# POINTER

Journal of the
Singapore Armed Forces

Vol. 30 No. 4 [2004]

# V30N4

**EDITORIAL**

In this issue, we present a brand new section of technical features under TECH EDGE. With a growing number of SAF officers on specialist postgraduate programs, there has been an increase in the number of high quality research papers which reflects the technological and scientific depth and innovativeness of our officers. TECH EDGE hopes to provide an avenue to showcase the best of these technology papers that are written exclusively by SAF officers. Many of these research papers are also presented at international conferences that require stringent peer reviews. A glowing example is this issue's TECH EDGE inaugural article, written by MAJ Chia Chien Wei whose research on low cost virtual cockpits for air combat experimentation, not only received favourable review at the Interservice/Industry Training Simulation and Education Conference (I/ITSEC) 2004, Orlando, USA, but also adopted by the SAF Centre for Military Experimentation.

In this issue, we are also privileged to have E.C. Aldridge and Norman R. Augustine share with us their insights into some of the broader issues implicit in systems engineering. The authors draw on examples and lessons from past systems failures to present the different dimensions and possible pitfalls to avoid in systems design and analysis. The article also addresses how systems engineers can be educated and trained to prepare them in meeting modern challenges that demand a significant expansion of traditional engineering thought.

Other articles in this issue dwell on a systematic approach to various aspects of military leadership. In their article, COL Ong Yu Lin and LTC Lim Beng Chong provide a possible framework that systematically guides the process for decision-making in a brigade command team. This framework was rigorously tested in several exercises participated by 3 rd Singapore Infantry Brigade and it drew widespread support and approval among its users. LTC Chan Kim Yin and CPT Psalm Lew, on the other hand present a systems approach to leadership development that builds up a doctrinal framework unique to leadership in the SAF.

Given the recent focus on humanitarian relief efforts, it is also timely to feature SAF's other nontraditional role of peacekeeping. LTC(Ret) Deep Singh provides an enlightening write-up of the SAF's peacekeeping efforts. Also in this issue is an interesting look at another aspect of humanitarian support; that of the controversial issue of humanitarian intervention. LTC Soh Star's article argues a convincing case for humanitarian intervention as a moral cause worthy of pursuit despite its imperfections and obstacles in implementation.

This year is also the 60 th year of the end of World War II. To commemorate this significant milestone, POINTER is profiling some of the great commanders who were involved in this historic event. Commencing from this issue, we will compare and contrast two renowned commanders from the four major theatres of World War II: Africa , Western Front, Russian Front and Asia . For this issue, the featured personalities from the North African Campaign are Field-Marshal Erwin Johannes Eugen Rommel (1891 - 1944) and Field-Marshal Viscount Bernard Law Montgomery (1887 - 1976).

Last but least, we are also pleased to receive a Viewpoint on the 3 airpower articles featured in the last issue. MAJ Chris Chan, an Air Force officer raised a pertinent point of political relevance in the application of force, which solicited a response from MAJ Ho Yung Peng, one of the co-authors of "Airpower in Ops Iraqi Freedom".

Editor, POINTER

# It’s a Systems World - After All

by E.C. Aldridge and N.R. Augustine

*“Parts answering parts shall slide into a whole.”*
*--- Alexander Pepe, Epistles to Separate Persons*

A group of horseback riders thunders across the barren slopes of Afghanistan in search of Al Qaeda terrorists. As the riders’ robes blow in the wind and dust, they give all appearances of being part of the Charge of the Light Brigade. However, there is a difference: These are the Special Forces troops who normally make their presence known by parachuting from airplanes. In their packs is a laser range-finder and a GPS receiver to tell them precisely where they are and where any nearby enemy is located. They also carry night vision goggles so they can see in the dark, a small computer that enables them to process prodigious amount of information and a portable link to a communications satellite orbiting far above the earth. Circling overhead is an aircraft carrying over 100 bombs which the horsemen can direct to within a few feet of whatever targets they pinpoint.

In Yemen, a group of terrorists drives a car along a remote road. Unknown to the occupants, a small drone aircraft circles slowly overhead and monitors their every movement with a suite of sensors. Communicating by radio back to a control center, the drone is given the go-ahead to attack. The drone launches a missile which is guided toward the unsuspecting terrorists and flies through the window of the vehicle.

In the recent conflict in Iraq, ground troops moved at remarkable speed, knowing exactly where the enemy compounds were located and avoiding or attacking them at their discretion. The locations of friendly forces were also known, along with their plans and how to coordinate with them to improve combat effectiveness.

These capabilities were all provided by an extraordinary fusion of intelligence, communications, precise navigation, firepower and the training, skills and dedication of the military personnel involved. In fact, a totally new world of combat has been introduced in recent decades through the application of advanced technology. Military forces can see in the dark, process huge amounts of information, know exactly where they are and deliver ordnance within a few feet against targets that are miles away. Further, the pace of military as well as civilian technology shows every sign of accelerating rather than slowing down, with particular emphasis focused on “The Three O’s” nano, bio and info-nanotechnology, biotechnology and infotechnology.

To the component designer, an electronic flight control box is a system. But to an airplane designer, an entire aircraft is the system. Yet, to a transportation designer, an airplane is only one element of a much broader system, one which encompasses railroads, ships, automobiles, buses, trucks, bridges and tunnels, not to mention passengers.

But there is one other ingredient that is belatedly being recognized as critical to bringing into being capabilities such as those described above. It is called systems engineering.

**Systems Engineering Defined**

Before exploring the role of systems engineering, it is useful to define exactly what is meant by a system. For the purposes herein, a system can be thought of as any collection of two or more entities that interact. Thus, a hydrogen atom fits the definition of a system very neatly - but so, too, does the entire universe. Within those bounds would be the example of a military force - a large collection of interdependent entities which encompasses such diverse functions as training, equipping, maintaining, transporting, communicating, fighting, and much, much more.

A not uncommon failing of systems engineers is to overlook one of more key elements that make up the system they are addressing. A humorous but instructive example concerns the bus system which provided service between the towns of Bagnall and Greenfields in the Midlands of England. A problem arose wherein buses were frequently observed speeding past long queues of would-be-passengers while drivers simply waved. Responding to the numerous complaints received, a bus company spokesperson was quoted as saying, “It is impossible for drivers to keep their timetables if they must stop for passengers!”

Alluding to the above definition of a system and borrowing the definition of an “engineer” from a dictionary, a systems engineer becomes one who, through the application of science, mathematics and other fields, combines various entities in a manner useful to people. That is, systems engineering deals with making things work together. It involves the interaction of various elements functioning in harmony to accomplish a task.

**Systems Engineering Neglected**

As systems become increasingly complex, often coupling very old technology (such as the 50-year-old B52 in the first of the above examples) with the very latest technology, not to mention involving humans as operators and as critical decision-makers, success depends on effectively combining disparate elements. Indeed, the outcome of future combat may well hinge on the extent to which diverse technologies and humans can be made to work in concert. A major step forward will be the ability of machines to communicate in ordinary spoken language but this remains largely for the future.

To date, the inability to regularly and predictably accomplish the integration task has resulted in a gaping hole in military capability. Too often, this lack of “glue” has denied would-be users the full benefits latent in readily available technologies. And while proper application of systems engineering can comprise the magical adhesive that holds complex systems together, its improper application, or non-application, can (somewhat uncharitably) be described as the epoxy that can grease the wheels of progress.

Shortcomings have periodically evidenced themselves at virtually every point in the spectrum of system pursuits, from system conceptualization through system implementation to system operation.

As an example of the former, consider a situation which recently evolved in the sphere of commercial aviation. Over the years, a number of surveys indicated that, among other things, air passengers are desirous of getting to their destinations more rapidly. With the possibility of supersonic flight over land generally rendered impracticable for both environmental and economic reasons, aeronautical engineers concluded, perhaps not illogically, that a new family of subsonic aircraft should be designed which would be capable of flying closer than its predecessors to Mach One, the speed of sound. This approach has, of course, major consequences, since aerodynamic drag tends to rise rapidly in the near-sonic regime and fuel inefficiency and operating cost increase correspondingly. Nonetheless, efforts were initiated to delay the onset of the drag-rise slightly and thereby squeeze perhaps another tenth of a Mach number from a new family of designs.

But if this same problem - get passengers to their destination faster was to be viewed by an aerospace systems engineer rather than an aerodynamicist, he or she would very likely begin by conducting an analysis that would rather quickly reveal that there was a logic problem underlying the entire undertaking.

Due to highway traffic congestion, it typically takes a traveller an hour to drive from their home to an airport. Another two hours are required, at least in the United States, to comply with airline and governmental guidelines for checking baggage and passing through enhanced security systems. A “typical” flight in many parts of the world might itself occupy two hours, and an additional half-hour or more would be needed to recover bags and depart the airport. Finally, another hour is often required for the traveller to transit to his or her final destination. The costly task of a ten percent reduction in the flight time, twelve minutes in this example, would be barely significant. Cutting down on overall travel time from the perspective of improving flight time is perhaps disproportionately inefficient. The aerospace systems engineer might then suggest that the airline continues to use its existing fleet of aircraft and devotes its resources to improve its baggage handling system or even the passenger security processing system.

The same question can of course be viewed even more broadly - through the eyes of a transportation systems engineer. This individual might well suggest that passengers contemplating relatively short flights simply take a high-speed train, perhaps a Maglev, from city-center to city-center and eschew flying altogether.

A second category of problems which has been encountered in engineering systems relates to the matter of implementation. That great ocean-going vessel-Titanic provides an instructive example. The ship’s designers were given the fairly straightforward requirement to transport passengers across the oceans in great comfort and safety. This was then translated into a system specification calling for a ship that was both elegant and “unsinkable”.

When the ship’s designers sought to implement this goal, a question that had to be addressed was how many lifeboat positions should be provided on an unsinkable ship. Now, one might reasonably argue that if the ship were unsinkable, there should be no need for lifeboat positions at all. On the other hand, if the ship were in fact sinkable, then presumably enough positions would be required to provide an assured space for every passenger and crew member. Somehow, the designers, departing from any pretense of sound systems logic, tragically decided to

provide only enough lifeboat positions for about half the passengers. Some might argue that the ship's designers thought the ship had only a fifty percent chance of sinking and then calculated the number of lifeboat positions based on that shaky premise or perhaps they thought the ship might half-sink, or whatever the case, the rest is history.

Examples abound of problems encountered in the third of the aforementioned categories, namely in the operation of complex systems. One such example occurred a number of years ago when a missile was scheduled for a test flight at the White Sands Missile Range. During the flight readiness review, it was discovered that two wiring bundles which as a pair connected two electronic boxes built by two different contractors, had inadvertently been connected to the opposite (incorrect) port. The flight conductor, upon becoming aware of this error, issued the instruction that the contractor should reverse the connections. And they did: Both contractors. The result was the wiring returned to its original incorrect paths and the flight ended prematurely - due to a quite remarkable explosion.

**Systems Engineering Failures**

There are of course numerous examples of highly successful yet very complex systems. The Apollo mission to the moon stands out in this regard, and important lessons are to be learned from each. These include the importance of discipline in all tasks, thorough requirements definition, conducting design trade-offs, establishing reserves (money, technology and schedule), controlling interfaces, limiting changes, stress-testing, identifying root causes for all anomalies and failures, eliminating single point failure modes, providing adequate spares, formally identifying and managing risk, conducting exhaustive reliability tests, providing suitable design margins, and a lot more. But rather than dwell on those positive observations, it is perhaps more instructive to focus on systems gone awry and learn the lessons they so painfully teach.

There are, unfortunately, a near-infinite number of ways a complex system can fail. Sometimes it seems to the authors that in our careers we have seen all of them. Three pervasive causes deserve particular attention. The first of these relates to the fact that many systems, particularly poorly conceived ones, are no stronger than their weakest link. For example, during the war in Vietnam, it was not uncommon for US forces to fly the latest state-of-the-art aircraft, with extremely well trained pilots, into a thicket of air defences with the attack aircraft being provided tanker support, air cover, surface-to-air missile suppression, flak suppression, reconnaissance, electronic countermeasures support, and search and rescue, only to drop unguided iron bombs which more often than not missed the target. The classic case was the Thanh Hoa Bridge in North Vietnam, against which 873 sorties were flown delivering two kilotons of bombs with the loss of 11 aircraft and aircrew, all without dropping a span. But when the technology which was already being used in other parts of the strike system was finally applied to ordnance, replacing iron bombs with guided weapons, a single mission involving eight aircraft collapsed the bridge - with no aircraft or crew losses.

The second issue concerns the importance during the systems design and analysis phase of properly "bounding" the system that is being addressed. Since every system is merely an element of one much larger system - the universe - it is obviously necessary to somehow restrict what is to be included when configuring and analyzing any proposed system. Too broad a definition can render the task unmanageable, but too narrow a construct is equally fraught with danger. A particularly onerous example of the latter could be found in an incident which occurred with an L-1011 commercial airliner flying from Miami to the Bahamas. The aircraft's designer, prudently seeking to avoid weak links, provided three independent engines such that the aircraft could remain aloft with only one of its engines operating. Among other additional precautions, chip detectors were installed in the oil lines of each of the engines.

Not long after take-off on the particular flight of concern, a cockpit warning light indicated that one of the aircraft's engines had lost its oil. The errant engine was thus shut down by the pilots as a precautionary measure. Shortly thereafter, a second, and subsequently a third warning was received from the remaining, presumably independent engines, that they too had suffered the affliction. It seemed impossible that any one aircrew could have such a bad day, not to mention the passengers.

Fortunately, the pilot was able to fly the aircraft safely back to Miami where it was discovered that; not withstanding all the engineering care that had been given to assuring independence of the engines, the particular definition of the "propulsion system" employed in the design process, was inappropriately narrow. In particular, it was learned that prior to flight during routine maintenance, the chip detectors had been replaced on all three engines and that the components of the chip detectors, which had been bundled in separate plastic bags at the factory, had all been assembled by the same worker. Through an oversight, that individual had left the same O-ring seal off each of the three chip detectors, a fact which was not observed during inspection, with the result that the three "independent" engines suddenly became very dependent indeed i.e. dependent upon a part of the "propulsion system" that the engine's designer had not considered: a worker in a subcontractor's factory.

As one examines the failures of complex systems, it is repeatedly noted that what were thought to be redundant designs were not really redundant. Redundancy, in the mathematical sense, requires independence - too often a neglected criterion among systems designers.

A critical responsibility of the systems engineer is thus to define the elements of a system broadly enough to ensure that externalities cannot significantly impact the operation of the system, yet narrowly enough so that the tasks associated with design, manufacturing and operation are still manageable.

This effort is to internalize externalities; that is to bring within the system engineer's control those things that can significantly impact the system at hand. This unfortunately cannot always be accomplished. Take the case of the space "tug" that was constructed for NASA to attach itself to the failing Skylab to prevent the latter's very large spacecraft from smashing into a populated area of the earth as its orbit decayed. The unanticipated cancellation of the tug project caused the world to rely on probabilities for safety, and, caused part of the company within which the project resided, to miss its financial goals for the year - and the cause was sunspots!

