MARCON project for teaching the Bridge Resource Management.

## 1 HUMAN RESOURCE MANAGEMENT

Human Resource Management is an innovative view of the workplace management which is established as useful method for analysing the strategic approach to the organizational management. This method of management system has been defined from different sources in a similar manner, for instance, While Miler (1987) who stated that ".....those decisions and actions which concern the management of employees at all levels in the business and which are related to the implementation of strategies directed towards creating and sustaining competitive advantage". Miler emphasised on actions related to the management employee in order to maintain competitive advantage. It should be noted that after about a decade the definition of Human Resource Management (HRM) is highlighted on its responsibility for staffing people into the organization. In this regard Cherrington (1995) expressed that "Human resource management is responsible for

how people are treated in organizations. It is responsible for bringing people into the organization, helping them perform their work, compensating them for their labours, and solving problems that arise".

The initiation of the advanced theory of management caused that the term of describing the function of workforce to be changed from "Personnel" to "Industrial relations" to "employee relations" and finally to "Human Resource". Although, all the above mentioned terms are used nevertheless, the precise and useful term is Human resource Management. Some people believed that HRM is a part of HRD (Human Resource Development) which includes the great range of activities in order to develop personnel of organizations; in fact, the objective of HRM is to increase the productivity of an organization by improving the effectiveness of its employees. In the last three decades, many changes have been applied to the HRM function and HRD profession; in the past, large organizations looked to the "Personnel

Department," nevertheless recently, organizations consider the "HR Department" as playing an important role in staffing, training and helping to manage people. The link between human resource management and the strategic goals of an organization has been investigated by Miller (1989) as "The goal of human resource management is to help an organization to meet strategic goals by attracting, and maintaining employees and also to manage them effectively". After World War II, more attentions needed to be applied to the labours due to the shortage of skilled workers of companies, therefore the general concentrate of HRM modified from concentration on labour efficiency and skills to employee satisfaction. Then, as consequences of the Act of 1960 and Act of 1970, companies began putting more accents on HRM in order to avoid of violating this legislations. In 1980, the HRM grows up rapidly due to the several reasons such as the organizations required skills of HRM professionals in order to adapt the organization structure with a new generation of labour attitudes and behaviours, improving educational levels, growth of offering services, white colour job and more women as workforce, etc. Marine Accident Investigation Branch (1999) stated that four factors or four "Cs" such as commitment, competence, cost-effectiveness, and congruence should be used in order to evaluate whether the HRM programme is succeeded or not? The author of this paper expand the above assessment to the following five factors by adding Customer as five item in order to determine whether the HRM programme is succeeded or not. It is because; the services of Human resource in an organization are provided for the customer satisfaction, therefore we should pay careful attention to attract our customers by improving the efficiency of the organization. In 1990, the new technologies such as IT, satellite communications, computers and networking systems, fax machines, and other new devices have forced to change the field of HRM. The second important change influencing HRM was related to the recent organizational structures, which emerged during the 1980s as a result of the operational expansions of many companies or diversification of their products and services that continued through the 1990s. The third or last factor of forcing to change the HRM field is market globalization through world trade which was enhancing competition abroad; in order to compensate with the international competition, companies should consider their HRM professionals for improving the quality of products, productivity, and innovation of the organization.

## 2 CREW RESOURCE MANAGEMENT

Crew Resource Management has come to light for more than two decades, nevertheless a misunder-

standing still exists within aviation and shipping industry for what the term entails. Crew Resource Management (CRM) is a reliable management system which makes the best use of all available means such as equipment, people in order to improve safety and increase operational activities within the shipping industry. CRM includes a broad variety of knowledge and skills encompassing cognitive skills and interpersonal skills. ....very often extremely traditional education forms and context are very demotivating of our young generations, Stephen J.Cross (2010). The cognitive skills are regarded as the psychological procedures used for acquiring situational awareness, for solving problems, and for taking decision and the interpersonal skills consist of communications and teamwork. Crew Resource Management is a management system which creates the best possible use of all available means such as equipment, communication, process and people in order to improve safety of ship operations.

