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Mission success and safety – striking the right balance

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ABSTRACT

For a military commander in the field balancing the requirement of successful mission completion while ensuring maximum safety is a complex task. Therein, arises many questions like: Do the risks outweigh the benefits?; Is a calculated risk benefit approach suitable for a military organisation in war? In today's transparent world there is a need to take cognizance of such aspects while catering for operational necessity. This paper analyses the concept of safety and military missions, by balancing the requirements via the application of available tools, measures, training and judgement like Operational Risk Management (ORM), Efficiency Thoroughness Trade-Off (ETTO), Bold Leadership, Novelty and Innovation, and technology management to name a few.

KEYWORDS

Safety Culture; Hazard; Risk; Leadership; Mission Success; Operational Risk Management (ORM); Efficiency Thoroughness Trade-Off (ETTO)

Introduction

Every organisation exists to fulfil its mission. In doing so, it faces a constant struggle between mission accomplishment and safety of personnel and resources. The expectation is to achieve both mission success and safe operations. In the Navy, we have stringent qualification and readiness standards for jobs at sea which contributes to mission success. At what point, does a commanding officer or mission commander or maintenance officer raise the safety flag and stop operations? Do the risks outweigh the benefits? Is a calculated risk benefit approach suitable for a military organisation in war? The answer is vexed as the military is indeed sworn to defend the nation at all cost.

This paper examines the challenge faced by every commander in the military in fulfilling his mission while balancing the need for safety. Initially the paper will discuss the concept of safety in the context of hazards, risks and failures along with the causes of failures. Next the paper will examine aspects that contribute to mission success in a military organisation. It will then highlight the uniqueness and peculiarities of a military organisation including the peacetime challenges in training and operational activities focused on preparing for war. Thereafter it posits measures to balance the conflicting requirements that are faced by military organisations in the quest for mission success. The paper will conclude that achieving mission success with due safety is contingent on harnessing a large number of factors. While failures are inevitable, in the military we cannot do away with the need for boldness while pursuing the mission.

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Concept of safety

Safety

'Safety' is a form of practice that helps reduce or eliminate the likelihood of hazardous events occurring[1] and has to be understood in relation to the presence of some hazard or risk.[2] Meanings of risk, safety and failures are social constructs that vary from organisation to organisation. The concept of safety refers to a situation where the statistical risk is deemed to be Acceptably Low or as Low as Reasonably Practicable (ALARP principle). Lack of adequate safety results in loss of life and limb, operational / support assets and collateral damage. In the military, safety is an implicit part of performing missions successfully and is more about safety in action rather than just abstract rules.[3] But there is always a tension between getting the job done and ensuring safety. Perspectives on safety also vary depending on institutional and individual views. Safety is also a relative term, appearing twice in the Chetwode motto[4] and suggests the priority between the nation, one's team and oneself.

Hazard

Originating from a gambling game with cubes called "az zahr" in North Africa, it went across to France and was called Hasard. It then moved across to England around 1500 AD and was spelt Hazard meaning an unlucky throw of the dice.[5] Hazard is any condition with the potential to affect mission accomplishment or cause injury, death or property damage. Hazards are dangers that can be sensed. Hazard identification and hazard analysis form first steps of the safety process. A hazard that is not identified cannot be controlled. Nearly all hazardous operations involve taking actions that lie outside the prescribed boundaries, yet remain within the limits of what would be judged as acceptable practice by people sharing comparable skills, as has been brought out by J Reason.[6]

Risk

"Risk" is the possibility or likelihood of danger, injury, loss, etc.,[7] and, unlike a hazard, it cannot be seen, heard or felt. It is the chance of an error causing you harm, where chance is an un-designed occurrence. But we need to embrace risk before we can conceive of safety.[8] In earlier days, risk was due to lack of knowledge, but many new risks we see today are due to the abundance of knowledge we possess and use to effect improvements to everything including the environment.[9] To manage risk, we undertake "risk assessment", which is nothing but a careful examination of what would cause harm so that the question of whether adequate precautions have been taken can be considered.[10] Risk management aims at defining and predicting limits, procedures or bounds, on the probability of future injury, loss or damage, based on our knowledge of the related outcomes of previous human activities.[11] While we feel that a system can be made safer by reducing risk, the Theory of Risk Homeostatis by Gerald Wilde states that measures that appear to make a system or organisation safer, do not do so, because human beings have a seemingly fundamental tendency to compensate for lower risks in one area by taking greater risks in another.[12] Aboard ships, we see that while the advent of electronic chart display systems have reduced the risk of

navigational errors, we often compensate it by reducing the margin of safety or choosing to handle the ship at higher speeds.