Now, one might reasonably ask how sunspots could cause a company to miss its financial targets. As it happened, the construction of the tug project was initiated only sufficiently early to match the decay of the orbit. Due to an unusually intense interval of sunspot activity, the density of the earth's upper atmosphere increased to the point that it became abundantly clear the Skylab's orbit would decay well before the tug could attach itself to the Skylab and direct the pair into a remote area of ocean. The project was thus cancelled, the company's financial target was missed, and it has once again demonstrated that seemingly remote occurrences can have very real impacts. Electronics Engineers sometimes refer to such couplings as "sneak circuits".

The third hazard - virtually a plague - has to do with inadequate attention having been devoted to assuring component quality, particularly as it affects systems reliability. Most well-conceived systems work reasonably well when they are working. That is, they provide the intended level of "performance" being sought by their users. But the underlying question should be, will they work when they are needed? A common mistake is to define the performance of a system only in terms of such parameters as range, payload, and speed and to overlook the all-important performance measure - reliability. It is the role of the systems engineer, through such means as prudent design and extensive testing, to ensure that the overall system does in fact work as intended when intended. In this sense, the systems engineer can be thought of as the "prime contractor" for the system itself.

**The Systems Reliability Problem**

Examples of systems failures attributable to reliability usually manifested as component failures, are not uncommon. But each teaches important lessons. Some particularly onerous yet instructive examples are cited herein, most of which relate to space operations - in part because space is an arena wherein reliability, quality control and testing errors reveal themselves in the most dramatic manners. Space is an environment that is particularly unforgiving of shortcomings, be they human or otherwise. Additionally, the lessons learned in civil space activities are not obscured by security classification. Nonetheless, their lessons, in most instances, have applicability to military and other operations right here on earth. Consider the following examples:

A spacecraft was designed, built and launched to explore the planets. Unfortunately, in its many thousands of lines of software code, a single hyphen was inadvertently omitted which affected one of the millions of possible operating loops of the guidance software. Although an extensive test program was conducted, the impracticability of testing every possible loop permitted the missing hyphen to remain undetected until the actual flight, where, as luck would have it, the spacecraft promptly found itself in exactly the backup operating mode that relied on the ill-fated hyphen. The result was the spacecraft decided to explore the universe on its own - never to be seen or heard from again!

In another case, a spacecraft designed to explore the planet Mars failed after a year-long flight to the planet. During the post-flight failure analysis, it was discovered that one of the two principal organizations involved in the mission, had provided spacecraft guidance data to the other in English units whereas the recipient had assumed the data were in metric units. This is notwithstanding that the organizations had worked together on space projects extremely successfully for many years. The result was that the spacecraft simply decided to bypass Mars!

In a related type of failure, an upper-stage delivering a military communications satellite failed to reach geosynchronous orbit because someone had inadvertently mistyped a decimal place in one of the constants in the guidance equations. But that wasn't the only cause of the failure. The failure also occurred because once again the testing process failed to detect the mistake. In this case, the software that was tested on the ground prior to flight had the correct value, but the software loaded on the actual flight hardware did not. The lesson was to always "fly as you test" and "test as you fly". There should not be two sets of flight software, one for ground testing and one for

flight that could have different functionality. In this case, a billion dollar satellite was lost because of a decimal point, and poor test procedures.

The flight of a space launch vehicle has been described as a “controlled explosion”, especially in the case of solid rocket motors. In an incident which occurred in the 1990s, a strap-on solid rocket motor failed in flight because of an incorrect assumption about a small cut in the propellant about the width of a razor blade. The solid rocket motor in this example, was designed to be assembled in segments, with rubber insulator liners between each segment. Prior to joining the segments, it was found that one of the liners had suffered a delamination between the rubber and the solid propellant - an unacceptable condition. The section of the rubber adjacent to the delamination was thus cut out with a knife about the thickness of a razor blade, and a new rubber section was reattached and inspected. In the repair process, the knife blade entered the propellant itself from the center core to the rocket motor wall - but the invasion was less than one-half inch deep in a rocket motor about ten feet in diameter. Analyses of the internal gasdynamics which characterized the rocket concluded that the cut should not pose a problem because at ignition, the rocket fuel was under compressive pressure and the “slit” in the fuel would be held closed, so as to prevent burning the motor wall prior to fuel depletion.

Unfortunately, this analysis proved to be incorrect; it omitted the secondary effect of a returning shock wave passing back up the solid rocket core after ignition. This secondary shock put the rocket fuel under tension and opened the slit long enough to permit burning in the slit which then sustained itself. In less than sixty seconds, the combustion reached the rocket’s steel wall and weakened it to the point that the case exploded in flight. The lesson was relearned: not to overlook the myriad of seemingly small issues which can affect the operation of a system, including those which are categorized as secondary or even tertiary effects.

**The Domain of Systems Engineering**

Given the impact of systems engineering, it is ironic that very few engineering schools have taught the subject in anything approaching a formal or focused manner. Only recently has systems engineering begun to be recognized as an important and legitimate academic discipline, although industry has long highly valued individuals skilled in the field. Unfortunately, most of these practitioners acquired their systems expertise not in the classroom but rather the expensive way through on-the-job training (through explosions, collapses and crashes!).

One reason for the perpetuation of this conundrum is the difficulty in describing exactly what subject matter legitimately resides within the “footprint” of systems engineering. The field obviously incorporates elements of all the traditional branches of engineering - but it also addresses these elements in a fashion which tends to be “orthogonal” or “crosscutting” to the conventional structure within which they are taught at most universities. Further complicating the matter is the fact that in addressing systems issues, an engineer must be prepared to deal with topics that extend well beyond the more conventional engineering disciplines, venturing into such areas as manufacturing, quality control, cost analysis, testing, and logistics - areas which do not fit the “stovepipe” approach employed in organizing most university academic departments or curricula.

The fact that systems engineering must necessarily address all significant factors which cannot be properly externalized poses the additional dilemma that the systems engineer must be prepared to deal with questions of economics and affordability, public policy and social science, management and finance, even propriety and ethics, and must do all this with a global perspective.

**Testing and Failure Analysis**

Among the many important responsibilities of the systems engineer is the conduct of systems testing and, where necessary, failure analysis. Perhaps the most dramatic example of the consequences of improperly conducting a systems test occurred during the design and manufacture of the primary mirror for the Space Telescope, now operating effectively in near-earth orbit. The subcontractor responsible for the mirror, an internationally respected optics manufacturer, designed a test to verify the accuracy of what was to be an extraordinarily precise mirror. However, the test indicated the presence of a gross error in the mirror’s overall surface dimensions. Concluding that an error of such magnitude was implausible, a second type of test was formulated, but its results again pointed to the presence of a major anomaly. Finally, concluding that the tests, not the mirror, must be flawed, the telescope was lofted into orbit - at which point any doubt about the mirror’s correctness was dispelled: the telescope produced disappointingly fuzzy images.

Fortunately, in this case, the project could be saved. A mission of the Space Shuttle was used to install a corrective lens in the telescope’s optical train and since then, the pictures gathered have been of extraordinarily high quality.

This recovery was made possible by the excellence with which one of the more fascinating, albeit unfortunate, aspects of the systems engineering trade was conducted: failure analysis the Sherlock Holmes work of the technological sphere. In the case of the Space Telescope, a truly superb piece of detective work pointed to the "smoking gun" and, as is often the case for basically well-designed systems, not one but two anomalies had coupled to take down the system. Such multiple failures are not uncommon. They make the task of failure analysis particularly difficult and point to the importance of identifying root cause of all escapements. The crash of the Concorde near Paris in 2000 provides an instructive example of the challenges involved in ascertaining root causes. Initial reports of the event identified the penetration of the aircraft's fuel tank by a foreign object as the cause of the accident. Indeed, the design of the fuel tank was a contributing factor to the accident, but it was not the root cause of the failure. The tire failure that resulted in rubber fragments penetrating the fuel tank was also a contributing factor, but again, not the root cause. Neither was the metal strip lying on the runway that apparently caused the tire to explode. Nor was the failure aboard another aircraft that caused the metal strip (which had been added as a "fix") to fall onto the runway. The root cause of the failure of the Concorde turned out to be the design error that necessitated the addition of a metal strip to a totally different aircraft. All these escapements were important facets of the Concorde accident, but until each had been identified, analyzed and rectified, the systems engineer's task was not complete.

**The "Because-It's-There" Syndrome**

Engineers have not uncommonly been accused of assuming that if they can do something, it must be worth doing. The underlying logic parallels the "we should climb Mt. Everest because it's there" school-of-thought. This argument is, of course, becoming increasingly more tenuous in a world suffering immense economic pressures to support a host of worthwhile undertakings - not to mention a growing public sensitivity to the unintended (adverse) consequences of many scientific and technological advancements. Engineers tend to forget how controversial such now-taken-for-granted developments as, say, household electricity once were. Contemporary reports show that there originally was considerable reluctance about permitting electricity to be "piped" into homes, based on the fear that the unused electricity would "leak out" of the sockets and onto the floor, electrocuting everyone in the area. Similarly, the first flashlights were regarded by some as a sort of witchcraft. The systems engineer, like it or not, must be prepared to address both the rational and the irrational.

Turning to more recent times, there are no compelling technological reasons why one could not build a superconducting supercollider, a new supersonic commercial aircraft or a network of nuclear power plants, but at least in the United States, it has been decided not to undertake any of these projects. The reasons have little to do with engineering; rather, the deciding factors have resided in the realm of economics and public policy. Engineers ignore such considerations at their peril.

The commercial nuclear power program offers a particularly compelling case. Even in the face of serious doubts over the sustainability of other sources of energy, no nuclear power plants have been built in the United States in several decades. Among the last to try was the Long Island Electric Company which spent millions of dollars and complied with all state and federal regulations, yet, was eventually forced to shut down the newly completed Shorham Nuclear Plant without producing a single watt of commercial electric power.

**Educating the Systems Engineer**

How then does one prepare engineers to deal with the broader issues implicit in systems engineering, issues which demand a significant expansion of traditional engineering thought? One curriculum seems to be remarkably well structured to addressing the demands of modern systems engineering. In particular, it prescribes for a degree the following course requirements, in addition to a heavy load of math, science and practical engineering: Six semesters of a foreign language, two semesters of political history, one semester each of rhetoric, literature, composition, political economy, industrial history, business law and industrial management, plus a thesis.

The only problem is that the above program appeared in the MIT catalog for Mechanical Engineering in the year 1900! (To its great credit, MIT has recently created a strong engineering systems program, and it is among a select few universities to have done so).

**What then should Systems Engineers be Taught?**

1. First and foremost, systems engineers must be provided a solid grounding in the fundamentals of mathematics, physics, and chemistry. Without this foundation, it is unlikely a technologically creative nature can be produced - or even understood.

2. Systems engineers should be given a solid grounding in the principles of engineering design and engineering analysis, including the conduct of trade-studies and the application of probability and statistics.

3. They should acquire an understanding of basic economics, including cost estimating, regression analysis, present value determination and other related topics.

4. They need to understand systems analysis, including modelling and simulation.

5. They will require a knowledge of manufacturing technology and quality control, including failure modes effects analysis.

6. They must be taught the principles of systems testing, including environmental testing, and the techniques of failure analysis and root-cause determination.

7. They should gain a general understanding of the processes of public policy formulation, including appropriate aspects of political science and law, and should do so in an international context.

8. They should acquire team skills - both leadership and fellowship, since most engineering projects today involve significant numbers of participants in what are often called Integrated Product Teams (IPTs). Usually, some of the members of these teams will not be engineers.

9. They must be capable of effective communication, both written and verbal. This is the foremost weakness of graduate engineers today and its importance cannot be overemphasized, particularly for systems engineers from where top managers are increasingly chosen.

10. And, finally, a familiarity with, and commitment to, the topic of ethics, particularly ethical comportment in real-world situations.

With regards to the final item on the list, many engineers embrace the notion that engineering has nothing to do with ethics... “Engineering has to do with laws of nature and laws of nature are absolute”. Period.

Of course, nothing could be further from the truth than the notion that engineers are immune to ethical dilemmas. In

almost everything that engineers undertake, there are potentially adverse consequences that offer abundant ethical conundrums.

One of the authors, teaching a university course generally related to systems engineering, posited a situation at each semester, wherein an entrepreneur was preparing to introduce a new innovation into the marketplace; an innovation which was virtually certain to enjoy enormous demand throughout the world. Further, it would have a major impact on strengthening the world's economy, create millions of jobs, and enhance the quality of life of billions of people. The question asked of the students was whether they would be interested in investing in such an enterprise. Invariably, the answer was a near-unanimous "Yes!" (This was, of course, a very hypothetical answer-after all, these were students!)

It would then be pointed out that there was one additional fact that should perhaps be mentioned: the product that was being considered would kill a million people each year. At this point, the students would invariably indicate that they had no interest - financially or otherwise - in being associated with such a reprehensible undertaking.

They were then asked if the product in question had already somehow slipped into the marketplace, would it be appropriate to ban it? Most in the room insisted that it would indeed, by a sound idea, to do so and quickly.

The students were then informed that the entrepreneur to whom the vignette referred was, of course, none other than Nicholas-Joseph Cougnot, the inventor of the automobile!

Further complicating such issues is the fact that some engineering practices that are considered highly unethical today, were in fact relatively commonplace in the past. There is one example: Consider the method that was devised to test the highly progressive ferro-vitreous structure of the Crystal Palace which was constructed in London in 1851 for the Great Exhibition.

The task was to determine whether the building's walkways, given their revolutionary design, would safely support the weight of the thousands of people who would traverse them each day. The engineer who oversaw the project conceived and initiated a series of extremely rigorous "practical tests", as he termed them, which were recounted in a contemporary newspaper in the following manner: "The first experiment was that of placing a dead load of forty-two thousand pounds, consisting of three hundred of the workmen of the contractors, on the floor of the adjoining approaches... The fourth, and that which may be considered the most severe test, was that of packing closely that same load of men and causing them to jump up and down together for some time."

**A New Approach**

A question which begs to be addressed is that, if a systems engineering education must encompass such an enormous breadth of material, how can it possibly be crammed into a four-year academic program?

The answer is simple. It cannot.

In this regard, it can reasonably be argued that the basic professional degree in all fields of engineering should become the Masters Degree. In the case of Systems Engineering, however, there can be no doubt that this must be the case. There is simply too much essential material for it to be covered in four years. To attempt to do so is to attempt to ignore the explosion of technological information that helped define the last century. The education of all engineers should be restructured as a six-year undertaking; focused on the master's degree as the basic professional degree, just as a law degree or a medical degree is the basic professional degree in those fields.

It is ironic that under today's practices, one needs more education to give a dog a vaccination than is required of an individual who designs a skyscraper, bridge, aircraft or tunnel to which large numbers of people will entrust their lives. The de facto recognition of the need for a change in the undergraduate engineering curriculum is that the average engineering education (at least in the United States) now takes some 4.7 years. It would, of course, be fruitless to attempt to expand the knowledge base of those wishing to be systems engineers simply by imposing more courses in the same four-year period. Simply put, more time is needed.

The systems engineering teaching challenge is magnified by the fact that it is not practicable to cover the topic simply by introducing students to a larger number of traditional but independent subjects. This is because it is also necessary to address the integrative and interactive aspects of the systems engineering discipline.

