Building "Error Tolerance" into the Marine Industry

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1. Introduction

Increasingly over recent years, a growing number of organisations, particularly those operating within complex industries, have been turning toward civil aviation for assistance in establishing modern, effective safety strategies. The reason for this is well known, namely, that since the early 1960s, the world of commercial aviation has invested heavily in safety management and associated training programmes and is proud to admit that the results are now testimony to the return on that investment.

However, it was not always this way and we have had our share of "wrong turnings" and failures along the way. The main benefit, though, from these negative experiences is that we have learned from our past mistakes and turned them into positive success stories.

In our world, the 1960s witnessed the introduction of the jet age, which brought new technologies and demanded new flying skills from our aircrews. It also brought the beginning of the recording devices that have now become synonymous with flight safety. With the invention of the first Flight Data Recorder (FDR) in 1957 by the Australian, Dr. David Warren, followed a few years later by the Cockpit Voice Recorder (CVR)[1], we now had the means of recording, at least then in a rudimentary fashion, some of the aircraft's behaviour and a little of that of the crew. Ten years later, two airlines[2] started to analyse sporadically some of this data to ascertain how their aircraft were indeed being operated away from base. With time and with the advent of the digital age, these devices became much more sophisticated and progressed from measuring tens of parameters per minute to over 1500 per second. The analysis of the acquired data also matched the sophistication but we were, on the whole, only measuring technical performance and the crews' technical skills.

Then on a Sunday afternoon in March 1977, in Tenerife, our worst nightmare became reality when two Boeing 747s collided on ground in poor visibility caused by cloud rolling in off the Atlantic and shrouding this high altitude airfield. That afternoon, our industry killed 583 people – to this day the industry's worst disaster. There were a number of contributory causes to this accident but what broke through the final defence barriers was a misunderstanding in communication (between the air traffic controller and the crew as well as within the crew) exacerbated by a very steep authority gradient on the flight deck of the departing aircraft. The Captain believed that he had received his take-off clearance; the First Officer was of another opinion and attempted to intervene. The Captain, rather than clarify the situation, overruled him, applied take-off thrust and seconds later collided with another 747 that was still taxiing along the runway as part of the taxiway had been closed for repair.

[1] The original predecessors of the VDR
[2] BOAC and Swissair

The realisation hit the industry that we were doing something very wrong and we had no alternative but to change – we had to change the way we were operating aircraft in the then modern environment; we could not tolerate creating such gruesome spectacles for the travelling public. The industry would not survive. We had been warned of such a possibility some years before but we chose to ignore those warnings – to our cost. One immediate consequence was that one of the airlines involved, KLM, launched their "KHUFAC"[3] programme created and led by Dr. Frank Hawkins, then a Human Factors consultant and pilot with the airline. Its emphasis was to be solely on the area of human factors or, otherwise referred to as, "non-technical skills" training.

2. Pro-Active vs. Re-Active Safety Strategies

This was, in essence, the birth of aviation's cockpit resource management (CRM) later to be renamed "Crew Resource Management" as it started to encompass crews and teams outside the cockpit. This philosophy has grown to the point that we are now teaching a "6th generation" format of the original but the initial pioneering work performed by Hawkins among others is as valuable to us today as it was revolutionary then. The training targeted soft skills, interpersonal skills, which, in the average pilot, had not been honed to the levels of his technical skills. Here was the identified weakness in our operating system.

In parallel with this new Human Factors approach to training, data analysis was used to support this, reporting systems were created and introduced; initially these were anonymous only later to evolve into confidential and even, in some companies, open systems. The emphasis was finally shifting from "reactive" safety management to a more "pro-active" approach.

Modern safety management has, at it heart, the anticipation of danger, the awareness of hazards and their identification. By raising the levels of awareness of all members of an organisation's staff to *potential* danger, we establish another line of defence in our system. Our culture begins to change to one that protects an organisation from possible events that have *not yet* happened.

Reactive safety management conversely is the most ineffective and expensive form of safety. With this approach we will never prevent the first accident, at best only the second. This philosophy presupposes that we are prepared to accept the first accident in every category.

