

COMMUNICATION AND DECISION UNDER STRESS IN MARITIME INDUSTRIES

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Abstract: *This paper discusses human judgment and decision making under stress. The authors review selected recent literature across various disciplines and suggest a definition of stress within the context of decision making during the management of emergencies. The authors of this study was to identify and examine the conditions that influence stress in the personnel range in marine industry activities or offshore, to identify the stressfull factors sources in the environment where people live and work.*

Keywords: *stress, judgment, decision making, emergency managemen, risk assessmen, maritime accident, human factors, human error, accident reports.*

1. Introduction

In the present context of the development of the marine industry, we can express without a doubt, the communication under stress has become a synonym with acting under stress, in which the physical and psychical request is permanent and often at levels that can disturb the physical, psychical and psychological mechanisms that constitute the ensemble that define us.

There are several basic aspects of maritime activity that make it unique: ships are confined and isolated systems, self-sufficient on energy supply, they have a limited manpower and resources, and they have a limited response capacity to face made maritime trade a risky activity, where a fault in navigation or in usual port operations can give rise to injuries or lost of life, to damage of property and some times irreparable damage to maritime environment.

Environmental and operational risks that can give rise to costly demands and

complaints, are nowadays, a significant matter to owners, and the evaluation of these and other risks is an essential requirement to maritime trade safety.

Although risk, inherent to maritime industry, can not be completely removed, it can be reduced to acceptable levels through the use of risk management principles.

On the other hand, several researches (UK P&I Club, US Department of Transportation) identify human error as cause of 60 and 80 per cent of maritime accidents, giving us an idea of the importance on maritime safety of quality living conditions on board –related to ship condition and maintenance– and quality of crews – related to crew competence and qualification.

People interact with technology, with the environment, and with organizational factors. Sometimes the weak link is with the people themselves; but more often the weak link is the way that technological,

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environmental, or organizational factors influence the way people perform.

The human factor is important not only for maritime safety and the safeguard of the marine environment, but also to support the growth and the prosperity of the maritime industry in all over the world.

Understanding human factors is devoted to understanding human capabilities and limitations, and to applying this information to design equipment, work environments, procedures, and policies that are compatible with human abilities. In this way we can design technology, environments, and organizations which will work *with* people to enhance their performance, instead of working *against* people and degrading their performance. This kind of *human-centered* approach (that is, adapting the system to the human) has many benefits, including increased efficiency and effectiveness, decreased errors and accidents, decreased training costs, decreased personnel injuries and lost time, and increased morale.

2. Stress Onset

The use of this term in a vague and general form creates this context of different interpretations that sometimes are contradictory. In this context, the different definitions of stress instead of creating a general definition.

- Stress as *stimulus*: stress is defined as any situation that provokes alteration in the
- homeostatic processes. This definition has been criticized since it does not consider individual differences in response to the same situation. Individuals are not passive and there are many situations that result in changes of the homeostatic processes but they are not stressful, for instance to breath.

- Stress as *response*: stress is defined in terms of the reactions provoked in the organism. Some authors argue that this kind of definition of stress can be misunderstood since there are both emotional and physical responses that can fit in this definition of stress and they result from non stressful situation, for instance to practice sport.
- Stress as *interaction*: many authors suggest that stress should be understood as a relationship between individuals and their environment. In this specific relationship, the environment is perceived as threatening by individuals who experience that environmental demands exceed their personal resources.
- H. Seyle distinguishes three phases in the adaptation of the organism to the environment:
 - Warning or shock
 - Resistance to change
 - Exhaustion

Subsequent researches showed that during those three phases, when external stress, of any kind, that exceed a certain edge, will determine in the human organism, a significant amount of secretions of cortical hormones, leading to the conclusion that the *human organism is a victim of the excess of his own biological defence mechanism.*

The american school, through the contributions brought forward by Harold G Wolff and Hinckle of Cornell University define stress as: „ *the dynamic state of an organism, as a response to a request to adapt*” concluding that „ *all living beings are more or less in a permanent state of stress*”

The french school, through Pierre Marty shows that an individual figure, stressed by prolonged external events, that disturbe his mental structure, should be capable to

handle mentally the situations which he is confronted with. In this way *the french school* shows that each and every individual figure resolves in a dissimilar way these problems of mental disorganization depending upon the individual structure of the psychic, of the quality of the mental mechanism and mental functions.