For the purpose of increasing the effectiveness of crew members on board ships, a special training course of the technical knowledge not only is essential for crew members; but also they require to implement the requirement of CRM which are developing and understanding of the cognitive and interpersonal skills.

Training of CRM skills are related to the theory and practice of group behaviours which are properly developed through a method called experiential learning. It should be noted that CRM skills have been taught individually as technical knowledge and skills, nevertheless the considerable area of overlap between the above two methods proposes that the training would be more effective if it was included from the basic of the Maritime Crew training method. Dominic Cardozo (1993) defined that Crew Resource Management is an active and interactive process including all crew members, which helps to detect, communicate and avoid or handle significant threats to an operation, action or task by developing and applying efficient countermeasures to minimize the safety risk. Hackman (1986) describes the crew as being frontline operators and safety to be a line function by which the entire company culture and company structure is defined. For the purpose of assessing CRM in the maritime industries, it is necessary to have a look at the growth of CRM in aviation. In 1980, the first CRM training course was implemented by the United Airlines which was about the evaluation of crew members of their own and their team members' performance. Nowadays, CRM is an essential training course not only for all airlines and aviation schools, but also is mandatory for maritime colleges in order to reduce human errors and to avoid any incident, accident or /and collision. Since the main reasons of the majority of ship accidents can be found in human errors, therefore,

CRM plays a vital role in reducing their negative result. CRM training course is necessary for operators in every work field especially for ship's crew based on the latest revision of the STCW in June 2010. In a sense, the overall integration of each responsibility on board ship as a complicated teamwork is called designing CRM training and application for the maritime industry. It means that deck and engine officers, OS, AB, cooks and stewards with different nationalities working closely together as a team. As a result of the technological improvement in shipping, the implementation of CRM strategies has been taken more than three decades which is not offer a completely agreeable result; therefore the old schemes of designing CRM training need to be updated. It should be noted that since the situation in aviation is completely different with shipping business, therefore it is not possible to copy or transfer CRM from aviation to maritime field. It is because a ship is a work place which cannot be left by the crew for months; navigators are working on board ship for 24 hours on seven days a week in order to keep the sea watch as duty officers who are not allow to sleep more than six hours.

### 3 BRIDGE RESOURCE MANAGEMENT

It is a training course in order to manage ship bridge activities by Master, Pilot, Watchman, Wheelman and officer on watch. Many collisions occurred as a result of misunderstanding of the parties doing different activities on the bridge for instance pilots with watch keepers. It is possible to imitate the expected situations by using ship handling simulators in order to improve the skill and communication between the responsible persons on the bridge. For instance, in 1974, Large Crude Carrier (VLCC) called "Metulla" grounded in the Magellan Straits with two pilots and watch keepers who were present on the bridge; it means that bridge teams were not working efficiently in order to support each other. In fact, there are two different comments on using simulator as training course, first Gyles and Salmon (1978) who stated that "Simulator-based training courses were introduced primarily to train the skills of passage planning and the importance of the Master/Pilot relationship". This training initiative developed into the Bridge Team Management (BTM) courses that are conducted today on many simulators world-wide and contain many of the elements to be found in CRM courses in other industries. The role of simulator as a tool for training CRM has been stated by Barnet (2060) as follows "Bridge Resource Management (BRM) courses are a more recent initiative, adapted directly from the aviation model, and are not always based on the use of simulators". Nowadays, Maritime Universities offer a training course called Bridge Team Management (BTM) or Bridge Re-

source Management (BRM) which is about the discussion of ship handling and navigational skills, unfortunately not emphasis on human factor. Micheal Barnnet (2060) quoted from Flin et al regarding the significance of the bridge resource management course in the following paragraph as follows "Within other safety critical industries, and the military, the training and assessment of resource management skills is taking on a high level of importance as a way of ensuring that errors are effectively detected and managed (Flin & Martin, 2001; Flin et al., 2000). It should be noted that CRM training course is not important by many ship owner, it is because no strong rule or regulation issued by IMO in order to support it such as SOLAS, ISPS Code or even the STCW. We hope that through the revision of STCW according to the 2010 amendment it will adjust CRM training as mandatory course for future seafarers. In addition to the above explanation, the limitation of bridge resources or bridge equipments should be considered by seafarers. Bridge watch-keepers should be aware of the dangers of being over-reliant on these devices and:

- understand the types of errors that are possible and recognise the operational warnings that appear on the display;
- understand the limitations of the devices;
- regularly test the devices using the built-in operational test facilities.