Damocles enjoyed the luxury of a banquet but with a sword over his head tied to the ceiling with a single hair from horse's tail that eventually breaks, and he gets struck down by the sword.[13] Danger is often silent, inexorable and discontinuous, striking abruptly after long periods of quiet, perhaps at the very moment that one has gotten used to it and forgotten its existence. What matters is the strength of the string, which is an identifiable and measurable vulnerability.[14] One needs to identify the danger and assess the risk. By its tasking, the military is more risk conscious than other professions. But, the challenge, as articulated by Donald Rumsfeld, is posed by the "unknown unknown", as against the "known unknown". As we learn with experience, the risk is reduced, and hence, an effective safety culture requires a good learning environment.[15]

Failure

Failure is an unintentional deviation from an expected outcome. It is a word that covers accidents, errors, incidents, mistakes, operational upsets, flaws, etc., and translates across languages, cultures and professions.[16] Failure occurs all the time, but we notice it only when it is large enough. An average skilled worker commits 5–7 errors/hour while an average knowledge worker commits 15–20 errors/hour.[17] While nature uses small errors to effect genetic variations, humans do not like errors. Hence, when we rely on human judgement, our avoidance of small errors makes the large ones more severe.[18] While in the case of causal analysis, Root Cause Analysis theory is a good tool for understanding failures of machines, this turns out to be unsuitable for the understanding of human failures, as the latter involves complex relationships between people and processes, people and technology, people and machines, people and their environment, and, people and other people. Failures that occur in complex socio–technical systems such as warships, space shuttles, nuclear power plants, etc., cannot be just attributed to the operator most proximate to the event but demand analysis of aspects contributed by those who control resources and impose constraints.

Causes of failures

Failures have happened over the ages and the broad causes remain the same over time. The Vasa, a Royal Swedish warship and state-of-the-art vessel of its time, set sail on its maiden voyage, on 10 Aug 1628. After sailing about 1300 m, a light gust of wind caused the Vasa to keel over on its side, causing the loss of 53 lives. Key causes for the failure were the pressure of maintaining the vessel's schedule, several changes to the operational characteristics as directed by King Gustavus, inadequate technical specifications, excessive innovation, an incremental "creep" in the technical requirements, lack of scientific methods, ignoring the obvious, and, possible mendacity.[19] We find much in common with the factors involved in failures today – deficiency in design and construction, deferred maintenance schedules, economic pressure, schedule constraints, training deficiency, not following procedures, inadequate planning and preparation, poor communication, arrogance and stifling political agendas. Hi-tech failures may not have obvious causes as they could be

inherent in the complexity of the technological system itself. A study on the Challenger failure concluded that a series of seemingly harmless decisions incrementally moved the space agency towards failure as minor events unexpectedly interacted to create a major problem.[20] Failures such as the ones that afflicted the Challenger remind us that we have constructed a world in which the potential for hi-tech catastrophe is embedded in the fabric of day-to-day life.

Mission-success requirements

"Mission" or "purpose" is a succinct description of what an organisation does, brings out its core activity and defines why it exists. The mission of a military is to train, equip and maintain forces in order to deter aggression and win wars. Towards this end, the military performs a number of activities in environments that may be broadly classified as wartime, less-than-war operations, and, peacetime. All military activities are team efforts. Ingredients for success consist of professionalism, training, experience, competence, doctrine, standard operating procedures, technology and luck / chance, made to come together by a well-motivated and cohesive team, often under inspired leadership.