3. The Conditions That Influence The Stress Phenomenon

The stress factors always act in conjugal way. The reaction of the human organism to these factors is determined by:

- The nature of the stress factors
- The acute or chronic way in which the stress factors are observed
- The social context in which the stress factors are operating
- Individual emotional factor

4. The Characteristics Of The Stressful Situation

The characteristics of the stress factors are reviewed depending on:

- *The intensity* of the stress factors is measured by the variations in the changes perceived in the personal situation or in the global environment of the society. The level of anxiety is higher when the change perceived is not desired and is even more higher if the social change has unwanted connotations in the personal life.
- *The dimension* of the stressful events is the measure of the stressful factor upon the individual person. The persons exposed to stressful situations of long duration and intensity, can't recover physical, biological and psychic formal well-being, and if these stressful situations regard the physical life of the

individual persons, those are projected in an universe in which the profound biological reaction of survival prevails.

- *The duration* of the event, can be variable in its impediments, in many cases a brief but intense experience can have a devastating effect, similar to that caused in durable stressful situations.
- *Unforeseeable* events have a more larger effect upon emotional disturbances rather than mental anticipated events.
- *Recency effect* grows the impact of the stressful situations upon the individual persons.

5. The Nature of Stressors

The stressors can be further divided into three types :

- *Physical Stressors*—The physical stressors are any physical demand made on the mind-body to adapt. They include heat, cold ionizing radiation, chemicals, poisons, toxins, fire, electricity, and trauma of any type.
- *Biological Stressors*—The biological stressors are any biological demand made on the mind-body to adapt. These are primarily adversary living systems which adapt by attacking and exploiting the mind-body. They may be simple or complex. Examples include viruses, bacteria, rickettsia, fungi, parasites, and predators.
- *Social Stressors*—The social stressors are any social demands made on the mind-body to adapt. Social stressors are of two types: coercive and non-coercive. The coercive social stressors are non-voluntary demands made upon the mind-body to adapt. This would include assault, murder,

rape, theft, arson, and any crime against an individual and his property. Another example of the coercive social stressors are the non-voluntary demands made by any form of political government such as taxation, regulation, restriction, and incarceration. This would further include all social stressors produced by action of the political government—i.e. war, inflation, recession, injustice, etc.

- A distinctive part of stressful agents emanated from the condition in the work place are considered acute stressful factors, for example in the case of marine industry activities, engine room accidents, explosions followed by flooding, fires in the engine room, personnel injuries, burns, accidents on the deck of the ship resulted in personnel injuries, wrecks in the deck installations, pollution or fires on the deck of the ship or in the cargo hold, in which the crew confronts with piracy actions, terrorist acts, sabotage acts, assault upon the ship, situations when the ship is in quarantine, situation of ship desertion.
- Exigency in the professional environment: due to the physical discomfort that the seaman has at the work place (noise, cold, excessive heat, filth, gas, light, vibrations, ship movement), constant physical requests, as well as strain with the rest of the crew (disagreements, criticism, disputes).
- The stressful factors that are related to *the post of the responsibility and the service at the work place* are factors that are related on one side of the habitude with the work conditions, routine, very low stimulating in a certain activity that has as a result the desinterest and uninvolvement of the workman as well as the feeling to cope with some duties on the degree of preparation and responsibility that he can handle, on the other side the fact that working in a govern job can be responsible of the good result in the activities of the other branches of work, or has direct implications in the good deployment of the life in the frame of the organisation.
- *The cult of professional performance* is a stressful factor related of the hypothetical and constant presence of a threat. The cult of professional performance reaches his high tide in the notion of „zero defect”. Through this looks on the quality of the production as well as it’s quantity.
- The human has an imperative need to be appreciated, useful, that his qualities and performances are approved, his emotional frustrations linked to *the lack of approval* from team mates, superiors, families and close ones represents a powerful stress factor.
- In the framework for *management through stress mediation*, the behaviors of the management staff in front of the employees are sustained by the idea that people are more efficient when they are constrained by intense pressure or even, in some cases, if they are afraid.
- *Overloading, overburdening, professional oversteering and the deficiencies in work* are all factors that manifest in the case of decisions that can affect the rest of the crew, of overworking, with long periods of physical and psychic effort, the stressful factor, can be at the same time of quantitative nature and qualitative nature. The action of the stressful factors in this case upon the human organism are the recourse to

alcohol and tobacco, the diminution of self-respect.