Thus, while it is important to provide undergraduate engineers of all specialties with at least some exposure to the basic concepts of systems engineering, the subject itself appears to be best taught at the masters and Ph.D. levels. The experience of the industrial world suggests that the most able systems engineers are those who acquired

considerable depth in at least one traditional engineering discipline and only then broadened into the field of systems engineering. Attempts to introduce a “survey” approach, leading to an undergraduate systems engineering degree, too often seems to produce engineers who are jacks of all trades and masters of none.

**One Final Thought**

The tenets of systems engineering are critically important to virtually every technological undertaking, but in few cases are they more significant than in the military sphere where the consequences of failure are so enormous. In the civilian sphere, perhaps the ultimate systems engineering challenge of the next decades will be that of placing humans on the moon and then on Mars. But there will be many other great challenges to be met, ranging from the provision of energy to providing healthcare; from protecting the environment to countering terrorism; from strengthening the global economy to providing food for the earth’s expanding population. The success of all such undertakings will depend upon the capabilities of the engineers who integrate the work of many thousands of other participants into smoothly functioning systems.

Perhaps a fitting summary of the demands imposed by these challenges is to be found in, in all places, the opening line of A.A.Milne’s, Winnie the Pooh:

“Here is Edward Bear coming down the stairs now, bump, bump, bump on the back of his head, behind Christopher Robin. It is as far as he knows the only way of coming downstairs, but sometimes he feels that there really is another way...if only he could stop bumping for a moment and think of it.”

Indeed, there is a better way.

E.C. “Pete” Aldridge is a graduate of Texas A&M University and has served as Secretary of the U.S. Air Force and Under Secretary of Defense for Acquisition Technology and Logistics in the U.S. Department of Defense. He has also held the position of President of the Electronics Systems Company of McDonnell Douglas Aircraft Company.

Norman R. Augustine is a graduate of Princeton University and has served as Under Secretary of the U.S. Army, Chairman and CEO of Lockheed Martin Corporation and Chairman of the National Academy of Engineering. He is the co-author of The Defense Revolution and author of Augustine’s Laws. Augustine’s distinguished corporate and technical leadership within the aerospace engineering community has established him as one of the world’s greatest engineers.

# Decision-Making in a Brigade Command Team: Integrating Theory and Practice

by COL Ong Yu Lin and LTC Lim Beng Chong

When time permits elaborate deliberations, the analytical approach to decision-making is still useful; however, under difficult circumstances (e.g., time pressure, high stakes, inadequate information, ill defined goals, dynamic and uncertain conditions), naturalistic decision-making process will become more relevant.

Figure 1 (please refer overleaf) depicts a preliminary model of decision making in a team context. As mentioned earlier, many of the insights were gleaned from NDM and team effectiveness literature. In this article, we value add by integrating both literature with military commanders' experiences. There are perhaps 10 key components critical to decision-making in a team context: two affective components (i.e., positive team orientation, high level of mutual trust), two behavioural components (i.e., open and constructive communication patterns, high level of team self correction), four cognitive components (i.e., high level of team situation awareness, accurate/shared mental models, collective sense making, collective understanding of command intent), and leader components (i.e., team leadership, leader's expert mental model or experience).

This framework depicts how a team goes about making decisions under time pressure and high level of uncertainty. The start state of this framework assumes that the team leader and team members are experts in their specific domains, and these experiences are captured in their individual mental models. Their mental models guide their information search by focusing their attention on relevant cues via situation awareness. At the same time, their mental models also facilitate the recognition of patterns in the arrays of cues and information. Both of these processes help the expert to size up the situation quickly. The interplay among the three processes - sense making, command intent and mental stimulation - enables the expert to first determine a course of action, evaluate it against the command intent by mentally simulating the consequences when that course of action is executed. If the consequences cannot fulfil the command intent, the expert will then seek another course of action. The judgement process repeats itself until the expert determines the first course of action that works (satisficing). Individually, the team leader and team members are capable of conducting this cognitive process at any point in time during the operation (i.e., individual cognition). As these experts do not operate in isolation, they need to function as a team. There is another level of cognition that will be operating as well - team cognition. At the team level, the extent to which the team leader and team members have similar mental models (i.e., team mental models), have a similar perception of the situation (i.e., team situation awareness), have a shared understanding of the situation (i.e., collective sense making), and have a common understanding of command intent, the team will be able to make swift and quality decisions.

Like individuals who have to accumulate experience to become experts, team cognition takes time and effort to develop. Moreover, team cognition can only be developed when the team develops the five critical team processes in the social domain of decision-making – team leadership, team communication, team self correction, mutual trust, and team orientation. The existence of these key team processes will facilitate the development and maintenance of the team cognition over time. In other words, we first develop individual experts, then develop the necessary team processes to transform "teams of experts into expert teams".

Once the planning process is completed, directives are disseminated followed by synchronization activities that are then translated into actions. These actions inevitably will effect environmental changes. Changes in the situations are represented as data and information for the consumption of the command team. However, the extent to which a piece of data or information affects team situation awareness or individual situation awareness depends very much on the representations and flow of the information. The whole cycle then repeats itself. Note that, individuals' mental models may be updated or may undergo refinements after getting feedback from the environmental changes (i.e., reality check). Hence, the whole process is very dynamic.

In the next section, theory is put into practice. Using 3 SIB as an example, the first author (then Commander 3 SIB) shares his first hand experience in building up his command team, in accordance with the depicted framework.

**Developing Decision-Making Process in a Brigade Command Team**

*Phase 1 Vision, Role, Rule, and Relationship* Developing a command team is a deliberate process. This section

briefly documents the efforts in building up a brigade command team. The build-up comprised two phases. In Phase 1, efforts were targeted at developing a shared vision and building team structures and relationships. The Vision, Role, Rule and Relationship (V3R) team building program advocated by Field Psychologists was adopted. Within the brigade, a shared vision was developed. The roles to be played by each member of the team were agreed on. Finally, a set of rules was set to guide the work and interactions of the team. For example, some of the rules were "Question and understand the reasons why", "Make it happen", "Don't complain about the problems - solve them!", "If there are no rules, invent them", "Who else needs to know and why". These efforts were consistent with building up the social domain in the framework.

*Phase 2 Understand and develop the thinking process, mental models, analytical skills of team members, and the information management process* In this phase, the effort was to focus on building the cognitive domain of team functioning. The focus was on understanding one another's thinking process, mental models and analytical skills. The process started off by analysing the strengths and weaknesses of each team member in terms of his thinking and analytical skills. This shared understanding of collective strengths and weaknesses allowed team members to complement one another. For this process to work, mutual trust was critical. From the onset, members were assured that these discussions would not be used for annual ranking purposes. Understanding the background of each team member, their past postings, experiences enabled other team members to have a better understanding of how their mental models were shaped and developed. All these efforts built shared understanding in the team (i.e., team mental models). In addition, team members also agreed on a common theory of success.

**Shared Theory of Success**

To improve the team communication process and team situation awareness, especially under time constraint, technology was leveraged on to enhance information dissemination and management. The Brigade Command post used webpages to present/organize most frequently used information. This information was just one click away.

These were some of the considerations when designing the brigade information management process:

• Post before Processing

Populate the network with information in a timely way to facilitate parallel processing to achieve speed. Experience showed that 80% of information in a product remains relevant/unchanged/unaffected. Where possible, new information were posted and merged with existing knowledge to produce richer products. Users were informed/updated of changes by highlighting what has changed and if possible why.

• Pull and Push

Pull/Push the right information in the right format to the right persons at the right time and right place by asking who else needs to know. Team members were constantly reminded that information has no hierarchy even though the military organisation has.

• Define what information is and what it is supposed to facilitate

Table 2 was instrumental in helping the Brigade make sense of the data, information and knowledge as part of the information management process.

The brigade's human intelligence sensors were trained to report data accurately and to highlight if they were reporting data or their interpretations/assessments, in order not to confuse receivers due to different experience levels and mental models. Likewise, as a standard operating procedure, planners in the HQ would highlight if they were stating data or information. To facilitate processing time, data and analysis were presented on webpages early so that team members had access to them ahead of time. When team members subsequently came together, discussions were focused on what the event meant, and what the implications were.

Every effort was also made to create an open HQ structure to increase situation awareness and facilitate information flow. For example, webpages were used to facilitate information flow in the command post. The Fire Support Cell was also moved from the fringe to the centre of the command post to enhance awareness and coordination.

To further develop the team mental models and collective sense making ability, there was a common understanding of what constituted team situation awareness and sense making.

Situation Awareness was defined as the following:

• Not what is on display but what is in the head

• Not static but a rich, dynamic comprehension of a situation and what drives it

• Looking beyond data to notice trends, build expectancies, spot anomalies and see windows of opportunities for exploitation

• Good situation awareness also envisions more than one potential future and recognises uncertainty as a key element of the situation

Sensemaking was defined as:

• More than just sharing information and identifying patterns

• Going beyond what is happening and what may happen to what can be done about it

• Involve generating options, predicting adversary's actions and reactions and understanding the effects of particular courses of actions

This shared understanding of what constituted team situation awareness and sensemaking engendered the development of many team-orientated behaviours. For example, there were more backup behaviours; members were more proactive in pushing information to the relevant people; members began to ask new questions; members began to see how the various moving parts fit together rather than piecemeal understanding.

The planning process was seen as a learning process. The purpose was to create shared mental models or framework to facilitate discussions and deliberations. Senge noted that "shared mental models are important mechanisms for development of effective communication strategies and also increase team performance".

Before the start of any exercise, there would be a deliberate planning process, adapted from Klein's work, as depicted in Figure 2 below.

As mentioned earlier, the leader component is critical to the team effectiveness. Hence, the Commander was made an integrated planner to share his experiences and knowledge instead of functioning as an approver of plans. Detailed commander planning guidance (CPG) was meant to provide possible frameworks for own course of actions (COAs) and enemy COAs so that staff can quickly fill in the gaps and details.

As the intent of the deliberate planning phase was to generate options, the end state was not to develop multiple COAs for comparison, but to understand the strengths and weaknesses of each option using a strength weakness-opportunity-threat (SWOT) analysis, and to understand the relationships between the options. These relationships were then mapped as Lines of Options with critical battlefield events as nodes in the lines of options. This line of options provided shared mental models of the various possibilities of how the battle can unfold. This process greatly enhanced not only the team mental models, but also the collective sense making capability of the team.

Mapping of the relationships also facilitated the support planners in working out their support plans with sufficient flexibility and robustness to support the alternatives. The variety of alternative paths to mission accomplishment was also an indicator of degree of flexibility. The line of options framework - a creative process stimulated by collaboration among multiple participants with different perspectives - allowed the team to develop its cognitive domain of team functioning, as depicted in the framework.

The experience in the brigade also showed that the team did not have to go through a deliberate selection of COA process to determine which COA to be selected as the plan, but intuitively each knew which option was the best to be adopted as the plan. To ensure that all members were informed, the commander would confirm that a certain COA was selected, often with unanimous agreement.

An example for offensive operations is shown in Figure 3 overleaf.

The line of options framework was subsequently used in the conduct of operations phase. As it captured the shared understanding of team members, it provided possible frames to interpret battlefield events as they unfold in a seemingly random fashion. Team members then made use of these frames to interpret the event in context as well as

use the event to explain possible emerging frames or to discard frames (i.e., collective sensemaking). In the operations phase, team members used the line of options to elaborate, question, preserve, seek a frame, reframe or compare frames*, with each line of options as a possible frame. In essence, this is an operationalisation of Klein's Data-Frame theory. The process is shown in Figure 4 below. This process also enhanced shared situation awareness and shared understanding of the situation.

The line of options facilitated control of operations in several exercises participated by 3 SIB as it provides:

• A frame for more rapid recognition of changes in the battlespace

• Seamless transition to foreclose or marginalise some options and maintenance of momentum without need to develop detailed contingency plans

• Foreseeable multiple futures - building blocks for actions

• Less likelihood of surprise and dislocation

To further facilitate the diagnosis of the evolving battle situation, all team members were asked to constantly review these four questions:

• Is the situation clear or uncertain? What are the key indicators/ patterns emerging? What are the implications?

• Is the operations proceeding according to plan? If not, what are the anomalies? What are the implications?

• Is the Commander Intent for this phase and entire operations achievable? If not, what are the alternatives or adjustments needed? What are the implications?

• Is the plan still relevant? If not, what are the alternatives or adjustments needed? What are the implications?

The team's discussions focused on interpreting the situation, and the implications for both enemy and own forces, and inevitably, a discussion of the options available using the line of options. If an event occurred and has not been considered as a possible line of options, the team would deliberate on the possibility of a new frame and the components of this new line of options. Experience from past exercises showed that the team was able to develop a good shared understanding of the situation and of the possible future states.

**Active Information Search**

The process was supported by an active search of information during the planning phase and conduct of operations phase. It is important to note that as the team saw the planning process as a learning process and accepted that it was an iterative process, it was inevitable that the team periodically referenced a previous product to make improvements as well as removed parts of the plan, as they crystallized the problem.

The team also acknowledged that information was unbounded and needed to be bounded by our own operational concepts as well as the most probable enemy COA. The information needed was then derived and crafted as Essential Elements of Intelligence (EEI) for the enemy as well as Blue Critical Information Required (BCIR) for subordinates to report the attainment of critical battlefield events. These information requirements were crafted to:

• Facilitate recognition of changes and emerging patterns which in turn facilitate the determination of the current perceived state

• Facilitate interpretation of possible enemy intent with a supporting list of descriptions of indicators and cues (which become Specific Information Requirement - SIRs) to allow us to foreclose or marginalise options and thus reducing enemy flexibility and prevent surprises

• The descriptions of indicators/cues allowed us to determine possible options (using the line of options) to counter emerging threats or exploit opportunities by disrupting enemy intent and decision cycles

In cases where the intelligence agencies were not able to provide a positive response on the EEI (i.e., no sightings), it was not to be taken as a non-event but rather it triggered further thinking and questions such as "so what can he be possibly doing?". Other intelligence agencies were then redirected to confirm the most likely alternatives.

**Implications for SAF**

There are a number of implications for SAF.

• Team Training/Field Psychologist Services

To enhance decision-making in command teams, it is important that team training for command teams should be systematically developed and conducted. Based on the proposed framework, efforts should focus on developing the cognitive and social domains of a team. Specifically, we should develop measurement tools to assess and outline interventions for developing team mental models, team situation awareness, team orientation, mutual trust, team self correction, and team communication. Team building programs advocated by both field psychologists from Applied Behavioural Science Department (ABSD), G6 and TRADOC have focused primarily on enhancing the social domain of team effectiveness (e.g., V3R framework of team building). To this end, field psychologists from ABSD can work with TRADOC to improve the current version of the team building program by augmenting it with measurement tools and interventions for enhancing the cognitive domain of team effectiveness.

Looking ahead, a revised command team development program may include three phases: phase 1 – build the basics through team building, phase 2 - enable component development through PC based simulation, phase 3 - make further refinements of the command team operations through field exercises.

In Phase 1, build team orientation through building team mental models (i.e., shared understanding of one another), and establishing mutual trust. This effort is similar to the current team building intervention (i.e., V3R model) advocated by ABSD field psychologists. One addition may be to provide feedback on team leader's team leadership style so that the leader can begin to enhance his leadership effectiveness in a team context.