Professionalism has four major elements: selflessness, skill, trustworthiness and discipline, all of which are well understood and need no elaboration. However, discipline is more difficult to achieve than the other three, since we are inconsistent creatures by nature, wired more for novelty and excitement, and not so much for attention to detail. While there is considerable emphasis on discipline in the military, it is something that militaries have to work hard at constantly, in order to meet with success in our endeavours.[21]

No plan or standard operating procedure can fully describe an activity to the desired level of accuracy as it is imagined to be done. The perfect way of working assumes perfect ships / equipment, perfect crew, perfect tools, perfect weather, perfect knowledge and perfect processes.[22] As this is never the case, practitioners arrive at their own way of undertaking an activity to achieve mission success, which will often be well below the threshold level of the ideal way but above the safety threshold level. This gap is where we get safety inputs on the organisation. Whenever the work falls below the safety threshold, failures occur.[23] This is a challenge that is faced by the military on a daily basis, in every activity it undertakes.

In contemporary times, training in most disciplines is longer and more intense than ever. Cutting edge technology is used by highly trained, highly skilled and hardworking military personnel to accomplish extraordinary things. Yet failures still occur, especially because the volume and complexity of what we know has far exceeded our individual ability to exploit it safely. Knowledge has both helped and constrained us.[24]

On 02 August, 216 BCE, the two largest armies in the world stood face to face on an open plain on Italy's east coast. The Romans, under the hot headed General Varro, held the better position with 80,000 armed men. Opposing them were 49,000 Carthaginian soldiers, led by Hannibal. Through maneuvers designed to embarrass his rival, Hannibal exploited the common human errors of ego and anger to ensure that the Roman leadership made a series of poor decisions, drawing the entire Roman centre into an unwise advance, and annihilated them, thus defeating a superior force on unfavourable terrain.[25] Thus, inspired leadership can sculpt success against tremendous odds.

Uniqueness of military missions

The essential basis of military life is the ordered application of force under conditions of unlimited liability, and it is this unlimited liability that sets the military apart from all other professions.[26] Daunting tasks and insurmountable odds are commonly faced and, for this, a "can-do" attitude is essential. Danger is the accepted normal, with the ethos being an avowed intent to go in harm's way. Then there is the matter of making the supreme sacrifice for the larger interests of the nation. Actions at Thermopylae, Imphal, Rezang La, Longewal, Basantar, Kargil, etc., are well documented instances of unqualified valour and sacrifice. The hardships, isolation and environmental challenges faced in the military are also unparalleled. In this regard, men at sea are isolated from the norms and functioning of land-based society. It is akin to being in a prison, with communal activities predominating and life itself being characterised by a suspension of the divisions between different spheres, as they eat, sleep, work and socialise with the same people for long stretches of time. Despite advances in communication technology, there is still a high degree of isolation from family, friends and the rhythm of ordinary life. Accordingly, to be a seaman means being a part of an alternative society and has no counterpart elsewhere.[27]

Military organisations are complex socio-technical systems with much higher levels of complexity and coupling today than before. Lorenz's "Butterfly in India Paradigm" says that a small input in a complex system can lead to non-random large results, depending on very special circumstances.[28] Such complex systems introduce a managerial dilemma since combat requires decentralisation to capitalise on transient opportunities and at the same time it also requires centralisation to prevent units from firing on one another. Charles Perrow states that deadly accidents are a normal consequence of such contradictory imperatives.[29] War is inherently complex, dynamic, fluid and characterised by fog, friction, uncertainty and chaos.[30] Friction arises not just from the enemy's efforts to frustrate one's plans but also from the gap between the theoretical knowledge of war and practical experience that cannot be fully gained from military exercises alone. When a system becomes highly complex, like the US war machine, it becomes even more sensitive to chaotic situations and more susceptible to losing control of operations, as was seen in the Vietnam War.[31]

Cognitive studies show that humans have limitations as information processors such that even a commander at the lowest tactical level cannot manage all the information necessary in combat.[32] While the IT revolution has, indeed, occurred, the average human brain has not evolved to handle it, resulting in the "toxicity of information". Heuristics techniques, like similarity matching and frequency gambling,[33] help overcome this to an extent. However, these result in people thinking that they have a better picture of reality than they actually do.[34] Situational awareness is of vital importance in military activities and demands considerable cognitive effort involving control of attention, mental simulation, forming expectancies and contingency planning.