- *Excigency in the proffesional enviroment*, with hard work conditions, dangerouse.
- *Professional undertasking*: especially when there is a postponement between the training and the ambitions of the crew member and the job he has onboard the ship.
- *Wearisome working*.
- *Working with continuous changes in the schedule*, the tasks are hard to accomplish because of the frequently interruptions and changes in the activity schedule and the seaman becomes nervous and agressive.
- *Structuring the time at the place of work*
- *The physical danger* is a stressful factor in high risk proffesions as well as those of marine industry. It has been observed that the workers in these areas, with this stressful factor, physical danger, may look as slightly sensible personalities, with difficulties in engaging in durable personal relations, and that correspond very little with the dominant conventional values. These character featureres allow to establish a distance in interpersonal relations and facilitates the overcoming of same attempts that rise a big fear , the deaht or ingiury of fellow colleques in the course of their dangerouse professional activity.
- *Uncertainty, Unforeseeable and Uncontrolable* situations that they have to confront, the imposibility to plan and scheduling all the stages of the activities of the task that need to be accomplished. The changes are so much stressful when are so little predictable, controlled and desired.
- *Changing the work place* necessitates an accommodation period, that

doesn't regard the degree of professionalism of the individual person.

- The work satisfaction can be estimated in the light of the concept *Persona/Enviroment*, meaning the proper psychosocial characteristics of an individual in the work conditions of his enviroment, or as a stress determination touchstone- the tension. In the case of unproper – anxiety, depression, discontentment, somatic disease appear.
- *The fear for tehcnology in ration with the responsibility of the work place*.
- Another type of acute stressful factors are the cases in which members of the staff are placed in situations where they are criticised for they activity. *The criticism*, the shame in front of the rest of the crew staff can leave deep and important traces and for long term in the psychic structure of the individuals. This type of stressful factors have as a reaction from the individuals the alarm phase. The problem can stop here but it can also, in the case in which the traumatism was important, generate an affection name *post-traumatic stress* in which the traumatising episode is obsessive relived by the seaman. The affection determines the decline in motivation and pleasure from day to day activity, fatigue, evolving towards depression.
- *Interpersonal conflicts*.
- *The responsibility* towards human beings is so much stressful then towards equipments. Stress is linked to the level of exertion of responsibility in the frame of the organisation. If the level of responsibility towards the organisation is high, then the

psychical pressure exerted upon the individual is as well high.

- *Anxiety in the career development.*
- *The lack of consideration*, in the case of „The hierarchical superior”, the insufficient consideration from the superior to his subordinates will have as an effect the growth in the tension feeling in the work place. The consideration is a feeling associated with friendship, mutual respect and a sort of warmth in human relations. The most delicate function of the manager consists in the way he controls his subordinates. The imbalance in formal power and real power, the losing of personal stature, the personality wear-out, the denial from his subordinates are all potential stressful sources.
- *Isolation towards the family*

6. The Reaction Of The Organism In The Presence Of Stressful Factors

The human organism, as a sequel to the stressful factors that act upon his functional ensemble, replies with an adaptation reaction to its new requests, reaction gathered in the „*general syndrome of adaptation*” which evolves in three phases:

The first phase : *The alarm reaction*, it is the period of the acute reaction, in which the organism acts first by a shock, then its mobilizes his defence mechanisms so it can be ready to deal with the new situation. In this phase the arterial blood pressure raises, the muscles contract, the vigilance grows, the attention and storage capacity is higher, the human organism adapts and prepares to deal with the situation.

The second phase: *The resistance period*, it is the period in which the organism is subject to a long period of solicitation from

the stressful factors, period marked by alert and continuous tension.

The third phase: *The exhaustion phase*, in which the organism has no more resources and it is chronic tired, reacts harder and harder to the stimulations and can no longer adapt to the situation made by the stressful factors, stage in which depression and functional affections set in. Exhaustion and the lack of reactivity is incompatible with survival. The failure of the adjustment mechanisms that prevent the stressful factors to induce functional, metabolic or psichical affections is called deatonelement (*decompensation*).