### 4 MARITIME CREW RESOURCE MANAGEMENT

Maritime Resource Management and Bridge Team Management Course are offered by maritime Universities in all over the world in order to concentrate on optimum approach of seafarers to reduce management error. MCRM is an essential training course for crew members of ships which approved by IMO. This training program deals with management in highly operational situations on board ship's bridges, in engine rooms etc. It defined by (Poop, 2009) as "MCRM is a course that aims to provide knowledge and a practical understanding of operative management skills". As we know majority of ship accidents or incidents are being caused by human errors, therefore the main part of the MCRM course is to review several case studies of accident and incident at sea. The following table illustrates the number of Iranian and foreign maritime accidents that rapidly raised in 2009 and reduced quickly in 2010, which was because of the standard training courses such as MCRM, BRM, BTM, etc.

At this part, there are two more or less similar ideas about the non-technical or resource management which have been stated in order to improve the required skill in crisis management.

Table 1 (Source: Iranian Port and Maritime Organization)

Maritime Accidents 2010	2007	2008	2009	
Total number of accidents	93	88	116	22
Number of Iranian accidents	85	82	113	19
Number of Iranian sunken ships	36	37	52	7
number of person survived	720	656	834	226
Medical care offered to seafarers	108	119	158	47

Michael Barnett, et al (2002) stated that although there is now a general acceptance of the core concepts for the non-technical or resource management skills required for competence in crisis management, there is also an acceptance that the behaviours associated with these skills are context specific. In addition, Helmreich et al. (1998) suggest that the optimal implementation of resource management skills is dependent upon the cultural context in which they are applied. It should be noted that in order to evaluate the application of resource management skills, the assessment should be carried out within a cultural context. The International Maritime Organization's Seafarer's Training, Certification and Watch keeping Code (International Maritime Organization, 1995) are the essential resource management skills. Table A-V/2 of this code indicates the minimum standard requires in crisis management and human behaviour skills for senior officers who are in charge of passengers in emergency situations. Majority of Maritime Universities run the Resource Management training courses which are combined as both deck and engine field. The most part of the courses are taken place by using simulator technique in order to teach the lessons by sequence casualties.

## 5 HUMAN FACTORS

By considering the following reports, we would be able to understand the role of human on maritime accidents: Data from research undertaken by the UK Protection and Indemnity Club (UK P&I, 1997) indicates that human error directly accounted for 58% of all shipping incidents that led to major insurance claims. The United States Coastguard (1995) stated that the human element was a root causal factor in 70% of all shipping incidents. Although not all of these incidents led to a crisis situation, all had that potential. Accepting that human error is inevitable, there is a need to understand the behaviours of effective error detection and management in order to ensure safe and efficient operations (Helmreich et al., 1998). The items related to the human factors are as follows: firstly, fitness which is related to the absence of factors cause negative effect on human performance such as regular sport and exercise or even mental factor. Secondly, use of non-prescription drugs, alcohol and extreme amounts of caffeine, etc. Thirdly, seafarers communication difficulty which is

because of different languages, cultures, customs and behaviours. Fourthly, fatigue of crew and the qualification with optimum training of seafarers based on the latest STCW requirements. The definition of human factor with the relevant items has been stated by DNV (Det Norske Veritas) as follows: We believe that a central result of this analysis is the paramount importance of the human factor. In fact, in the majority of cases reviewed, the incident was due to one or more of the following: Poor crew competence, lack of communication, lack of proper maintenance, lack of application of safety or other procedures, inadequate training, poor judgment of the situation, and so forth. This general conclusion also means that many of the serious accidents reviewed might have been averted if some of the above deficiencies did not exist. It should be noted that the causes of accidents are grouped in different codes as A,B,C,D,E,F,G, the codes defined by (DNV) as "DAMA" database structure which is used for both statistical and fault tree analysis. The following comments extracted from different opinion of the five authors about the cases such as "what was the cause of an accident" or "what possible measure could have prevented it" in quantitative terms. The five more important DAMA causes were:

- F04 (8.2%): Existing routines for safety control known, but not followed.
- G02 (7.9%): Insufficient real competence (practice from occupation, waters, with equipment or suchlike).
- A01 (6.6%): Very heavy weather, natural disaster, etc.
- G07 (5.0%): Not adequate observation of own position/not plotted on charts.
- G09 (4.0%): Misjudgement of own vessel's movements (current, wind etc.).

Within each group, the most important causes were: Group A: Circumstances not related to the ship: cause A01-Very heavy weather, natural disaster etc (49.5% of the total), followed by cause A07-Operational fault with other ship (wrong manoeuvre/poor seamanship etc) (16.2% of the total) and A02-Current, wind etc led to strong drift or other manoeuvre difficulties (7.1% of the total), covering together a percentage of 72.8% of Group A cases. Group B: Construction of the ship and location of equipment on board: cause B01-The ship's structural strength not sufficient (49.1% of the total) and cause B02-The structural strength weakened by later welding jobs, corrosion etc (30.9% of the total), together coming to an 80% of Group B cases. Group C: Technical conditions concerning equipment on board: cause C09- Technical fault with equipment (34% of the total) only.

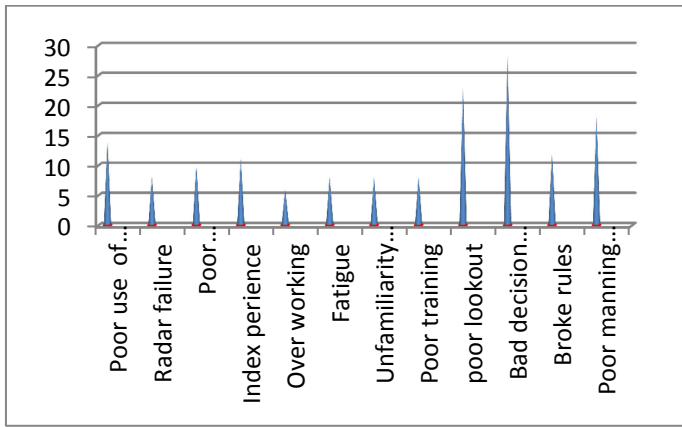


Fig.1 (Source of data: R.Ziaretie, 2010)

Group D: Conditions concerning use and design of equipment: there is no statistically significant cause. Group E: Cargo, safeguarding and treatment of cargo and bunkers: cause E01-Self-ignition in cargo/bunker, also by “sloshing” in tanks (50% of the total) only. Group F: Communication, organization, procedures and routines: cause F04-Existing routines for safety control known, but not followed (31.4% of the total), followed by cause F10-Failure of routines for inspection and maintenance on board (11.3% of the total).

Group G: Individual on board, situation, judgment, reactions: cause G02-Insufficient real competence (practice from occupation, waters, with equipment or suchlike) (22% of the total), followed by cause G07-Not adequate observation of own position/not plotted on charts (13.8% of the total), and cause G09-Misjudgment of own vessel’s movements (current, wind etc) (11.2% of the total). Figure.1 shows the cause of maritime accidents and human errors as common factors at sea; it should be noted that the maximum factor is related to the bad decision making of officer on watch and the next is poor lookout of watchman, both by human errors.

By reviewing the above mentioned groups, there was a serious statistical attention which has been emphasized on groups F and G. In fact, it is not amazing; because the two groups include mostly to the maritime accidents which were due to the human error. Figure.2 shows the causes of on board ships with the main reason of bad decision and the next is poor lookout.