In Phase 2, team development should continue to build up the team mental models, communication patterns, and team self correction strategies systematically through scenario based training. While this team development can be done using traditional field exercises, the use of PC based simulations for team development is also advanced in this phase. This is because PC based simulations (e.g., command and conquer) can be easily customized to simulate various military scenarios so as to develop certain aspects of their mental models (i.e., experience with different military scenarios), and critical team processes (e.g., team mental models, communication patterns, team leadership, mechanisms to promote team situation awareness, collective sensemaking and collective understanding of command intent, and team self correction strategies). All these learning can be acquired within a shorter time period and possibly with lesser resources. Moreover, PC based simulations once developed, can be used for other command teams. Not all training needs to be done in the field. Team development training can be more effectively carried out at a simulation centre, as long as the learning takes place in the cognitive and social domains of decision-making. Once the critical mental models and team processes have been developed, then the command team is ready for phase 3.

In Phase 3, the command team will be ready for field exercises. Further refinements would be made to ensure the decision-making process in the command team is optimised.

Expertise takes time and effort to develop. However, in order to maintain our professional edge, knowledge management is critical. It is essential to capture expertise from the senior commanders and package them in a useful and meaningful manner for learning by the junior commanders. One way is to first identify critical military scenarios faced by military commanders in operations. Knowledge databases can then be built by eliciting expertise from experts (i.e., senior commanders) on how they go about making decisions in these scenarios using Cognitive Task Analysis (CTA) methodology. This newly acquired knowledge can then be used to design military scenarios for command team training.

• Leader Development

Similarly, incorporating scenario based training into leader development is critical to build expertise (i.e., expert mental models). Leaders have a disproportionate influence on decision-making in the team. As mentioned, leaders can affect the team process not only with his leadership style but also with his mental models (i.e., what he knows and does not know, and his biases and inclinations). Klein contends that "if we can present many situations an hour, several hours a day, for days or weeks, we should be able to improve the trainee's ability to detect familiar patterns." If the hypothesis is correct, leveraging on technology (e.g., PC based simulation) to deliver scenario based training may be effective.

• Battle Procedure

There is a need to align the current 15-step battle procedure to the decision- making framework. The objective of

procedures should be to facilitate human decision-making rather than to inhibit it. Given that there is now greater insight into how humans go about making decisions, battle procedures should be aligned to facilitate the naturalistic decision-making cycle of human decision makers. Here, the experience of the brigade command team is again used as a case study to illustrate the usefulness of the proposed framework.

• Human Resource Policies/Team Selection

Human Resource policy makers must break away from the traditional mindset of viewing job postings as independent decisions for individuals. They must begin to be more team focused and take into consideration how personnel movement can affect command team effectiveness. The objective of personnel movement should be to retain or build the ideal command team configuration. Considerations should be given to the make-up of a command team. Personnel movement should not be piecemeal. Collective attributes of a command team must be considered. This would however require some radical change in the mindset of the Human Resource Departments/Personnel Management Centres.

• Disrupt the Adversary's Decision Cycles

In order to enhance one's probability of success, one can enhance one's decision-making process. On the other hand, one can also attempt to disrupt the adversary's decision cycles. The framework mentioned here is equally applicable to the adversary. Given what we know about the human decision-making process, military commanders can attempt to disrupt the adversary's decision cycle by overwhelming him in the physical domain like what the Americans did in Operation Iraqi Freedom with superior firepower. Unlike the Americans, this option may not be applicable to the SAF given that we may not have significant technological advantage over our adversary. Disrupting the adversary in the information, social and cognitive domains of decision-making may be the strategy to explore. These are some suggestions.

*Cognitive domain* We can profile adversary commanders by understanding the adversary's mental models, values, beliefs, doctrine, and cultural values and beliefs. Armed with this information, our military commanders can better read the actions of these adversaries, and subsequently exploit their cognitive vulnerabilities (e.g., biases and heuristics) of these adversary commanders.

*Social domain* The effectiveness of exploiting the vulnerabilities of the adversary commanders' cognition can be further enhanced by disrupting the social domain of the adversary's decision-making cycle. To do this effectively, profiling the other team members in the adversary command team is critical. Based on this profiling, a team can be postulated in terms of their communication patterns, level of trust among members, level of team orientation, team mental models, team situation awareness, existence of team self correction strategy or adaptability. Once the adversary team profile can be identified, vulnerabilities and weaknesses in their social domain of decision-making cycle can be targeted and exploited. The objective is to disrupt their team dynamics.

*Information domain* If the strengths and limitations of the adversary's Command and Control Information Systems (CCIS) and decision support tools are well understood, it will enable us to attack the information domain of their decision-making cycle. The adversary's information domain can be targeted to disrupt their cognitive and social domain. Essentially, the aim is to shape the adversary's decision-making by letting him see what we want him to see.

• Leverage on Technology

People first. Technology must be built to facilitate human functioning and not the reverse. Hopefully, this framework can provide some insights for decision support tools development and CCIS.

**Conclusion**

Research in decision-making has spanned three decades. Much more work is needed to further our understanding of decision-making, especially in a team context. In this article, a preliminary framework of decision-making in a team context has been put forth, using 3 SIB as a case study to illustrate its utility. We have also drawn up the implications for team training, leader development, human resource policy, and use of technology to facilitate human decision-making.

It is our hope that this article can engender some lively discussions and dialogue on this important topic.

**Endnotes**

1 Gary Klein, Sources of Power: How People Make Decisions (Cambridge, Massachusetts: MIT Press, 1998), p3.

2 McIntyre, R.M., and Salas, E., “Measuring and Managing for Team Performance: Emerging Principles from Complex Environments”, in R.A. Guzzo, and E.Salas (eds.), Team Effectiveness and Decision Making in Organizations (San Francisco: Jossey-Bass, 1995).

3 Mohammed, S. and Dumville, B.C., “Team Mental Models in a Team Knowledge Framework: Expanding Theory and Measurement across Disciplinary Boundaries”, Journal Of Organizational Behavior, Vol.22 (2001), p90.

4 Mathieu, J.E., Heffner, T.S., Goodwin, G.F., Salas, E., & Cannon-Bowers, J.A., “The Influence of Shared Mental Models on Teams Process and Performance”, Journal Of Applied Psychology, Vol. 85, pp273-283.

5 Stephen Zaccaro, Andrea Rittman, and Michelle Marks, “Team leadership”, The Leadership Quarterly, Vol.12 (2001), pp451-483.

6 Bernard Bass, Transformational Leadership: Industrial, Military and Educational Impact (New Jersey, Lawrence Erlbaum Associates, 1998).

7 Pearce C.L., “The Future of Leadership: Combining Vertical and Shared Leadership to Transform Knowledge Work”, The Academy Of Management Executive Vol.18 No.1 (2004), pp47-60.

8 Carol R. Paris, Eduardo Salas, and Janis A. Cannon-Bowers, “Teamwork in Multi- Person Systems: A Review and Analysis”, Ergonomics Vol.43 No.8, p1052.

9 Gary Klein, op cit, p30.

COL Ong Yu Lin is currently the Commander of Officer Cadet School in SAFTI Military Institute. He is a Guards Officer by training, and has attended the Royal Military Academy at Sandhurst , UK , the US Army Infantry School at Fort Benning , and the Australian Command & Staff College . He has previously held command appointments at the battalion and brigade levels. He holds a BSc in Physics from the National University of Singapore, a Master of Management in Defence Studies from the University of Canberra, Australia, and an MBA from the Nanyang Fellows Programme at Nanyang Business School .

LTC Lim Beng Chong, PhD, a Guards Officer, is currently Head Training Psychology Branch, Applied Behavioural Sciences Department. He holds a BSc (Honours) in Psychology from University of Nottingham , MSc in training and development from Leicester University , MA and PhD in Industrial and Occupational Psychology from University of Maryland .

# The Challenge of Systematic Leadership Development in the Singapore Armed Forces

by LTC Chan Kim Yin and CPT Psalm Lew

The spectrum of missions that the Singapore Armed Forces (SAF) has to deal with has expanded in recent years. At the same time, the SAF is transforming itself to exploit the rapidly emerging possibilities presented by networked new technologies. This article describes two frameworks recently adopted by the SAF to enhance leadership development. These are: a framework for leadership that includes values, competencies, styles, the "self", and the leadership "context", and, a framework for leadership development that includes the "self", "superiors and instructors", "curriculum", "developmental tools", "peers" and a "climate of learning" in the organisation.

**SAF's Changing Spectrum of Operations**

Until the 1990s, the SAF was largely structured for conventional military operations. However, things have changed since the mid-1990s. During the 1990s, the SAF found itself increasingly involved in UN peacekeeping missions, especially playing medical or observer/advisor roles - Namibia in 1989, Kuwait from 1991 to 2003, Angola in 1991 to 1992, Cambodia in 1992 to 1993, Afghanistan in 1997- 1998. In 1999, we provided medical and logistics support as part of a Unsanctioned international force led by Australia (INTERFET) to stabilize the situation in East Timor which was seeking independence from Indonesia . The total number of personnel who served in INTERFET was about 370 and was our largest contribution at that time.

From 2000 to 2002, the SAF continued to support the UN's call to stabilise the transition of East Timor to independence. When the SAF completed its UN operation (UNTAET) in Nov 2002, it had deployed up to a company-sized force of armed peacekeepers in Timor Leste. For the SAF, this was a significant milestone in our limited peacekeeping experience as it was our very first deployment of armed peacekeepers.

Singapore 's security environment also changed greatly since September 11. Today, the SAF not only deals with peacekeeping or conventional threats, its spectrum of threats has expanded to include non-conventional threats, most notably, terrorism by global networks and their affiliates.

The SAF recognises that dealing with such threats requires different capabilities and skills, and a different orientation in mindset. Today, the SAF operates very closely with other security agencies in Singapore . Our troops work closely with the Singapore Police Force to guard our key installations from air, sea and land threats. Our government has also recognised the need to develop new operating concepts and technologies to deal with new scenarios that are very different from what we have been used to.

In 2003, the SAF published two Monographs suggesting some of the "new thinking or concepts" needed in the SAF. One was entitled "Creating the Capacity to Change - Defence Entrepreneurship for the 21st Century" or C2C4, the other was entitled "Integrated Knowledge-based Command and Control" or IKC2.5 The C2C Monograph suggested an approach to create a capacity for internal change to deal with the rapid changes in our security environment - before these changes were forced upon us from the outside. The IKC2 Monograph described how the SAF could leverage on networks and knowledge to fight with greater speed and precision. The latter recognized with the strong science and technology base in Singapore , we could leverage on our well educated soldiers to master technologically sophisticated weapons and equipment in the "future generation" SAF.

It is clear that the security and operating environments of the SAF have changed, and are expected to change at an ever-increasing rate. Hence, in 2001, the SAF initiated a major effort to review and enhance its system for leadership development. An important assumption underlying this effort was that we could no longer leave the development of our leaders to chance processes such as passive role modelling, or common-sense notions of "leadership" and "leadership development". In 2001, a project team was established to map out the scope of leadership thinking or doctrine, and a system for leadership development in the SAF. In 2003, this project team was centralised in the SAF's Military Institute in an interim organization called the "Centre of Leadership Development" or CLD, headed by an ex-Army Brigade Commander and staffed with a mix of military officers from the various Services as well as military and civilian behavioural scientists. The interim CLD's mission is to promote leadership excellence and to spearhead leadership development in the SAF.

The rest of this paper aims to describe the SAF's review of its leadership development system and the development of a new doctrinal framework for leadership and a model of the components of a leadership development system. Both were starting points to systematically enhance leadership development in the SAF.

**Review of Leadership Development**

At this point, it is useful to point out that the SAF did in fact attempt to introduce a more systematic approach to leadership training since the 1990s. In 1995, at the time that the SAF established its tri-service, tri-level military institute called "SAFTI Military Institute" or SAFTI MI, the SAF also published a provisional leadership handbook that introduced a leadership framework, called the Knowledge- Abilities-Qualities or KAQ Model of Leadership. The idea behind the KAQ was simple: to break down the concept of leadership into its parts, and thereby, to spell out the knowledge, ability and qualities desired for effective leadership in the SAF. The KAQ Handbook defined leadership as "the process by which a commander applies his knowledge, abilities and qualities to influence others to successfully complete a desired task".

Besides introducing the KAQ as a "common language" and "framework" for commanders and trainers to think and talk about "leadership", in 1996, the SAF also introduced a set of Core Values as "a unifying force for all members of the SAF".7 The significance of the SAF Core Values was that it was a statement of the shared beliefs of all three Services of the SAF. In a way, the 42 SAF Core Values marked a maturing of the SAF into an integrated and "Joint" military force.

When the KAQ model was developed in the 1990s, the focus of the research was on entry-level leaders in our Officer and Specialist/NCO corps. A decision was also made then not to introduce the teaching of "leadership styles" to our 18-20 year old entry-level leadership trainees because it was felt that they lacked the experience needed to appreciate the nature and impact of different leadership styles.

**Four Leadership Paradigms**

The review of leadership development in the SAF in 2001 concluded that it was useful to retain both values and the KAQ or "behavioural competency or skill" approach to describing leadership in the SAF. However, the SAF also felt that it was necessary to introduce the language and study of "leadership styles" to our leaders, especially because we wanted a new leadership framework that could apply to all levels of leaders in the SAF - junior and senior.

Studying the behavioural science literature on leadership, we noted what seemed to be four paradigms in the scientific study of leadership - each of which focusing on a unique aspect of the nature of leadership, and, each of which having a different approach to leadership development. First, we noted the theories of leadership that provided taxonomies of different leadership styles or orientations.8 We also observed that the scientific literature of leadership styles and orientations in the 1960s and 1970s emphasised the importance of understanding the contingencies between different styles with situational factors (e.g., group and task characteristics) in predicting outcomes.9 Each of the leadership style theories had its own method and tools for developing leadership that varied depending on their assumptions about the rigidity of leadership styles. For example, theories assumed that leaders possessed certain styles and it was important to match the leader to the situation. Others assumed that leaders could be trained to be more flexible in their styles and to match the appropriate leadership style to different situations.

Next, there were the leadership "skill" or "competency" approaches to leadership that seemed more commonly applied in the human resource (HR) domain.10 Whereas the "style" approach tended to focus on the question "how can this leader lead effectively in this situation", the competency or "skill" approach to leadership focused on the question "whether this leader is able to lead given his/her skills?" Along with competency or skill approach came a different approach to leadership development that included behavioural skills training, leadership coaching and feedback, and the design of performance management systems.

Separately, a less dominant paradigm in the study of leadership that concerned the question "why a leader leads". The theories in this domain of leadership varied greatly from McClelland's theory of unconscious needs and motives of leaders11, to more recent trait-oriented models of leader motivation.12 Recently, a Special Issue of the Leadership Quarterly13 called for more research to link leaders, followers and values.

Finally, a fourth leadership paradigm focused on the "self" aspects of the leader and leadership development. Whereas the "values", "competency/skill" and style approaches to leadership focused on the overt, behaviours that leaders displayed or enacted to influence their followers, the self-approach to leadership emphasised the importance of more "inward" actions by the leader to influence him/herself. A leadership theory that focused on the "self" was the theory of "self-leadership" by Manz.