7. Basic Human Error Forms And Communications Under Stress

Decision Errors. This is one of the more common error forms. Here the conscious, goal -intended behaviour proceeds as intended, yet the plan proves inadequate or inappropriate for the situation. Often referred to as “honest mistakes”, these unsafe acts represent the actions or inactions of individuals whose heart is in the right place, but they either did not have the appropriate knowledge available or just simply chose poorly. Regardless of the outcome, the individual made a conscious decision. Decision errors come in many forms, and occur for a variety of reasons. However, they typically represent poor decisions, improper procedural execution, or the misinterpretation or misuse of relevant information.

Skill-based Errors. Skill-based behaviour is best described as those basic operating skills that occur with little or no significant conscious thought. The difficulty with these seemingly automatic behaviours is that they are particularly vulnerable to failures of attention and / or memory. In fact, attention failures have been linked to many skill-based errors

such as the breakdown in visual scan patterns, task fixation, the inadvertent activation / deactivation of controls, among others. For example, have you ever locked yourself out of your car or missed your exit because you were either distracted, in a hurry, or daydreaming? This is an example of an attention failure that can occur during highly “automatic” behaviour. In contrast to attention failures, memory failures often appear as omitted items in a checklist, omitting a step in a procedure, or forgotten intentions. For example, most of us have experienced going to the refrigerator only to forget what we came for. Likewise, it’s not difficult to imagine that in emergency situations, when under stress, steps in bold-face emergency procedures or radio calls can be missed. The bottom line is that skill-based errors are unintended behaviours. That is, individuals typically do not choose to limit their scan patterns, forget a procedure, or fly poorly – it just happens, unbeknownst to the individual.

Perceptual Errors. Not surprisingly, when your perception of the world is different than reality, errors can, and often do, occur. Typically, perceptual errors occur when sensory input is degraded or ‘unusual’, as is the case when visual illusions or spatial disorientation occurs. Visual illusions occur when the brain tries to ‘fill in the gaps’ with what it feels belongs in a visually impoverished environment, like that seen at night or in the weather. Likewise, spatial disorientation occurs when the vestibular system cannot resolve your orientation in space and therefore makes a “best guess”. For example, while flying at night, visual (horizon) cues are generally absent. In this case, the individual is left to make a decision based on faulty, mis-perceived or absent information, often leading to an error, and in some cases, an accident.

8. Case study

The loss of the “Green Lily” in 1997 is used as a case study to highlight the characteristics of escalating crises. As in similar safety critical industries, these situations are unpredictable events that may require co-ordinated but flexible and creative responses from individuals and teams working in stressful conditions.

On 18th November 1997, the 3,624 grt Bahamian registered vessel “Green Lily” sailed from Lerwick in the Shetland Islands with a cargo of frozen fish for the Ivory Coast. The weather on departure was bad with wind speeds increasing to severe gale force 9. The following morning, a sea water supply line fractured in the engine room.

The engineers controlled the flooding and pumping out had begun when the main engine stopped. Unsuccessful attempts were made to restart the engine while the vessel drifted northwards towards Bressay.

Attempts were made by two of the tugs to secure a line and tow the “Green Lily” away from land but although initially successful, each line parted. The starboard anchor was released and the third tug attempted to snag the cable and pull her head to wind, but the cable parted. At this time, the lifeboat rescued five crewmen, including two injured, from the ship’s deck. The ten remaining crew members were rescued by the Coastguard helicopter but the winchman, who had remained on the deck of the ship, was swept into the sea and lost. The “Green Lily” went aground and started to break up. The investigation by the Marine Accident Investigation Branch (MAIB), published in June 1999, advised the cause of the grounding was: *“the lack of propulsion and failure to restart the main engine to arrest the drift of the vessel towards the shore in the prevailing environmental conditions. Contributory causes included flooding of*

the engine room, failure to reset the mechanical over-speed trip, inadequate knowledge of the cooling water system, failure of the towage attempts and inadequate teamwork”.