## 6 MARITIME CASE STUDY

On 6<sup>th</sup> January 2002, the Dover Strait, one of the busiest waterways in the world, was shrouded in thick fog. Visibility was less than 200 meters in places. Two ferries were crossing the Dover Strait at 0900 that day. The “Diamant” was coming from Oostende heading for Dover. The “Northern Mer-

chant” was heading to Dunkerque from Dover. Both vessels were travelling at close to normal cruising speed: “Diamant” a high-speed craft was travelling at 29 knots, and the “Northern Merchant”, a Ro-Ro ferry, was travelling at 21 knots. Were they to have continued their course and speed, the vessels’ paths would have taken them to within half a mile of one another. As it was, at just over a mile apart, the bridge teams started to question the assumptions they had made about each other’s probable course of action and started to implement course changes, but not speed changes, that would, they believed, put a greater distance between themselves. At 0952 they collided.

## 7 INVESTIGATION OF THE CASE

Seafarers Mistake: it was because of failure to maintain adequate distance; It means that ‘violation of procedures’ (it was too late for assuming about the actions of the other vessel in thick fog).

Seafarers Mistake: it was because of failure to reduce speed; it means that ‘violation of procedures’ (as a result of the speed of the craft in poor visibility, thus they had no time to take action to avoid the collision).

Seafarers Mistake: it was because of poor professional judgment; it means that ‘violation of collision regulations’ (As the Rule stated that, when a vessel can only ‘see’ another vessel on its radar and a risk of collision exists, she shall take avoiding action in ample time. Altering course at one mile or three minutes before the collision, with 21 knots speed was not in ample time).

As consequence of the report, fault of the collision was due to the Crew Resource Management or Bridge Team Management errors. Through the official report and investigation which had been carried out by the Department of Transport regarding the incident, the cause of accident was because of the operator errors (the bridge team or the Master errors) by the eighteen reasons as the official report (MAIB, 2003; pp. 43-44).

## 8 THE STCW CONVENTION

The Manila amendments are the result of nearly five years of intensive debates and discussions on various accessions also at the annual IMLA Conferences and at IMEC gatherings. Although the outcome is not the optimum, it is, however, an acceptable and practicable instrument suited to further develop Maritime English as an essential but relatively new knowledge area in order to satisfy the new provisions and thus the complex requirements of maritime industry. As

Prof. Trenkner (2010) emphasized on the outcome of the Manila Conference which was not an optimum result, further Prof. Ziaretie (2010) had more or less similar idea in this field. It should be noted that several attempts carried out in order to revise STCW95 convention through the Manila Conference 2010. Nevertheless, the implementation of the revised Convention will take time and a number of deficiencies kept in the Convention until the proposed changes to be taken place.

In addition to the above explanation, regarding the role of optimum training of MET based on STCW Convention Prof. R. Prasad (2010) stated that seafarers need to acquire comprehensive understanding of technical facts through active learning processes that enhances deep understanding of scientific as well as social concepts and help develop technical, cognitive and social skills. Skills for group/team work, good communications and resolving issues are as essential because they have to work in such environment.

## 9 THE MARCON PROJECT

The MARCON is an improvement of maritime lecturers' competencies project which is based on Lisbon European strategies fortune in order to maintain the European maritime university system as worldwide framework. It should be noted that the eEurope has been launched as e-learning in 2001, therefore communication and computerized technology became the main component of maritime training. The objective of this project has been stated by Prof. R. Hanzu-pazara et al (2009) as follows: The general objective of the MARCON project is represented by multidisciplinary research concerning initial and continuous formative of the lecturers from maritime universities and providing of advancement programs according with the maritime industry requirements.

Although, around 40% of the present teaching staff of Constanta Maritime University has pursued this program, therefore the author believes that if all maritime lecturers become familiar with the latest technologies, advance computerized system and simulation procedure, than their competencies in maritime training will be improved in a great extent.

## 10 CONCLUSIONS

Many maritime accidents have been reported in the last couple of decades, there were because of the shortage of seafarers' skill to supervise both resources and crises. CRM training has been seen gradually more as a fundamental part of the human error management viewpoint. The International Mar-

itime Organization gave the impression of the require for resource management skills on board ships, nevertheless the standards of competence and their evaluation criteria are not fully formed similar to the civil aviation. CRM training is a technique that has been formulated for organizing people to arrange maritime/bridge resources in order to avoid collision at sea.

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