In 2002, London published a book entitled “Leadership Development” that emphasised the importance of the “self”. In the same year, Daniel Goleman published a book entitled “The New Leaders” linking this theory of “emotional intelligence” to leadership, in which he described two constructs: self-awareness and self management that were considered vital to effective leadership. In the SAF’s KAQ Model of Leadership, “Knowing oneself” was in fact identified as one of the important qualities desired of leaders in the SAF. In a 2001 Study published by the US Army17, “self-awareness” was in fact identified as a “meta-competency” needed to sustain life-long learning and effectiveness in dynamically changing military environments. The concept of a meta-competency was introduced by Hall18 to refer to a competency that “grows” other competencies.

**A New Doctrinal Framework**

Having identified the four paradigms of leadership that could scope the nature of leadership thinking in the SAF, the next challenge was to capture in a doctrinal framework what was unique to leadership in the SAF. We were highly aware that a complete understanding of SAF leadership should include an appreciation of the context in which SAF leaders were expected to lead. Indeed, it was the SAF’s military context that would make the leadership framework a doctrine about military leadership, rather than merely an academic leadership model. For this purpose, three contextual domains were identified that could guide the nature, specification and manifestation of leadership in the SAF. These were: the SAF’s Mission and Purpose, the Operating Environment, and the Desired Outcomes of the SAF.

*Mission and Purpose* First, unlike the corporate world where results can be directly translated into dollars and cents, leadership in the SAF is about influencing soldiers to achieve the SAF mission - a responsibility without a tangible bottom line. Unlike the employees in the civilian world, our soldiers are ultimately expected to die for their country if necessary; what Sir John Hackett referred to as the “unlimited liability” of the soldier. Leadership in the SAF is therefore a sacred duty and a privilege because of the intangible and paradoxical nature of the SAF’s mission; our soldiers train hard everyday to prevent the very thing that they ultimately train to do, i.e., to fight and to defeat the aggressor. Hence, it is vital that SAF leaders understand their sacred mission to defend the country and to communicate the specific intent or purpose underlying any assigned SAF mission or task, if they are to influence their soldiers effectively to accomplish the mission.

*Operating Environment* Second, leadership in the SAF is also unique because of the complex, multidimensional and dynamic nature of the environment in which our leaders operate. Each operating environment demands from leaders, the flexible employment of a wide range of leadership styles and competencies. The complexity of leadership in the SAF also increases as each SAF leader moved through a variety of assignments and organisations and units in the SAF. The dimensions of the SAF leader’s operating environment include: (a) the social context - the SAF is largely a National Service-based military force and a reflection of Singapore’s multiracial, multi-religious population; (b) the “temporal dimension” - today’s security context is one that rapidly changes across a wide spectrum of operations and our leaders must therefore understand the different requirements of military leadership as they shift from one type of operation to the next; (c) the level of leadership - it is vital that our leadership doctrine recognises the different responsibilities and challenges of leadership as the leader progresses up the organizational hierarchy;20 (d) the socio-technical context - SAF leaders must understand the different requirements of leadership in different technological contexts if they are to lead effectively.

*Desired Outcomes* Besides the mission, purpose and operating environment, leadership in the SAF is also unique because of the complex nature of the desired outcomes in the SAF. For example, in order to achieve the SAF’s mission, SAF leaders are required to lead in a manner that not only leverages on technology to get the job done, but also to constantly build and maintain the followers’ motivation or will to fight. Like any other organisation, the SAF has to compete in the job market to ensure that it recruits and retains only the best as regulars. The SAF also has to keep its regulars and national servicemen feeling engaged and involved in their assignments. Moreover, just like any organisation, the SAF has to stay relevant in a changing world. For example, SAF leaders must lead people in a manner that ensures constant organisational learning. Hence, the kind of leadership required in the SAF is one that must balance a host of outcomes that matter, not only to the SAF, but also to the individuals who serve with them.

*Framework* With the above in mind, the SAF decided to adopt a new framework for leadership in the SAF as shown in Figure 1. The triangle in Figure 1 provides a framework for specifying “what SAF leaders need” for effective leadership in the SAF. The hierarchy of building blocks says values must always form the basic foundation, upon which competencies and a full range of styles are best employed in leadership. “Self-awareness, self-management and personal mastery” is most difficult to attain, and consists of a good understanding of one’s own values, competencies and styles. The hierarchy does not prescribe a sequence for development or imply that some building blocks are more important than others. The circle in Figure 1 emphasises that SAF leaders must influence people with a good understanding of the SAF’s mission & purpose, the operating environment, and desired outcomes. It is

the SAF's mission & purpose, operating environment and desired outcomes that shape the specific contents of the doctrinal framework, i.e., the specific styles, competencies, values desired in a Service or level of leadership.

Together, the four building blocks that form the triangle and three "leadership contexts" in the circle spell out the scope of concerns of the leadership development system in the SAF. In other words, when we think of "leadership development in the SAF", this includes education and training in the domain of values, behavioural competencies, styles, self-awareness and management, and in the mission and purpose of the SAF, the SAF's operating environments, and its desired outcomes.

*Definition of leadership* Whereas the SAF's 1995 definition of leadership focused primarily on task accomplishment, a decision was made in consultation with the SAF's senior leadership to re-define leadership as a process of influencing others to accomplish the mission, inspiring their commitment, and improving the organisation. The new definition presented a balanced view of leadership that was not only mission or task-focused, but also concerned with the commitment of the followers, and the long-term improvement of the organisation.

**A Systems Approach to Leadership Development**

Having developed the new Definition and Framework that collectively addressed the question "What Is Leadership" in the SAF, the next step was to derive a set of principles to guide system-level thinking on "How to develop leadership in the SAF".

Until the Review, the common tendency in the SAF was to think of leadership development or training in terms of lessons and periods in a training curriculum. However, leadership development practitioners in the commercial world and the academic literature have suggested that it is important to take a process approach to leadership development. The basic developmental processes in leadership development are best summarised in the experiential learning cycle21 and vicarious learning processes (e.g., role modelling, learning by observation) described in the social learning literature. Recent scientific literature also showed that leadership development should also engage aspects of the individual trainee or learner.

For example, in his study of the many different approaches to formal leadership training and development, Conger found that effective leadership training included elements of conceptual development, personal growth (including challenge, risk taking, self-discovery), skill-building and feedback. He concluded that ultimately, the primary contribution of formal leadership training (e.g., in courses/schools) is "awareness building". Time and actual on-the-job leadership experience are needed for mastery of leadership. He also found that leadership training also depended on the individual's motivation, ability and opportunity to learn, reflect and change (e.g., defensive people find it harder to change, learning is enhanced in a supportive workplace that provides coaching, and where bosses do not feel threatened by subordinate leaders, etc).

Similarly, in its Handbook of Leadership Development, the Center for Creative Leadership (CCL) defined leadership development as the expansion of a person's capacity to be effective in leadership roles and processes. From its experience and research, CCL argued that any developmental experience must have three elements to have an impact: Assessment to provide accurate and constructive feedback; Challenge that stretches the individual; and Support that encourages and allows the person to make mistakes.

The SAF therefore decided to think of leadership development from a systems perspective that involves the six components as follows (see Figure 2):

*Component 1*: The Self The Self is at the core of the leadership development. This component refers to the trainee's personal involvement in the developmental process. An important assumption in leadership development is that the trainee is motivated to lead and motivated to learn in the first place. Although selection procedures (e.g., "expressed interest") may be used to identify leadership trainees who are motivated to lead and to learn, these should be complemented by training processes that strengthen the trainees' personal commitment to improve themselves and to grow as a leader. It is vital that all leadership trainees take ownership of the developmental process, if they are to benefit from it.

*Component 2:* Environment This refers to the immediate organizational culture and climate and also the extent to which it is conducive for personal learning, growth and change. The ideal climate for leadership development is one that is not only "open", but one that has the capacities and disciplines for organisational learning. The learning climate should be grounded in a learning organisational culture, with personal and social practices and disciplines that facilitate individual, team and organisational-level learning, e.g., check-in/check-out, rules for quality conversations, deep listening, reflection, understanding the ladder of inference, etc.

*Component 3:* Superiors and Instructors who are Coaches and Facilitators Superiors and instructors have direct influence over their trainees and subordinates, and therefore have natural impact on their leadership development. To date, the SAF has emphasised role modelling as a primary mechanism for superiors and instructors to influence their subordinates/trainees. While role modelling or learning by observation is effective, it is also a relatively passive method of leadership development, especially when it is at the level of behaviours rather than values or purposes. Superiors and leadership instructors need to actively role model values and a sense of purpose and commitment. They should also play the role of coaches and facilitators if they are to actively assist in the leadership development of their subordinates and trainees. For this to happen, all superiors and instructors must be equipped with the necessary skills and tools to coach and facilitate development, and for active (rather than passive) role modelling.

*Component 4:* Peers, Colleagues & Subordinates Leadership is a social activity. Hence, besides individualised reflection and learning processes, leadership development is also more effective when there is team learning and feedback. Peers and subordinates can act as a "Hall of Mirrors" to facilitate leadership development among trainees and leaders on the job. For this to happen, it is necessary to facilitate team building for team learning in all learning syndicates in schools. Team building should also be introduced in units not only for team performance but also to encourage team learning of leadership and team processes.

*Component 5:* Curriculum Design A key process in leadership development is the experiential learning cycle, which calls for leadership development to be infused into everyday life activities in our training schools and units, rather than as isolated events or activities. As far as possible, training curricula should be designed to connect abstract concepts with active experimentation, concrete experience, and reflective observation. We should also incorporate the Center for Creative Leadership principles of challenge, assessments/feedback and social support in the design of leadership development activities/curricula. Finally, leadership training should incorporate a balance of the explicit and the tacit knowledge of leadership in our military context.

*Component 6:* Developmental Tools & Procedures Besides the social components (e.g., instructors/ superiors, colleagues/peers) of the leadership development system, it is also necessary to design some basic tools and procedures to support leadership development. These would include psychological assessment tools to be used to provide feedback for the individual (e.g., self-assessments, peer appraisal, 360-degree feedback), as well as tools to facilitate team and personal reflection (e.g., personal journal, team journal). The "tools" can also include procedures that facilitate leadership or command effectiveness and development, for example, processes that facilitate the preparation for command and command transition, and the facilitation of learning through after action reviews, etc.

**Conclusion**

For the SAF, the process to systematically enhance leadership development has only just begun. This article has described two guiding frameworks in the SAF's recent initiative to systematically enhance leadership development. An important assumption underlying this effort is that we can no longer leave the development of our leaders to chance processes such as passive role modelling, or common-sense notions of "leadership" and "leadership development".

The broad frameworks were developed to scope and establish a shared, organisation-wide thinking or doctrine on leadership. We have also tried to identify the organizational processes that need to be enhanced, if we are to be more systematic about leadership development in the SAF.

The next challenge will be to move from theory to practice and application. In this regard, it is interesting to note that a recent review of the scientific literature on leadership development concluded: "the practice of leadership development is far ahead of its scientific understanding", and, that "there are few extant theories of leadership development to test scientifically". We therefore expect to meet further challenges, for example, in the measurement of change and impact of or leadership development methods. It is also necessary to take a cautious, creative and experimental approach to implementing changes to the system. Finally, it will also be a challenge for the system as a whole to balance its emphasis on technical/ vocational military training with the more behavioural aspects of leadership development.

*This article was presented at the 40 th International Applied Military Psychology Symposium (IAMPS) at Oslo , Norway in 2004. The paper was voted by the symposium participants as the "Best Paper" at the Symposium "in recognition of outstanding scientific achievement and contribution to the field of military psychology". The Award was conferred by The Division of Military Psychology, Division 19 of the American Psychological Association.*

**Endnotes**

1 Tan Huck Gim, “United Nations Peacekeeping Operations: The Singapore Experience.” Presentation at 7th ASEAN Regional Forum Heads of Defence Universities/Colleges/Institutions Meeting in New Delhi ( 15 Oct 2003 ).

2 Ibid.

3 RADM (NS) Teo Chee Hean, Minister for Defence, Ministerial Statement at the Committee of Supply Debate ( 14 March 2004 ).

4 Choy Dawen, Kwek Ju Hon, Lai Chung Han, Lee Seow Hiang, Joseph Leong, Roland Ng and Frederick Teo, Creating the Capacity to Change – Defence Entrepreneurship for the 21st Century, POINTER Monograph No.1 (Singapore: SAFTI Military Institute, Feb 2004).

5 Jacqueline Lee, Melvyn Ong, Ravinder Singh, Any Tay, Yeoh Lean Weng, John J. Garstka & Edward A. Smith, Jr, Realising Integrated Knowledge-Based Command and Control: Transforming the SAF, POINTER Monograph No.2 (Singapore: SAFTI Military Institute, Mar 2004).

6 SAF Leadership Handbook (Singapore: SAFTI Military Institute, 1995), p2.

7 The SAF Core Values (Singapore: SAFTI Military Institute, 1996), pi.

8 See, for example, Bass, B. M. Leadership and Performance Beyond Expectations, (New York: Free Press, 1985); Bass, B. M. & Avolio, B. J. (Eds) Improving Organizational Effectiveness through Transformational Leadership, (Thousand Oaks, CA: Sage, 1994); Yukl, G., Leadership in Organisations (4th Ed.), (London: Prentice-Hall International, 1998).

9 See, for example, Fiedler, F. E., A Theory of Leadership Effectiveness (New York: McGraw- Hill, 1967); Blanchard, K. & Hersey. P., “Life Cycle Theory of Leadership”, Training and Development (May 1969), pp26–34.

10 See, for example, Mumford, M. D., Zaccaro, S. J., Harding, F. D., Jacobs, T. O., & Fleishman, E. A., “Leadership Skills for a Changing World: Solving Complex Social Problems”, Leadership Quarterly, 11 (2000), pp11-35; Spencer, L.M. & Spencer, S.M, Competence at Work: Models for Superior Performance (John Wiley & Sons, 1993).

11 McClelland, D. C., The Achieving Society, (Princeton, NJ: Van Nostrand, 1961).

12 For example, Chan, K. & Drasgow, F., “Toward a Theory of Individual Differences and Leadership: Understanding the Motivation to Lead”, Journal of Applied Psychology, 86, (2001), pp481-498.

13 Offerman, L.R., Hanges, P.J., & Day, D. V. (Eds) “Leaders, Followers, and the Values: Progress and Prospects for Theory and Research”, Special Issue of Leadership Quarterly, 12 (2001), pp129-131.

14 Manz, C. C., The Art of Self-Leadership: Strategies for Personal Effectiveness in your Life and Work. (Englewood Cliffs, NJ: Prentice- Hall, 1983); Manz, C. C., “Self-Leadership: Toward an Expanded Theory of Self-Influence Processes in Organisations”, Academy of Management Review , 11 (1986), pp585-600.

15 London , M., Leadership Development: Paths to Self-Insight and Professional Growth ( Mahwah , NJ : Lawrence Erlbaum Associates, 2002).

16 See also Daniel Goleman, Working with Emotional Intelligence (London: Bloomsbury, 1998).

17 US Army Training and Leader Development Panel Study (2001). Report available at http://www.army.mil/features/ATLD/ATLD.htm

18 Hall, D. T., The Career is Dead – Long Live the Career (San Francisco, CA: Jossey-Bass, 1996).

19 Hackett, J. W., The Profession of Arms (London: Times Publishing, 1963).

20 Jacobs, T. O. and Jacques, E., “Executive Leadership” in R. Gal & A. D. Manglesdorff (Eds) Handbook of Military Psychology (Chichester, England: Wiley, 1991).