The causal factors in this case suggest that this tragedy bears all the hallmarks of similar critical incidents across a range of safety critical industries:

- An initial technical failure has precipitated events and has been compounded by a hostile environment and further technical problems and failures. The situation was escalating in severity. An emergency was becoming a crisis, but the actors in this tragedy did not have the benefit of hindsight to read the script.
- The available emergency plans, which tend to be procedures based on single failures, were not applicable. The individuals involved were forced to fall back on their experience to cope with an increasingly complex and unpredictable set of circumstances.
- Initial diagnosis of the technical failure was incorrect and led to a faulty but persistent mental model of the situation. In this case, the chief and second engineers, together with the electrical engineer, failed to understand why the main engine stopped and were consequently unable to restart it. They believed that the main engine failure was due to the effect of the flooding, previously caused by the fracture of the sea suction pipe. The probable reason for the main engine stoppage was actually due to the mechanical over-speed trip either not being reset or reset incorrectly.
- Awareness of the overall situation by individuals was based on incomplete or inaccurate information. In this

case, both the Master, based on his calculation of drift, and the engineers were over optimistic in their belief that a tow would be available before the ship ran aground. Meanwhile, the skippers of the rescue craft had unexpressed reservations about various aspects of the operation including the appropriateness of some of the towing gear, the weather conditions and sea room, and the ability of the ship's crew to handle the towlines.

- Individuals and units were separated physically and several agencies were interacting through various forms of communication. In these circumstances, it was very difficult for the key players to communicate meaningfully and maintain a shared and agreed awareness of the rapidly changing situation.

9. Decision Making Under Stress

Modern concepts for understanding decision-making have progressed from classic rational choice models to ones that try to reflect the way decisions are actually made in the real world. The most influential of these models is called the naturalistic decision-making (NDM) model and has been defined as follows:

“The study of NDM asks how experienced people, working as individuals or groups in dynamic, uncertain, and often fast-paced environments, identify and assess their situation, make decisions and take actions whose consequences are meaningful to them and the larger organisation in which they operate.”

These characteristics suggest that NDM is an appropriate model for the understanding of decision making under stress in escalating marine emergencies. These characteristics are:

- The situations in which decisions are made are uncertain, unpredictable and dangerous.
- Knowledge of the situation is incomplete, and constantly changing.
- The consequences of decisions and actions based on poor situational awareness are potentially catastrophic.
- Experienced people, not novices, generally conduct decision making in such situations.

10. Conclusions

The characteristics of crisis situations in which decisions have to be made under stress by often experienced individuals are uncertainty, unpredictability and danger. Situational awareness is incomplete, and constantly changing. However, the consequences of decisions and actions based on poor situational awareness are potentially catastrophic. The key skills therefore of successful crisis management are situation awareness and decision making.

Training in crisis management is likely to require a much more demanding approach to practise the skills required in these situations than procedurally based emergency training .

The direct training of crisis management skills is based on the belief that by exposing individuals or teams to a variety of simulated crisis scenarios, their mental models of situations will be enriched, thus enhancing their situational awareness techniques and their repertoires of decision making. The key to this approach is in the “richness” of the mental models developed by the individual or team.

The results of a survey of marine and other experts in simulator training suggest that a variety of simulation based options have different strengths and weaknesses

for crisis management training. The most cost-effective training option, therefore, is likely to be determined by a number of factors. However, at present, the only really viable option for the assessment of competence, for marine certification purposes, is in the use of full mission simulation.

A comparison of assessment methods used in other safety critical organisations reveals that the assessment of competence in crisis management is largely open to subjective interpretation, even where criteria exist. This situation is moderated, in some cases such as the military, by the number of assessors used. Another interesting difference between civilian and military practice is that the military are often assessing the competence of the team whereas, certainly in the maritime context, it is the performance of the individual within the team that is of primary concern for the purposes of certification.

In other words, stress is a dynamic process involving both the individual and the environment. The environment provides the initial stimulus, but the key determinants of stress are the way the individual perceives the environment and the coping resources selected to face it.

Communicating under stress is always pointed towards change, because the change generates stress.

Research into the nature and consequences of acute stress on the communicative and overall performance and well-being of emergency managers is sparse. We have identified several potential stressors for those fulfilling disaster management roles and discussed how planning, communication and co-ordination, team development and management, training, and decision-making systems and capabilities can be developed and/or implemented to reduce stress and promote effective response management.

Nonetheless, there remains a clear need for more systematic research into response management stress in those individuals likely to fulfill incident command and emergency management roles during and/or after disaster.

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