While the logic of calculated risk-taking is to be factored, there is a need for boldness in most military operations. The need to "push the envelope" is particularly applicable in military operations where one seeks to acquire and sustain a "combat edge" over one's opponent. A decision to launch an air strike from an aircraft carrier under marginal weather conditions could prove crucial in deciding the outcome. Thus, actions that are not tolerable in peace become acceptable in war. The distinguishing feature of decision-

making in combat, unlike that in other situations, is that the consequences of all options centrally involve risk of life.[35] So long as novel and chaotic situations arise, there will be need for bold, innovative decision making and leadership at every level, as we cannot apply the logic of calculated risk in ill-defined situations.[36] Israel could sustain its capability in the Six Day War due to the ability of its combat commanders to initiate bold activities capable of bridging the gaps between their plans and the realities of war.[37]

Fratricide is another challenge that is unique to the military. It is complex, multi-causal, and is the result of problems at various levels. Some important causal factors are inadequate communication, coordination, cooperation, schema and situational awareness.[38] Mutual interference between Black Hawk helicopters and F16 fighter aircraft in Iraq, is illuminating.[39] On 15 Apr 1994, in the Tactical Area of Responsibility (TAOR) constructed to provide a secure area for Kurdish refugees as part of Operation PROVIDE COMFORT, in Iraq, which included a "No Fly Zone" for Iraqi aircraft, two US Army Black Hawk helicopters were shot down by two US F15 aircraft, killing all 26 personnel on board, after the fighter aircraft mistakenly identified them as "Hind" enemy helicopters. The incident occurred despite both sets of pilots being controlled by an AWACs team. The F15 pilots had no knowledge of presence of the Black Hawks/ the AWACS team did not advise the F15 pilots. The Black Hawks used an incorrect radio frequency and IFF-response code. The F15 pilots made an incorrect visual identification due inadequate training in visual recognition, exacerbated by the fact that additional fuel tanks that had been fitted to the Black Hawk helicopters led to a change in their normal appearance.[40] The CTF HQ did not give clear guidance on supporting helicopter missions, and to top it off, there was insufficient training on the Rules of Engagement.[41] All these factors came together and resulted in the failure.

Unlike other organisations, a military also faces unique challenges in peacetime. Training and preparation for war remains the most important peacetime activity of the military. Ideally, every activity performed in peacetime has a war time utility. Training is intended to attain requisite skills to enable a combatant to perform his role with safety and success. For consolidation of skills, repetitiveness is also essential. Combat simulation is attempted in order to provide as much realistic training and experience as possible. Thus, the military needs to train-for and perform activities that are not undertaken in any other organisation. Further, these need to be repeated regularly, in order to achieve high levels of competency and experience. Experience comes handy when a military person comes under stress in combat or operational activities. As stress suppresses out his short-term memory, an experienced person tends not to panic because he still retains a residue of experience to draw upon.[42] The above rationale and the need for repeatedly pursuing peacetime activities that involve high levels of risk are seldom understood in the face of budget cuts and very limited tolerance for failures.

Balancing the requirements

We need to remember that public organisations such as the military cannot afford to prioritise safety over all other values and must serve multiple, mutually contradicting values, some of which have been brought out in the previous section of this paper.[43] A mission commander, while undertaking a combat appreciation to decide the best course of action, takes into account force-protection aspects, in order to ensure the safety of

his men and assets. But issues surrounding military safety are complex and cannot be reduced to a few principles.[44] While it is recognised that the risk of physical harm and its occasional failure is inevitable in military work, we see an increasing propensity towards accountability as in civilian organisations, while managing risk, safety and failures.[45] Hence, there is a need to balance the requirements to the extent feasible through the application of a host of tools, measures, training and judgement, as elaborated below.

Operational risk management (ORM)

ORM is a useful tool to help guide our decisions and is used by many modern military organisations. It is a five-step process, consisting of hazard identification, hazard assessment in terms of its severity and probability, risk decision-making, the implementation of controls, and, supervision / review of the effectiveness of risk-controls throughout the mission.[46] Incorporating the basics of ORM as an integral part of training, could be a useful first step. ORM could (and should) be made part of every activity and mission, so as to enable its accomplishment with due regard to safety.