21 Kolb, D., Experiential Learning: Experience is the Source of Learning and Development (Englewood Cliffs, NJ: Prentice Hall, 1983).

22 Conger, J. A., Learning to Lead (1992).

23 McCauley, C.D., Moxley, R. S., Van Velsor, E. V. (Eds) Handbook of Leadership Development

24 Kolb, op cit.

25 Day, D.V., & O'Connor, P.M.G., Leadership Development: Understanding the Process ( Mahwah , NJ : Lawrence Erlbaum Associates, 2003), p12.

LTC Chan Kim Yin, PhD, is currently the Head of Leadership Doctrine and Research Branch at the Centre of Leadership Development in SAFTI Military Institute. He is an Infantry Officer by training, and has held command appointments at the platoon and company levels. He received his BSc in Psychology from the University of London , and a PhD in Industrial-Organisational Psychology from the University of Illinois at Urbana-Champaign, USA . He is presently also an Adjunct Associate Professor at the Nanyang Business School.

CPT Psalm Lew presently holds the appointment of Staff Officer (Army) for Leadership Training and Curriculum at the Centre of Leadership Development in SAFTI Military Institute. He is an Infantry Officer by training and has previously held platoon and company command appointments. CPT Lew holds a BSc in Psychology (Hons 1st Class) from the University of Birmingham, UK. (Greensboro, NC: Center for Creative Leadership, 1998).

# The SAF's Experiences in Peace Support Operations

by LTC(Ret) Deep Singh

**Singapore's Commitment to UN and its Missions**

Singapore has enjoyed years of peace, prosperity and stability. Much of our success as a nation-state today is due to an international system based on justice and peace as well as the rule of international law. As a beneficiary of the international system, we have tried to play an active role in supporting it. We also recognise that as a small state, developments in other areas of the world, especially in the region around us, will have a direct impact on our security and economic well being. International peace and security can only be maintained with support for the efforts of the United Nations (UN) and other like-minded countries.

In spite of recent developments, the UN remains a vital and relevant institution for the maintenance of international peace and security today. Since 1948, the UN has undertaken many peacekeeping missions in all regions of the world. This has helped to defuse crises and resolve conflicts, and in doing so, allow the UN to fulfil its objective of securing international peace and order, as provided for under the UN Charter. The UN's efforts in other areas, such as the provision of humanitarian assistance and the protection of people displaced by war and civil strife, have also been crucial to the survival of millions of people.

**The SAF's Experience in PSOs, particularly in Timor Leste**

Singapore is a relative newcomer to UN peacekeeping. We first participated in a UN peacekeeping mission in 1989 when we sent a contingent of 82 men from the Singapore Armed Forces (SAF), the Singapore Police Force (SPF) and some civil servants, to help supervise the elections in Namibia under the banner of the UN Transition Assistance Group (UNTAG). Over the years, however, the SAF has contributed to numerous other UN peacekeeping missions and SAF personnel have performed many roles – military observers in Angola and on the Iraq-Kuwait border; election supervisors in Cambodia and South Africa ; and medical support staff in the Persian Gulf and Guatemala . The SAF has also undertaken a peacemaking mission in Afghanistan , and performed inspection duties with the UN Special Commission (UNSCOM) in Iraq. In all, about 1,500 SAF personnel have now served in UN missions.

The situation in East Timor , now called Timor Leste, developed very quickly following the 30 August 1999 popular consultation in which the East Timorese voted for independence from Indonesia . There was a significant increase in militia activities in East Timor and a refugee problem began to form. We saw East Timor 's future and that of the region as being inextricably linked. An unstable East Timor would have unsettled the entire region, which was undergoing wrenching transformations. This would have complicated the region's efforts to overcome the political and economic problems it faced in the aftermath of the Asian Financial Crisis. For us, East Timor was not an abstract matter but one of vital and immediate strategic importance for the whole region.

It was against this backdrop that the government made a quick decision to participate in the UN-sanctioned International Force in Timor Leste, or INTERFET, led by Australia , in 1999. There was an immediate need for the international community to step in to stabilise the situation in East Timor . However, the region also had to ameliorate Indonesia 's suspicions about the presence of such a force in East Timor . Indonesia would have been very reluctant to accept an international force made up largely of Western countries. An Asian or ASEAN face to the international force would be necessary for it to be acceptable to the Indonesians. As such, it was not coincidental that INTERFET saw the participation of many other ASEAN countries, including Malaysia , Thailand and the Philippines . Among the first countries to be in East Timor, Singapore's support in INTERFET took the form of two RSN LSTs, an SAF liaison team and a medical detachment from the Medical Corps. A total of about 370 SAF personnel served in INTERFET, which made it our largest ever contribution to a PSO at the time. However, INTERFET alone was not sufficient to guide East Timor into self administration and eventually independence. In October 1999, INTERFET's mandate was handed over to the United Nations Transitional Administration in East Timor (UNTAET). UNTAET had a wider mandate, not only being tasked with maintaining law and order throughout the territory of East Timor but also establishing an effective administration, assisting in the development of civil and social services, coordinating humanitarian aid and rehabilitation. Singapore recognised that UNTAET had a challenging task ahead, and that in order to succeed, UNTAET would require not only the support of East Timorese but also the continued support of the international community.

We stood ready to support the UN's efforts in two ways. We assisted in a smooth transition to UNTAET, and helped UNTAET maintain the peaceful conditions necessary for the return of normalcy. In January 2000, we continued the participation of our medical teams and offered staff officers for the UNTAET Headquarters in order to help the transition. The Singapore Police Force also deployed 40 officers to join the UN Civilian Police mission in East Timor . And in May 2001, at the UN's request, we deployed a platoon of armed peacekeepers in UNTAET for a period of one year, and then extended the deployment of our platoon for another six months from May to Nov 02.

Looking back, this was a significant milestone in our limited peacekeeping experience as it was our first deployment of combat peacekeepers. It was not an easy decision sending our men on a combat peacekeeping mission. The SAF exists to protect Singapore 's sovereignty and territorial integrity. There was a concern that our soldiers would not see it as their primary or natural responsibility to restore law and order to a land so far away from home. We had to muster the support of our population and we would certainly have had to grapple with political consequences should anything have happened to our troops. Notwithstanding these considerations, we responded positively to the UN's call.

A stable and lasting foundation for Timor Leste cannot be built overnight. The assistance of the international community was and will remain crucial in helping Timor Leste meet the challenges of a newly independent country. In recognition of this reality, the UN continued to maintain a presence in Timor Leste during the post independence period to ensure the security and stability of the nascent state. A successor mission, the UN Mission of Support in Timor Leste or UNMISET, replaced UNTAET, and its mandate will run till May 2005. In line with our support for the UN in Timor Leste and our interest in ensuring a stable regional environment, we committed a company of combat peacekeepers, staff officers and civilian policemen, and also provided an air lift capability to UNMISET with the deployment of four UH-1H helicopters from the RSAF.

It was a great honour for the SAF to have an officer, BG Tan Huck Gim, selected to be Force Commander of the UNMISET peacekeeping force. During his tour of duty as Force Commander, BG Tan oversaw the development of the Timorese defence forces' capabilities to ensure a sustainable security environment, tactical and operational improvements within the peacekeeping force as well as the successful management of the border. BG Tan successfully completed his one year term as Force Commander in August 03 and returned to Singapore to take up the post of Commandant, SAFTI Military Institute.

**The SAF's Approach: Developing Niche Areas**

The deployment of SAF personnel in international peacekeeping is not without its challenges. Given that the bulk of our personnel are Full-time National Servicemen, we are limited in the extent and scale to which we can contribute to UN peacekeeping missions. Small size does not preclude states from contributing effectively to UN peacekeeping operations and we believe that we are still able to contribute effectively through the development of niche areas of expertise. Our approach has therefore been to participate in areas where our contributions would have the most effect and where they are most valued.

Over the years, one niche area in which we have built up considerable expertise is the provision of medical support. In January 1991, we contributed a medical team during the first Gulf War. In fact, our assistance was in response to the request by the British Government to provide medical manpower enhancement to a British rear hospital in support of multinational forces fighting the Gulf War. Our 30-man medical team worked alongside the British at the 205th General Hospital . This was the first time that we had operated in a war theatre.

Our stint with the British 205th General Hospital had allowed us to gain experience surrounding the establishment and management of a large rear military hospital as well as to study field medical support systems and hospitals of many other nationalities, including the British, Americans, French, Canadians, and the Swedish. We were also able to learn the chemical protection and decontamination doctrines of the Americans and the Swedish. Our time spent in the Gulf was invaluable – it brought home the lessons of the terror of war and showed us how we could make the SAF Medical Corps more operationally ready. Such a lesson could never be learnt through exercises in peacetime.

These experiences proved to be extremely beneficial as more medical missions were sent after Gulf War, including 10 teams operating in Timor Leste between 1999 and 2002. In 1997, another medical team provided support to the UN Military Observer mission attached to UN Verification Mission in Guatemala (MINUGUA). In addition, we have sent medical and surgical teams on numerous humanitarian and disaster relief missions. The RSAF has also undertaken airlifts of humanitarian aid to disaster areas throughout Asia .

**Conclusion**

Small states need to adopt a different approach and strategy from their larger cousins to be effective as contributors to UN peacekeeping. There is no “one size fits all” solution. States have to tailor their participation accordingly, taking into account the peculiar characteristics of each mission as well as their own circumstances.

Singapore has tried to formulate its own strategy for UN peacekeeping based on our strengths as well as our constraints. The SAF continues to work on developing capabilities in niche areas, and seeking new areas in which we can contribute to global peacekeeping. However, we need to remain selective and participate in missions where we have the means and ability to make an effective contribution. Singapore views its responsibilities as a member of the international community seriously, and the SAF will continue to support UN peacekeeping and humanitarian efforts, to the best of its ability, to help build and maintain a peaceful world.

*This article is adapted from a presentation at the 2nd Royal United Services Institute – Institute for Defence and Strategic Studies Conference, held in London in 2003.*

LTC(Ret) Deep Singh, PP, is currently Branch Head, Joint Operations Department, MINDEF. He has held numerous command and staff appointments during his 32 years of active service with the SAF. LTC(Ret) Deep Singh also has significant international experience including serving as Lead Military Planner for the UN Mission to East Timor, Military Division, United Nations Department for Peacekeeping Operations in 2001, Military Consultant to the United Nations Office of Internal Oversight Service in 2003 and a Member of the teaching staff of the International Institute of Humanitarian Law, San Remo, Italy. LTC(Ret) Deep Singh holds a BSocSci (Hons) (2nd Div Upper) (Political Science) and BA (History) from the National University of Singapore as well as a Graduate Diploma in Personnel Management.

# Armed Humanitarian Intervention: An Emerging Issue and Controversy In Need Of a Consensus

By LTC Soh Star

International politics was dominated by the Cold War for over four decades until the collapse of the Soviet Union in 1989. With the end of the Cold War and increasing globalisation, the focus on state security with regard to conventional threats has greatly diminished, particularly among the Western nations. The United Nations (UN), which encapsulates the affairs of international politics, found herself a new role and identity by shifting focus to human security, i.e., a global concern for individual human rights and well being. In order to achieve human security, intervention in states to prevent or stop human death and suffering is sometimes necessary. As an indication of this changing focus, the number of UN-sanctioned humanitarian interventions after the cold war increased many times when compuiared to the period from 1945 to 19901.

However, humanitarian intervention is a very controversial issue in international politics. The fundamental issue is that it violates the sovereignty of the state which embodies the principle of non-intervention in the manner a state chooses to conduct its domestic affairs (Article 2(7)2 of the UN charter). This principle of nonintervention is almost sacrosanct, with the exception of the inherent right of self-defence and UN-sanctioned intervention (article 513 of the UN charter). It is this principle that many have believed and adopted to maintain international peace and order. The established world order paradigm is now being challenged!

The controversy goes beyond conceptual (moral and legal) disagreement. There are many operational issues with humanitarian intervention that also pose a challenge to international politics. Some of these issues include the criteria for humanitarian intervention to be activated, the authority for deciding intervention, who to intervene, the form and extent of intervention, and when the intervention should terminate. This article will examine both the conceptual and operational issues of humanitarian intervention, drawing mostly on post-Cold War events in Iraq , Somalia , Bosnia , Rwanda and Kosovo to illustrate the issues. Finally, this article will discuss the developments that have been made to advance the humanitarian intervention cause and reduce the controversies, and conclude with an appraisal of the future for humanitarian intervention.

**What Is International Politics And Humanitarian Intervention?**

International politics is about relationships and “trans-border actions of states and non-state actors” in the international community. They are anchored on a set of assumptions and principles that is widely accepted by all the states, allowing the states to peacefully co-exist and function with each other, thus bringing about global stability and order. The concept of the state and its sovereignty can be traced back to the Peace of Westphalia which ended the Thirty Years War in 16485. The state is “a form of political organisation that claims the exclusive right to govern a specific piece of territory”. Sovereignty has two dimensions, the internal/domestic dimension which lay claim to final legal authority within the state, and the external/interstate dimension which rejects the legitimacy of any authority higher than the state. The principles of equal rights of states and non-intervention of each other’s domestic affairs naturally follow from the definition of sovereignty. Because there is no legal higher authority or enforceable laws on the state, the international system is therefore anarchical and self-help becomes the sine qua strategy for the survival of the state. As such, there is an important assumption that states will look after the welfare of their citizens.

There are many definitions of humanitarian intervention. Below is a sample to give a sense of the essence of humanitarian intervention.

Humanitarian Intervention is an armed intervention in another state, without the agreement of that state, to address (the threat of) a humanitarian disaster, in particular caused by grave and large-scale violations of fundamental human rights.

• North Atlantic Treaty Organisation (NATO) seminar in Scheveningen (November 1999)9 Coercive action by states involving the use of armed force in another state without the consent of its government, with or without the authorization from the United Nations Security Council, for the purpose of preventing or putting to a halt gross and massive violations of human rights or international humanitarian law.

• Danish Institute of International Affairs (1999)10. . . coercive, and in particular military action, against another state

for the purpose of protecting people at risk in that other state.

• International Commission on Intervention and State Sovereignty (2001)

Culling from the above definitions, the essence of humanitarian intervention is a coercive intervention that breaches the sovereignty of the state and the goal is to prevent or restore fundamental human rights, and/or prevent or stop human sufferings. The remaining of this article will focus on humanitarian intervention in the form of an armed or military intervention against the will of the state or in failed states where there is no functional or legitimate government.

**Conceptual Issues of Contention**

The conceptual issues of contention revolve around the moral and legal basis of humanitarian intervention, set against the legal rights of states and the goals and principles of international society, and as interpreted by the different schools of thought (e.g., realist-liberalist; pluralist-solidarist).

**Moral Basis**

Proponents of humanitarian intervention, in particular the liberalists and solidarists, would argue that it is a moral duty for the international community to intervene to prevent humanitarian disasters and that the principle of protecting human lives is above that of protecting state sovereignty. According to Vincent and Wilson (1993), "states ought to satisfy certain basic requirements of decency before they qualify for the protection which the principle of non-intervention provides". The authors believed that it is the duty of the state to protect and provide for its own people, and should the state fail in its duty, the international community then has the right to intervene.