A number of shipping companies are integrating human factors training into their crew training curricula but unfortunately too few. P & I Clubs and Classification Societies are together collecting data that indicate that 80-90% of shipping incidents and accidents can be traced to human error or inadequate team performance. Despite these figures, crew training is still heavily weighted towards training and retraining of technical and ship handling skills. The human weaknesses are almost being disregarded, with the result that there are often too few "error tolerant" procedures in place on complex vessels. As with aviation in the 1970s, many of the technical weaknesses in our system were improved with improved technology but it was only when we radically shifted our focus to the

[3] KLM Human Factors Awareness Course

non-technical factors and fully integrated these into our training that we finally laid the foundations for the safety record, which other industries wish to emulate today.

The central point of the "pro-active" safety approach is the installation and effective management of a safety reporting system. Without such a well-functioning system, management is blind as to what is actually happening within its fleet. The crews, those in the front line, are the eyes and ears of the company and it is essential that they are motivated to report all perceived hazards, errors and incidents to the safety officer. We must not omit to mention that these systems are also ideal channels for feeding positive suggestions and good ideas to the policy makers.

In addition to reporting, training is also a major component in ensuring safer operations. For a pro-active system to work effectively, all ranks of a ship's crew ought to be availed of the same training, from the Master through all levels of the officer team. This is essential as the introduction of a reporting system *and* a safety programme (the first is only a component of the second) necessitates the introduction of a totally new operating culture within the whole organisation.

Fear and reluctance normally predominate at the introduction of such a programme. It can be wrongly interpreted as just another means by which management wishes to control or even spy on its employees. Quite the opposite is the case; a reporting system is finally a tool for the staff, a tool by which they can effectively improve their working environment. It focuses on the staff and the programme is driven by the staff. This message is seldom brought across to them strongly enough, however. Only when all are fully integrated into the programme will a "unité de doctrine" stand any chance of being established and, only when that has successfully been achieved, will the system perform as the creators designed it to and the management expects.

Safety management is another form of change management and we all know how we inherently tend to resist change. It is unfamiliar, we fear it, we are suspicious of it and it upsets our comfort zones. This is why it is imperative that safety awareness and non-technical skills training accompany the introduction of safety programmes. Such programmes demand a wholly new set of attitudes, behaviour patterns, methods and styles of communication. This was the experience of the aviation community and it was not easy. Those who needed the training most at the start were exactly those who resisted it the most, walking out of what were then voluntary training courses. However, the critical mass of the change drivers slowly started to prevail and the former detractors realised that, even without openly admitting it, they, too, might have something to benefit from the new culture that was being introduced.

The result in the airline world was a flatter hierarchical structure, more open communication, enhanced team performance and a phenomenal degree of "error tolerance" in the entire system. People create safety, no person or system has an automatic right to it; it has to be earned – every day.

3. The Way towards "Error Tolerant" Marine Operations

Much has been written in more recent times on the Marine industry leaning from aviation. Many of the proponents of safer marine operations concede that the airline industry, though much younger, has overtaken marine.[4]

It is, nevertheless, most important that we take time to recognise the different characteristics of the two complex industries. There are fundamental differences and it is essential that we are aware of these. However, it serves us well to concentrate on the multitude of similarities that exist between the industries and the common denominator is – the human element. We are able to offer considerable support in this area as the increasing complexity of the ship's bridge environment is driving it closer to the aircraft's flight deck and the challenges facing the crews produced by systems automation and integration. The same human weaknesses in the man-machine interface are manifesting themselves.

Aviation is most fortunate in that the vast majority of research carried out into human factors in aviation during the 1970s and 1980s was supported by State Government institutions or universities, which have had generous resources at their disposal. The knowledge gained, though, is not the exclusive property of the aviation world alone and may be shared and profited from by other complex, human controlled industries.

Whereas CRM or non-technical skills training is now mandatory in the airline business throughout most of the world, it is a long way from being so in the world of shipping. This is unfortunate because institutions, as mentioned above, are gathering enough data to prove that the percentage of their incidents resulting from deficiencies in non-technical skills (NTS) is similar to that traditionally in aviation, namely 70-80%.

If we take the view that non-technical skills comprise the glue that holds together the professionals' technical skills, then the standard of NTS takes on a new importance. By improving these skills, by raising them to the level of the technical skills, we are taking a quantum leap towards a pro-active safety management culture and building effective error tolerance into the marine system.

Statistics point to the greatest causes of incidents and accidents being poor communication, loss of situational awareness, poor decision-making, lack of effective leadership, breakdown in team performance and non-adherence to procedures and checklists. Nothing here has anything to do with the individual's ship handling or technical skills training and yet the training programme emphasis remains on these technical skills instead of focusing on these self-evident weaknesses in the operating system.