Efficiency thoroughness trade-off (ETTO)

The ETTO[47] Principle states that there is always a trade-off between efficiency and thoroughness, which results in our being efficient, thorough, or lying somewhere in between, but both efficiency and thoroughness can seldom be achieved simultaneously. This is a characteristic of human beings. The organisations they man cannot be made by machines unless it is part of the latter's design or programming.[48] ETTO happens every day, in every activity that humans perform aboard ships or in the field, and as such, this trade-off is inescapable. The need is to be able to identify those critical processes where thoroughness cannot be traded off at all. For example, while efficiency demands timely entering / leaving harbour, the inescapable need is for the ship's team to be thorough in its preparations / checklists.

Checklists and SOPs

In situations of high risk and complexity, humans seek solutions through skill, audacity, courage, wit and improvisation, especially when situations go beyond the scope of checklists and SOPs. The use of checklists and SOPs is but another tool to strengthen institutionalised actions and responses. so as to minimise room for failure. They build on experience, take advantage of the knowledge other people have, and, attempt to make up for inevitable human inadequacies.[49] A well-made checklist or SOP gets routine stuff out of the way and frees the brain to focus on challenging matters.[50] They need frequent refinement, should change with time,[51] and, most importantly, must be used diligently. Much as we need expert audacity, we need to accept the virtues of regimentation.[52] The paradox here is the impossibility of having an SOP or checklist for every conceivable situation and, therefore, the need to encourage initiative at every level. In the Navy, the "Seaman's eye" is honed through experience and skill. That said, SOPs and checklists, especially regular adherence to and respect for the same, certainly help develop this "Seaman's eye". It is this same skill and the "Seaman's eye" that must

be relied upon and used, in order to determine the most appropriate action in conditions or situations where the checklists and SOPs are inadequate and, further, to incorporate changes and improvements in the same.

Bold leadership

In the words of John Kotter, it takes 10 to 20 years to develop a leader. The military needs to develop bold leaders at all levels who will not only do their best to accomplish the mission, but are also empowered to ensure performance is linked to safety standards and have the courage to make the tough call when required.[53] To make a decision, one needs to focus on consequences (which one knows) rather than on probability (which one cannot know).[54] For a leader, understanding how to act under conditions of incomplete information is the highest and most urgent pursuit.[55] Today, technology allows the constant supervision of a lower commander's actions and the immediate provision of orders derived by the logic of calculated risk-taking. The temptation to impose headquarters solutions through a 1000-mile long screwdriver, without being actually "on-the-scene", needs to be avoided, as it curbs the initiative of the tactical commander.[56] In many combat operations, the balance between success and failure is so close that boldness can and often does make the difference.[57] Unless proactive measures are taken to ensure balance, calculated risk-taking can effectively suppress boldness[58] and could result in our not seizing the initiative when the window of opportunity is open, howsoever fleetingly. Political scientist Ivan Arreguin Toft studied all wars over last 200 years between very large and very small countries and concluded that despite a 10:1 disadvantage, about 30% of the time the smaller (and apparently weaker) country won. When the apparently weak side resorted to unconventional tactics, the weaker country won 63.6% of the time.[59] In large measure, this can be attributed to the larger force getting bogged down by its larger organisation and consequent stereotyped approach, shunning risk. The smaller force, on the other hand, out of necessity for survival, is more open and responsive to taking risks for higher gains. In essence, bold leadership is more likely to happen where agility and flexibility is inherent or ingrained. Heroism on the battlefield requires experience and judgement, which in turn allow the commander to choose and implement new courses of action amidst confusion and disorder, even when it requires violating orders, drills and expectations. Accepting the inevitability of chaos is essential to encourage boldness, which manifests as the willingness to take initiative, deviate from rules, challenge high risks, and take responsibility for one's actions.[60] It is illustrative that the mariner's "Rules of the Road" emphasises that Masters are expected to act in departure to the rules themselves, if necessitated by the situation, and may be held accountable for a failure to do so.[61]