Opponents of humanitarian intervention, in particular pluralists, would cite "rule consequentialism" to argue that human security is morally better served by the principle of nonintervention than by humanitarian intervention. In the absence of clear criteria and control over humanitarian intervention, international order will be destabilised by the abuse of humanitarian intervention to intervene in state sovereignty, resulting in greater inter-state conflicts and hence human suffering. Realists would support the position of the pluralists by arguing that states would not intervene purely on humanitarian reasons because actions of states are guided by national interests and that they have no moral right to risk the lives of their own soldiers for citizens in another state.

What do humanitarian disasters and interventions in the last decade tell us about the moral duty of the international community and consequences of humanitarian interventions as argued by the different schools of thought? Plight of about one million Kurds in Northern Iraq after the 1991 Gulf War led to UN Security Council (UNSC) resolution 688 (which called upon Iraq to stop its attacks and allow humanitarian relief to reach them) and Operation Provide Comfort. U.S. and allied forces enforced 'no-fly zones' to deny Iraq aircrafts from attacking the Kurds, and at the same time, together with non-government organizations (NGOs), provided humanitarian aid and facilitated Kurds refugees to return to their villages. Indeed, the international community's humanitarian intervention prevented a humanitarian disaster from developing.

As for Somalia , tens of thousands were killed and hundreds of thousands fled their homes as a result of fighting among factions after the government collapsed. Under the pressure from NGOs, the UNSC passed resolution 794 (in Dec 1992) to employ "all necessary means to intervene and establish as soon as possible a secure environment for humanitarian relief operations in Somalia " as the U.S. was prepared to sponsor a military intervention (Operation Restore Hope). With UN protection, relief reached thousands of Somalians. The intervention again reinforced the importance of human security over state sovereignty (a failed state in this case).

In March 1999, NATO led by U.S. , launched Operation Allied Force in a bid to prevent the ethnic cleansing of Kosovar Albanians by the Serbs. The official justification for the operation was unprecedented, it was based on the protection of fundamental human rights and the prevention of a humanitarian disaster from developing.

On the other hand, NATO did not seriously intervene in Bosnia until summer 1995, four years after civil war broke out between Bosnia Serbs, Muslims and Croats, and only after thousands of civilians were killed, a million displaced internally and another million as refugees17. Similarly, UN did not decisively intervene in Rwanda when genocide took place between April and July 1994; about a million Tutsis and "moderate" Hutus were systematically killed by Hutu extremists. Two million Rwandan citizens were internally displaced and another two million sought refuge in neighbouring countries. In fact, three weeks after the genocide began, the UNSC voted to reduce the number of UN

military personnel in Rwanda .

Looking at the humanitarian interventions in Northern Iraq , Somalia and Kosovo, and “non-interventions” in Rwanda and Bosnia for the last decade, UN and NATO have been criticised for their inconsistency to uphold their moral duty to intervene, to prevent or stop humanitarian disasters. The reality is that a lot has to do with the support of the U.S. Being the only superpower, U.S. has considerable influence over UN and NATO’s decision and ability to intervene militarily. Clearly, the exercise of the moral duty has been constrained by various political considerations (as the realist would argue). Many scholars have suggested that the U.S. was pressured into military intervention in Northern Iraq and Somalia because of homeland public opinion shaped by daily media reporting of deaths and atrocities. And because of the bad experience in Somalia where 18 U.S. soldiers were killed in a single incident and low returns for national interest, the U.S. was reluctant to go into Rwanda and Bosnia . The ghost of inaction in Rwanda and Bosnia seemed to have partly caught up with the U.S. and NATO, hence, Operation Allied Force was launched for Kosovo to prevent another genocide and humanitarian disaster.

Was international stability and order affected by the humanitarian intervention episodes as claimed by proponents of rule consequentialism? Since post-Cold War, there has been no inter-state conflict (other than UN/ NATO sanctioned) that has originated from the claim of humanitarian intervention. It is unlikely that such a claim by individual states will ever be made under the current UN Charter (even though it was probably legitimate to do so when Vietnam invaded Cambodia to remove the Pol Pot regime and when Tanzania invaded Uganda to oust Idi Amin)19. However, the jury is still out there given that humanitarian intervention has only recently begun its journey to challenge the existing norm of non-intervention in the internal affairs of sovereign states.

**Legal Basis**

What is the legal basis for human intervention? Although there is no higher authority than the state, the UN Charter and other international conventions such as the “Convention for the prevention and punishment of the crime of genocide” have been regarded as international law. While the principle of non-intervention and the conditions for use of force are clearly spelt out in the UN Charter (Articles 2(7) and 51), humanitarian intervention can only be inferred from the goals of the UN to maintain international peace and order (Article 1(1)) and to advance universal respect for human rights and fundamental freedom for all (Articles 1(3), 55 and 56). Restrictionists and most international lawyers would argue that the Articles cannot be interpreted as legal justification for humanitarian intervention whereas Solidarists and Counter-restrictionists would argue otherwise. Interestingly, when the UN sanctioned humanitarian intervention, the resolutions were often worded to include the aim to “restore international peace and order” (as if to confer greater legitimacy) and in general terms such as “all necessary means” to allow the use of force (e.g., the UNSCR 794 for Somalia ).

Although there is no clear legal provision for humanitarian intervention in the UN Charter, if a UNSC resolution is passed for a humanitarian intervention, that in itself provides adequate legitimacy for the intervening military force. With increasing number of UN sanctioned humanitarian interventions, one might concede that it has become a customary law and may in future be codified more specifically in the UN Charter as an international law.

If UNSC-sanctioned humanitarian interventions are seen as legitimate, what about humanitarian interventions that might be sanctioned by regional organisations such as NATO, EU or ASEAN? For example, NATO’s Operation Allied Force in Kosovo was a humanitarian intervention but undertaken without UNSC’s approval. This was because any resolution for an armed intervention would have been vetoed by Russia and China . This precedence presents a new controversy regarding the legitimate custodians of humanitarian intervention in international politics. In particular, what should be the size, composition and nature of regional collectives in order for their actions to be perceived as legitimate by the international community?

**Operational Issues of Contention**

Besides moral and legal issues, there are also various operational issues such as the criteria/conditions that justify intervention, who can authorise the intervention, who should intervene, the form the intervention should take and when intervention should terminate? These issues are not independent, they bear implications on the moral or legal basis of humanitarian intervention as well. Altogether, these operational issues have resulted in three main concerns with humanitarian intervention in international politics.

The first concern is abuse. There is a concern that humanitarian intervention may be abused to justify the invasion and occupation of another country when the intent is purely a political one. Realists will point out that government of

states do not engage in humanitarian intervention primarily out of morality because of the high cost to the state in terms of financial cost and endangerment of their troops. There will always be a political reason for the state to approve humanitarian intervention. For example, one of two neighbouring countries competing for scarce resource may claim the ill-treatment and abuse of human rights of certain ethnic or religious groups in the other country to justify an invasion on humanitarian grounds. This hypothetical example exemplifies the strong end of abuse where the goal is to occupy the territory of another state or to remove its government. Lesser form of abuse is to capitalise on humanitarian intervention to gain political mileage. For example, it has been argued that the main motivation for the U.S. to intervene in Northern Iraq and in Somalia was to appease their own public who were shown daily footages of human rights abuses by the media (the "CNN effect"). The danger of such lesser abuses is that when events take a turn or when the media diverts its attention elsewhere, the state commitment to the humanitarian intervention wanes, leaving those in need in the same or sometimes more dire condition. This was the case with the U.S. in Somalia after 18 of their elite rangers were killed in a single firefight in Oct 1993. The U.S. homeland support nose-dived and within 6 months after the incident, the U.S. pulled out its forces, about 18 months ahead of the UN mandate.

The second concern is the inappropriate application of humanitarian intervention. The issue here concerns the subjectivity of what constitutes human rights violation and suffering that would justify a humanitarian intervention. While the definition and identification of genocide21 are fairly clear, there is much less consensus on what are the violations of fundamental human rights. Although there is the Universal Declaration of Human Rights which was adopted and proclaimed by the UN General Assembly in Dec 1948, it is merely a statement of the ideals. There are many cross-cultural differences in the definition and standards of what constitute basic human rights. History has also taught us that what was acceptable to the society at one point in time (e.g., slavery and capital punishment) was not acceptable to the same society a few generations later. Who then has the authority to impose moral values on another state?

The third concern is that humanitarian intervention may result in greater harm than good. This is likely to occur when the participating nations are primarily motivated and/or constrained by national self-interest and do not adhere to the principles of jus ad bellum and jus at bello22. This concern is borne out by the actions of the U.S.-NATO operation in Kosovo in their claim to prevent a humanitarian crisis from becoming a catastrophe. As the U.S. was unwilling to lose any troops (as they did in the humanitarian intervention in Somalia ), the operation took the form of a 78-day high altitude bombing campaign of Serbia . Many critics have pointed out the paradoxes of the campaign. Firstly, the imprecise high-altitude bombing on political non-military targets in Serbia has resulted in about 1,500 civilian casualties killed and 6,000 wounded as compared to only hundreds of Serbian troops. Secondly, the non-commitment of ground forces has allowed the Serb Army to intensify its ethnic cleansing of Kosovor Albanians after the air campaign has started. Hence, the claim of a humanitarian cause is hollow in the light of high civilian casualties and increased suffering of the Kosovor Albanians.

The above three concerns of humanitarian intervention are certainly valid because presently there is an absence of clarity and consensus on the criteria and authority to sanction humanitarian intervention, as well as the manner in which humanitarian intervention should be conducted and terminated. As such, humanitarian intervention by individual states or even regional groupings should not be sanctioned or legitimized now. UNSC, which has the approval of the international community, must therefore be the authority to sanction humanitarian intervention. With its diverse members representing the interests and cultures of different regions of the world, it has the legitimacy to prevent abuse and inappropriate application of humanitarian intervention and to dictate the manner in which it should be conducted.

**Reducing the Controversies**

Recognizing the concerns and in an attempt to advance the global human security cause, United Nations Secretary-General Kofi Annan, in his report to the 2000 General Assembly, challenged the international community to try to forge consensus around the principles and processes involved in humanitarian intervention: when should intervention occur, under whose authority, and how? In response to the challenge, the independent International Commission on Intervention and State Sovereignty was established by the Government of Canada in September 2000.

The Commission's report, The Responsibility to Protect, a culmination of twelve months of research, worldwide consultations and deliberation, was formally presented to the UN community in December 2001. The report adopted a fresh perspective by focusing on the "responsibility to protect" so as to move away from the existing paradigm and contest between sovereignty and humanitarian intervention. The central idea is that sovereign states have a responsibility to protect their own citizens from avoidable catastrophe, but when they are unwilling or unable to do

so, the international community must bear that responsibility. Also, if the international community has a right to intervene, then it has a responsibility to stay and help with the aftermath of a conflict, i.e., rebuilding of the state. The intervention may be in the form of political, economic or judicial measures or, in extreme cases, military action. The report spelt out two thresholds for military action, i.e., “large scale loss of life, actual or apprehended . . .” and “large scale ethnic cleansing . . .” Any military action must adhere by the principles of jus ad bellum (just cause, right intention, last resort, proportionality, reasonable prospects and right authority). The report even urged the five permanent members of the UNSC not to exercise their veto powers in such matters where their vital national interests are not involved so as to give the due process even greater credibility.

The report has done a great job by clarifying and specifying many aspects that were previously ambiguous, thereby addressing directly the conceptual, legal and operational issues and concerns of the international community. For example, with the threshold for military intervention defined at such a high level, many states will be comforted that humanitarian intervention is unlikely to be abused or inappropriately applied. Hopefully, the report will be able to generate dialogue and build a new consensus and attitude in the international community regarding their responsibilities, which ultimately will help to facilitate prompt intervention to prevent a humanitarian disaster in failed or rouge states.

Another development that would help advance the humanitarian intervention cause is the revamp of the UNSC structure. Presently, the UNSC has five permanent members with veto powers: Britain , France, USA , Russia and China , and another 10 members with 2-year rotational seats. The composition of members with veto powers does not proportionately represent the interest of international community. It has been proposed that the current structure be revamped to a three-tier structure where Indonesia , India , Japan , Germany and Brazil would form the second tier with permanent seats but no rights of veto. If such a proposal is adopted, it would further enhance the status and legitimacy of a UNSC-sanctioned humanitarian intervention.

**Conclusion**

Humanitarian intervention is a controversial issue in international politics today because its very essence goes against the established international norm of non-intervention which has been upheld as the key principle for maintaining international order. However, in the last 12 years after the Cold War, the sacredness of the established norm has been challenged in the face of growing attention paid to human sufferings in failed or rouge states. Various armed humanitarian interventions sanctioned by the UN and NATO, in the absence of legal provisions and a well-articulated doctrine, have highlighted the complexities, issues and concerns regarding humanitarian intervention.

The watershed report, The Responsibility to Protect, is a bold attempt to change mindsets and build consensus for humanitarian intervention. Armed with definitions, declarations and recommendations, the report removes many existing ambiguities and provides the framework for dialogue to reduce the controversies and addresses the concerns. The success of the report would be measured by the establishment of a new international norm for humanitarian intervention that can effectively co-exist with the nonintervention norm.

While a new mindset may be established, there is no illusion that there will continue to be many practical problems and inconsistencies in implementing humanitarian intervention because of the high cost of such operations and the inherent self-interest of states. However, the alternative is to passively wait and accept the repeat of another genocide. In the final analysis, humanitarian intervention is a moral cause worthy of pursuit despite the imperfections and obstacles in its implementation.

**Endnotes**

1 International Development Research Centre, The Responsibility to Protect, “Interventions before 1990” and “Interventions after the Cold War” (Online). Available: http:// www.idrc.ca/books/963.html [2003, June 7].

2 UN Charter Article 2(7): Nothing contained in the present Charter shall authorize the United Nations to intervene in matters which are essentially within the domestic jurisdiction of any state or shall require the Members to submit such matters to settlement under the present Charter; but this principle shall not prejudice the application of

enforcement measures under Chapter VII.

3 UN Charter Article 51: Nothing in the present Charter shall impair the inherent right of individual or collective self-defence if an armed attack occurs against a Member of the United Nations, until the Security Council has taken measures necessary to maintain international peace and security.

4 Alan C. Lamborn and Joseph Lepgold, World Politics into the twenty-first century: Unique contexts, enduring patterns ( Upper Saddle River , NJ : Prentice Hall, 2001), p52.

5 Ibid, p22.

6 Ibid, p22.

7 Hedley Bull, The Anarchical Society: A study of order in world politics (London: Macmillan, 1977).

8 Ibid.

9 Cited in Center for Strategic Studies, "Humanitarian Intervention: Definition and Criteria", CSS Strategic Briefing Papers, Vol. 3, Part 1 (June 2000), p1.

10 Danish Institute of International Affairs, Humanitarian intervention: Legal and political aspects (Copenhagen: DUPI, 1999), p11.

11 International Commission on Intervention and State Sovereignty, The responsibility to protect. ( Ottawa , ON : International Development Research Centre, 2001), pVII.

12 Nicholas J. Wheeler, "Humanitarian intervention and world politics", in John Baylis and Steve Smith (eds), The globalization of world politics: An introduction to international relations ( Oxford : Oxford University Press, 2001), pp470-493.