At some time we have all heard the phrase "fail safe". Simply defined it means that if a component somewhere fails, the system in question (usually a machine or the person operating it) will not come to grief. It is possible to build the same principle into complex environments that are people intensive. The starting point is to identify what is referred to in accident investigation as

[4] "Seaways" April 2009, The Nautical Institute

a "single point of failure". This implies in the complex environment that if the individual perpetrates an error, either of commission or omission, then the whole system becomes endangered and runs the severe risk of failing – and tragically often does. The marine environment if littered with a multitude of these single points of failure and the industry is fully aware of this. The old culture of blame and punishment has failed to shore up the defences. Imagine the consequences if, every time a pilot made a mistake, the result was an accident. You do not have to look far for the answer – just review our pitiful statistics of the 1950s and early 1960s and several recent fatal accidents in Asia.

The more complex the working environment becomes, the greater the demand for team performance. The complex world no longer tolerates "star performers" as they have no place. We have all, as fallible humans, become dependent upon one another. No-one can any longer function as an island, a law unto him/herself. This intensifies the demand for perfecting skills in communication, intervention, leadership, followership, judgement, decision-making, feedback and more. Only by consciously developing new processes and procedures can we effectively reverse the trends in incidents and accidents. Attitudes towards different communication styles, to monitoring the work of colleagues and to intervening in times of uncertainty must change. However, they can only change and bear fruit in a new, open culture where all involved are genuinely encouraged to anticipate an event and not await its arrival. This is known as a "Just Culture"[5] and is a subject for another time. It is essential to investigate all incidents and casualties thoroughly. It is then critical, not only that the findings are published and circulated to all parties but also that any resulting recommendations are acted upon and all possible lessons learned. In the aviation world this is tragically the part of the safety process where our reputation stalls and risks coming unravelled. This is a harsh admission but true. Why? The industry is struggling to survive in its present form and much-needed resources are being diverted elsewhere.

4. Toward a Safer Future

The external market pressures are enormous with the competitive, environmental and, more recently, security demands being placed upon world shipping. However, it is worth considering the short- and long-term perspective. Are all economies and cost-cutting measures truly effective even

[5] (Reason 1997) A "Just Culture" is an atmosphere of trust in which people are encouraged, even rewarded, for providing essential safety-related information but in which they are also clear about where the line must be drawn between acceptable and unacceptable behaviour.
It refers to a way of safety thinking that promotes a questioning attitude, is resistant to complacency, is committed to excellence and fosters both personal accountability and corporate self-regulation in safety matters.
A "Just" safety culture is both attitudinal as well as structural as some personal attitudes and corporate styles can enable or facilitate the unsafe acts and conditions that are the precursors to incidents and accidents.

if the costs of failure are deducted from another account? Has everyone given serious thought to the *uninsured* costs entailed in a marine casualty?

Safety management is a profit centre, not a cost position. It constitutes an investment in future earnings. No-one budgets for an accident, the costs of each tragedy are met out of net profit. Safety management is wealth protection.

The cost of these accidents is increasing. The focus of the media is turning away from the traditionally sensational aviation accident (there are not enough of them) to another area that stirs public opinion sooner or later and carries with it equal quantities of emotion as does an air disaster – the environment. Where the media leads, litigation is not far behind. Criminalising accidents is a subject all by itself but it is anathema to a healthy safety culture. However, ignoring NTS training may, one day, risk being classified as a breach of duty or even negligence. The world's legal systems were designed to deter wrongdoing not to deter human error and accidents. However, recent high profile cases[6] are proving to us all that the thirst for "justice" and blame is smudging these divisions to the detriment of safety in all complex industries.

Pro-active thinking and the heightened need for "error tolerance" in every aspect of the mindset of the shipping industry are the keys to protecting its resources and its future image. The perception of the public is predominantly subjective and highly emotional, facts and statistics are seldom given the attention they deserve.

Tenerife forced change upon aviation – we had absolutely no alternative. Change is painful but essential – the professional image of our two industries hangs upon it. We ignore it at our peril but let it not be forgotten, it is easier to change in our own time than to delay and have change imposed through legislation upon us.

[6]viz. The Hebie Spirit in South Korea (2007), the GOL air accident in Brazil (2006), the Tuninter air accident in Italy (2005), the innumerable malpractice suits brought against Health Care professionals worldwide.

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