Experience and redundancy

Earlier, privilege came with command-obligations to physically lead one's troops upon the battlefield. Thus, Ceasar, Livy, Hannibal, Alexander, all went on to the battlefield. The need to have "skin in the game" by being in the field or at sea gets overlooked often and often needs to be re-emphasised.[62] It is also necessary to have redundancy, a reasonable margin of safety and avoid "over-optimisation" as a strategy to mitigate risk.[63] Success

in risky military operations demands having the minimum inescapable means with just the required redundancy. Excess redundancy creates more complexity, more need for coordination, less flexibility and more dependence upon the exact execution of the original plan. When chaotic situations arise, these factors will hamper attempts to shift from the plan, as was seen in the Iran hostage rescue mission.[64]

Novelty and innovation

Experienced soldiers know the important role that small, uninstitutionalised novelty has played in their survival and ability to perform battlefield duties, particularly when confusion and disorder are overwhelming.[65] Most "novelty" originates from lower levels of the organisation. The German Army's mission-oriented command and control (Auftragstaktik) had much more room for novelty and initiative than in the British system.[66] In the words of George Bernard Shaw, "the reasonable man adapts himself to the world; the unreasonable one persists in trying to adapt the world to himself. Therefore, all progress depends on the unreasonable man".[67] To succeed in combat one needs to encourage an adequate share of "unreasonable" men. It is only the maverick that finds new paths. In so doing, mavericks tend to get lost or hurt, and hence, there is need for an institutionalised approach to nurturing mavericks, even as the bulk of the team moves along clear, established paths.

Managing technology

There is no doubt that militaries need cutting-edge technology as this increases their combat capabilities. However, increased sophistication of military technology also generates the threat of exerting an overall pressure towards greater remote control. Indeed, there is much that technology cannot do and, in many ways, technology has complicated matters. It has added yet another element of complexity to the systems that militaries depend upon and has created entirely new kinds of failures that must be contended with.[68] Failures from apparent human error need to be seen as the effect of system vulnerabilities, often lying deep inside the organisation. Only by constantly seeking out its vulnerabilities can an organisation enhance safety.[69] Warren Buffett says that he tries to invest in businesses that are so wonderful that an idiot can run them, because, sooner or later, one will.[70] This has much relevance to the military. Every effort must, therefore, be made to make critical systems idiot-proof, by design.

Human bias

There are some human biases that need to be identified and guarded against. The fundamental attribution error overestimates the contribution of an operator's basic traits and underestimates the contribution of context and situational factors in an activity.[71] Humans also have a mental "hang-up" about failures, with the loss-aversion ratio being between 1: 1.5 and 2.5.[72] In other words, humans tend to feel loss up to 2.5 times more than an equivalent gain. Further, our knowledge of outcome (hindsight) biases our judgment about processes. This manifests in the fact that we judge personnel at the lower level by both process and results, while personnel at higher management and

leadership levels are judged only on results.[73] It is worth remembering that epic heroes were judged by their actions and not by the results. Militaries would do well to emphasise "processes" at higher levels as well, in order to reduce failures. Human thinking is largely linear, and humans find it difficult to comprehend non-linear processes that characterise complex military systems. Edward Lorenz found that "while not all non-linear systems are chaotic, all chaotic systems are non-linear".[74] It must be kept in mind that no matter how sophisticated one's choices or how good one is at dominating the odds, randomness may still have the last word.[75] At the same time, many a fleeting opportunity lies in such randomness. It is important that both, leadership and organisations, are geared to discern and act in a manner that maximises opportunity and minimises risk, in the event of randomness emerging within one's own force or environment or adversary.

Safety culture

Militaries need to develop a vibrant safety culture without becoming timid. According to Peter Drucker, world-class safety-organisations seek "shared ownership by all" instead of "forced accountability by a few".[76] Highly reliable organisations aggressively seek to know what they don't know and believe that "what gets measured gets managed". Since most people do what is rewarded, rewarding the unsafe and not recognising the safe leads inevitably to unsafe behaviour and failures. If reliability and safety are critical, they have to be measured, incentivised and rewarded,[77] for which a military must implement a reward and incentive system that recognises the cost of failures as well as benefits of reliability.

Circle of competence

Charlie Munger wrote of the need to operate within one's circle of competence, failing which one is bound to lose. It does not matter how big the circle is, but it is important to know where the perimeter lies.[78] Within this circle one can apply heuristics, think fast, decide quickly and succeed. But outside this circle one needs to think slowly, reason, deliberate and tread carefully, while deciding a course of action.

Organisational learning culture

Militaries need to encourage a culture of learning as opposed to a culture of denial. Study of the universal learning curve indicates that after long periods, as learning tapers off, a failure will occur, which will trigger fresh learning / improvements.[79] This has been my own experience as a practitioner who has pushed the envelope to meet both success and failure. It is essential that we are seized of our preparedness, anticipate risks, observe how close we are operating to the margins of safety and retain flexibility in adapting to disruptions. There is much more to be learned from everyday successful activities than from the few serious failures. We need to study successful outcomes more carefully as it is much easier to get adequate details for analysis. People also tend to be more amenable to discussing successful outcomes, which could lead to learning and corrective actions that could prevent a future failure.

Via negativa to success

The Pope asked Michaelangelo, "Tell me the secret of your genius. How have you created the statue of David, the masterpiece of all masterpieces?" Michaelangelo answered, "It is simple. I removed everything that was not David".[80] Negative knowledge (knowing what not to do) is often more potent than positive knowledge (knowing what to do).[81] Theologians used this fact to describe God by explaining what God is not. While it is difficult to state what brings success, it is easier and more robust to identify what prevents success. It is much more prudent to avoid difficult problems than learning to solve them. Thus, we could be more rigorous in identifying and addressing aspects that contribute to mission failure.

Precursors to failure

By looking out for precursors, we could reduce failures. We need to look for high-consequence activity and small signals that indicate systemic weaknesses within the normal work process.[82] Error-provoking system-steps must be identified early.[83] Inadequate communication remains a key contributory factor to failure. It is important to listen to team members in the field. There is a need to constantly communicate the big picture of what the organisation seeks to do and try to get everyone to communicate with each other about how they fit in. Instead of assuming that everyone in the organisation would be aware of the organisation's identity and purpose, we must regularly communicate what the organisation is all about, why it does what it does, and what everyone should be looking out for and worrying about as they perform their tasks.[84] The mission leader needs to ask himself what keeps him awake at night, and then identify the longer term solutions and short term risk mitigation measures.

Despite all this, Black Swan events in the domain of "unknown unknowns" will occur once in a while in our profession. We should not unduly worry about this, but prepare well to reduce its impact. Henry Petroski asserts that failures are vital for us to improve as lack of failures leads to complacency.[85] However, we must keep in mind that a mere absence of failure does not, in and of itself translate into success. By adopting risk-management tools, encouraging organisational learning and innovation, developing a vibrant safety culture from the bottom up, managing technology, looking out for failure precursors, being aware of our biases and limitations as humans, and operating within our circle of competence under bold leadership, we should be able to strike the right balance between mission success and safety.

Conclusion

To conclude, safety is not the mission of the military, but a process that contributes to mission success through conservation of personnel, resources and assets. The words of Admiral Chester W Nimitz are poignant: 'to insure safety at sea, the best that science can devise and naval organisation can provide must be regarded only as an aid, and never as a substitute for good seamanship, self-reliance and sense of ultimate responsibility which are the first requisites in a seaman and naval officer'.[86] As an organisation, we must help the man at sea to succeed. Every effort must be made in terms of technical, logistics, administration, operations and procedures, to help him fight, survive and win. Each of us

ashore have to ask ourselves what it is that we are contributing to help the man at sea succeed in his mission to deliver ordnance on target. If we do not get a satisfactory answer, then we need to rework every aspect of the organisation's functioning and at every level. Systems will fail, as there are always contributory causal factors present in complex socio-technical systems. Yet, failures must not deter us from the boldness of action needed for mission success, as we balance the needs of safety through a combination of leadership, organisational, technological and procedural initiatives.

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