13 Vincent and Wilson (1993), cited in Wheeler, op. cit., p396.

14 Wheeler, op. cit., p395.

15 Robert Jackson, The global convenant: Human conduct in a world of states ( Oxford : Oxford University Press, 2000), pp260-263; Robert C. DiPrizio, Armed humanitarians: U.S. interventions from Northern Iraq to Kosovo ( Baltimore , MD : The John Hopkins University Press, 2002), pp23-43.

16 Robert C. DiPrizio. Armed humanitarians: U.S. interventions from Northern Iraq to Kosovo ( Baltimore , MD : The John Hopkins University Press, 2002), p46.

17 Jackson, op. cit., p268.

18 DiPrizio, op. cit., p65.

19 Wheeler, op. cit., p392.

20 Ibid, p396.

21 William Schabas, The genocide convention atFifty (Online, 1999). Available: http://www.usip.org/pubs/specialreports/sr990107.html [2003, June 7].

22 Michael Walzer, Just and unjust war: A moral argument with historical illustrations, 2nd edn. (New York: Basic Books, 1992).

23 Robert Hayden, Humanitarian Hypocrisy (Online, 1999). Available: http:// www.jurist.law.pitt.edu/hayden.htm [2003, June 14].

24 International Commission on Intervention and State Sovereignty, op. cit., p32.

25 Robert Go, "Revamp for UN Security Council?", The Straits Times, May 2003.

LTC Soh Star, PhD, is currently Acting Head, Applied Behavioural Sciences Department (ABSD)/Chief Psychologist

and an adjunct associate professor at Nanyang Technological University. LTC Soh has previously held the appointments of Head, Field Psychology Branch and Social Psychology Branch, ABSD. He attended the Singapore Command and Staff Course in 2003 and holds a Bsc (1st Class) in Psychology from the University of Manchester , and PhD in Industrial-Organisational Psychology from Ohio State University.

# TECH EDGE: Low Cost Virtual Cockpits for Combat Experimentation

by MAJ Chia Chien Wei

*"MAJ Chia, who has a PhD in modelling and simulation, has been pursuing various modelling & simulation ideas and this one is clearly one very interesting and useful idea."*

*- Prof Lui Pao Chuen, Chief Defence Scientist*

*"The author's innovative idea was presented to I/ITSEC as a paper and received positive feedback from various participants. The solution has in fact been adopted by the SAF Centre for Military Experimentation and would be considered for application in other modeling simulation."*

*- Teo Chin Hock, Dir (C4IT Services), DSTA 6u*

**Abstract**

The first stage in any new concept experimentation is often known as "screening"1 or "discovery"2. In general, the idea behind this experimentation stage is to weed out the fuzziness that usually surrounds new concepts. Two options were available for discovery air combat experimentation prior to this research: (1) the use of domed simulators and (2) the use of actual live platforms. While not ruling them out for experimentation when the concepts are clearer, both of them were considered too scarce and pricey for the purpose of initial concept discovery experimentation. Although two low cost options were available based on a technology scan, none was found to be suitable for various reasons. This paper describes the research in which an innovative solution for a simulation environment was found to more cost efficiently enable air combat discovery experimentation. The solution has been incorporated into the Singapore Armed Forces Centre for Military Experimentation's (SCME) simulation system and is used on a routine basis. This has brought about a two orders of magnitude savings in cost when compared with a domed simulator.

**Introduction**

In the original configuration of the Joint Battle Simulation System (JBS) at SCME, a virtual cockpit was simulated with two consoles as shown in the Figure 1: one screen to display the avionics and weapon systems and the other screen to display a 60 degrees Field of View (FOV) forward out-of-window view. The two-screen virtual cockpit set-up was deemed inadequate for discovery air combat experimentation because it does not cater for scenarios spanning Beyond-Visual- Range (BVR) to Within-Visual-Range (WVR) air combat. Specifically, the limitation is in its inability to simulate the WVR scenarios. The limited 60 degrees FOV out-of-window view is not able to provide the pilots with the necessary situational awareness to carry out WVR Basic Fighter Manoeuvres (BFMs).

Two options were available for discovery air combat experimentation prior to this research: (1) the use of domed simulators and (2) the use of actual live platforms. While not ruling out these options during hypothesis testing and demonstration experiments when the concepts are clearer, both of them were considered too scarce and pricey for the purpose of initial discovery experimentation where concepts could be very fuzzy. As a result, there was therefore a need for SCME to find a solution to enable cheap air combat discovery experimentation.

The purpose of this research was therefore to see how the limitation imposed by the two-screen Virtual Battle System (VBS) virtual cockpit could be addressed most cost-efficiently without introducing side effects such as motion or simulator sickness for the experimentation pilots.

**Technology Scan**

Based on a technology scan, two low cost options were available to SCME for incorporation into the JBS. They are described below vis-à-vis their limitations.

**Virtual Reality (VR) Goggles**

The defining feature of VR goggles is that the stereoscopic display stays with the user as he or she moves about performing a task. This gives the perception that it provides better immersion or presence. One of the concerns, however, with the use of VR goggles for experimentation has been the reports of discomfort commonly referred to as simulator sickness. There have been many research examining motion sickness with the use of VR goggles.

For SCME, the possibilities offered by stereographic computer graphics in VR goggles are exciting, but the findings from past research need to be seriously considered, especially with a possibility of them introducing simulator sickness. Another of SCME's considerations was the cost and weight of such goggles. In general, VR goggles that are capable of providing more realism and comfort tend also to be heavier and costlier. For these reasons, SCME decided that although VR goggles has the potential to be used for air combat discovery experimentation, it could perhaps be integrated with the VBS at a later stage.

**Multiple Out-Of-Window-View Screens**

The other option that was reviewed was to have multiple screens providing a larger horizontal FOV. Although it is thought that the pilots will encounter less discomfort or simulation sickness as compared to VR goggles, this common approach still does not provide a satisfactory vertical FOV available in the domed-simulator. Without the necessary vertical FOV and therefore situational awareness, this option also seems unlikely for its applicability in WVR scenarios during air combat discovery experimentation.

**Mindset Shift**

The technology scan revealed that there may be no suitable solutions out there that will meet SCME's need for air combat discovery experimentation. The outcome of this assessment prompted a necessary change in mindset to perhaps look at the problem differently. That different perspective was found by asking "What information is actually needed for WVR?", rather than the classic question of "How to best represent the live environment that is being seen by the pilots?" Both questions are related to the issue of simulation fidelity but approach it from opposite poles; one aims to provide extreme fidelity and the other aims to provide just enough for experimentation. When considering levels of fidelity for experimentation, it is traditional and often assumed that high fidelity is never a disadvantage. Asking the second question was therefore a mindset shift and one that really sets this research in motion.

Unstructured interviews with the pilot Subject Matter Experts (SMEs) were then carried out to determine the information needed for WVR air combat. Based on the outcome of these interviews, several pieces of information turned out to be critical for decision-making for WVR scenarios. It was decided that an additional LCD display over and above that in Figure 1 could be used to display them. This augmentation is shown in Figure 2.

**The Frames Of Reference Problem**

What was not very certain during the prototyping stage was whether the information should be displayed in a pilot's-eye (egocentric) or god's-eye (exocentric) manner. See Figure 3 for the different displays. The pilot's-eye display presents an egocentric frame of reference because the symbol representing ownship remains stationary while the flight environment moves around it. The god's-eye display presents an exocentric frame of reference because the airplane symbol moves while the flight environment represented by the computer display remains fixed. This uncertainty was based largely on the fact that the literature search on display engineering identified this problem as a key area of controversy and concern. The Frames of Reference Problem, especially under the context of navigation and electronic map displays has been extensively studied. This has been a controversial subject from the date of invention of gyroscopic flight instruments, directional gyros, and attitude. This issue continues to be a controversy almost two decades later and continues to intrigue researchers, e.g. to attempt to provide neuropsychological explanations as to why the exocentric view is better. The frames of reference problem therefore became the focus of the experiment.

**Experimental Methodology and Hypotheses Tested**

Using a sound statistical methodology, the following simulation environments were compared in the experiment using 6 operational pilots and 72 experimental runs: (1) domed simulator, (2) desktop with egocentric 2D augmentation, (3) desktop with exocentric 2D augmentation and (4) desktop with no augmentation. The main hypothesis was that the performance on the egocentric 2D augmentation will do no worse off than a domed simulator.

## Findings

The performances from the four environments were statistically different. Figure 4 shows the plot of the performance produced by each of the four experimented environments. This finding augurs well for the purpose of this research because there is now evidence to show that the desktop with egocentric 2D augmentation configuration can now feature as a discovery air combat experimentation platform. This will reduce the needed resources to explore new warfighting concepts at the initial discovery stage without starting in the domed simulators or live environments.

Although the performance in the desktop with egocentric 2D augmentation environment is statistically different with the domed simulator, the plot in Figure 5 suggests that the preference of an egocentric display might not apply across the board to all pilots. Pilot 6, for example, did better in the desktop with exocentric 2D augmentation environment as opposed to all other pilots. This tells us that the preference and performance for the different frames of reference may not be so uniformed. This has a larger operational implication especially when there is a need to synchronize different preferred frames of reference in real time for combat.

## Future Research

Due to the potential savings in cost, it is perceived that there would be a general interest to develop the process undertaken in this research into a development methodology for determining suitable levels of simulation fidelity for experimentation. Although it has been stated that “if decision making skills and tactics are being evaluated, then high fidelity in simulation vehicle handling characteristics are not critical”, the question of how low this fidelity can go remains to be investigated. The author believes that the answer can be found in the methodology known as Cognitive Task Analysis (CTA) in which the goals and sub-goals of the tasks are mapped out and the cues needed to make the decisions leading to the sub-goals and goals are elicited Further, for this future track to be successful, the question of how other related human factors issues are to be integrated should also be investigated.

As it turned out, there is a lot more to discover about the Frames of Reference problem beyond this research. This research has given a glimpse of its intricacies for air combat as well as for experimentation. It is believed that this is a key area to be addressed under the larger investigation of aligning mental models for the purpose of self-synchronization in Network Centric Warfare (NCW).

## Conclusions

The research sets out to address the limitations of the simulation system in SCME for the purpose of air discovery experimentation and has done so successfully. This research has also demonstrated that it is not always necessary to scramble for the latest gadgets in the market and that a cheaper solution may emerge with careful deliberation, research and experimentation. While the product of this research will not replace higher fidelity simulations like the domed simulators, it does provide a very useful and cheap platform for the initial discovery experimentation. This is important because the most important questions to answer in transformation and experimentation are often not so apparent at the stage of a new conceptualization. Having as cheap an environment to sieve out the most important questions therefore makes a lot of sense not only for air combat but also for all other experimentation in the other contexts. Last but not least, this research is operationally significant because air combat discovery experimentation can now potentially be conducted at a cost two orders of magnitude lower when compared with a domed simulator. Its routine use at SCME serves as the best testimony for its effectiveness.

## Acknowledgements

The author would like to thank Richard Thiang from Defence Science Technology Agency and the pilot SMEs and participants that were part of this effort; especially MAJ Maharaj or “BIG MAC.” This research would not have been successful without their inputs.

## Endnotes

1 D. C. Montgomery , Design and Analysis of Experiments, ( New York , NY : John Wiley & Sons, Inc., 2001), p9.

2 D. S. Alberts and R. E. Hayes, Code of best practice for experimentation, ( Washington D.C. , VA: Command and Control Research Program (CCRP), 2002), pp19-24.

3 R. L Shaw, Fighter Combat: Tactics and Maneuvring. (Annapolis: United States Naval Institute, 1985), pp62-97.

4 B. W. Knerr, S. L. Goldberg, D. R. Lampton, M. J. Singer, & B. G Witmer, Training in virtual reality: human

performance, training transfer, and side effects (IMAGE Conference, Scottsdale, Arizona, 1996).

5 Chia Chien Wei, “Low Cost Virtual Cockpits for Air Combat Experimentation”, Interservice/Industry Training Simulation and Education Conference 2004. Orlando , pp3-4.

6 A. J. Rehmann, R. D. Mitman, et al, A handbook of flight simulation fidelity requirements. (Springfield, VA: Crew System Ergonomics Information Analysis Center (CSERIAC), 1995), pp22-24.

7 C. D. Wickens, and J. G. Hollands, Engineering psychology and human performance, ( Upper Saddle River , New Jersey : Prentice-Hall Inc., 2000).

8 F. H. Previc, “The “Outside-In” attitude display concept revisited”, The International Journal of Aviation Psychology, Vol. 9, No. 4, (1998), pp377-401.

9 S. L. Johnson and S. N. Roscoe, “What moves, the airplane or the world?” Human Factors, Vol. 14, No. 2, (1972), pp107-129.

10 C. D. Wickens, and J. G. Hollands, Engineering psychology and human performance, ( Upper Saddle River , New Jersey : Prentice-Hall Inc., 2000).

11 W. C. Barfield, Rosenberg, et al. “Situation awareness as a function of frame of reference, computer-graphics eyepoint elevation, and geometric field of view”, The International Journal of Aviation Psychology, Vol. 5, No. 3, (1995), pp233-256.

12 A. J. Aretz, “The design of electronic map displays”, Human Factors, Vol. 33, No. 1, (1991), pp85-101.

13 K. Harwood and C. D. Wickens, “Frames of reference for helicopter maps: The relevance of spatial cognition and componential analysis”, The International Journal of Aviation Psychology. Vol. 1, No. 1, (1991). pp5-23.

14 F. H. Previc, “The “Outside-In” attitude display concept revisited”, The International Journal of Aviation Psychology, Vol. 9, No. 4, (1998), pp377-401.

15 S. L. Johnson and S. N. Roscoe, “What moves, the airplane or the world?” Human Factors, Vol. 14, No. 2, (1972), p108.

16 F. H. Previc, “The “Outside-In” attitude display concept revisited”, The International Journal of Aviation Psychology, Vol. 9, No. 4, (1998), pp377-401.

17 Chia Chien Wei, “Low Cost Virtual Cockpits for Air Combat Experimentation”, Interservice/Industry Training Simulation and Education Conference 2004. Orlando , pp7-8.

18 A. J. Rehmann, R. D. Mitman, et al, A handbook of flight simulation fidelity requirements. (Springfield, VA: Crew System Ergonomics Information Analysis Center (CSERIAC), 1995), pp65-67.

19 J.M. Schraagen, S. Chipman , et al, Cognitive Task Analysis. ( Mahwah , NJ : Lawrence Erlbaum Associates, Inc., 2000).

MAJ Chia Chien Wei, PhD, is currently Head Battle Lab, Singapore Armed Forces Centre for Military Experimentation, Future Systems Directorate. He obtained his PhD in Industrial Engineering from the University of Central Florida (UCF) in 2003 and his MSc in Interactive Simulations and Training Systems from UCF in 2001. He obtained a BSc (Hons) in Computer Science from the National University of Singapore in 1995. His research interests include complexity theory, agent-based simulation, sensemaking, cognitive and behavioural modelling, human factors, team psychology and design of experiments. His previous appointments were as a flight commander in an ADA squadron as well as a staff officer in HQ RSAF.

# Viewpoints: Re-Thinking The Political Relevance Of Airpower

Evidently, the transformation process has led the SAF to re-think the operational and tactical assumptions that were long held to be integral to its mental model. The RSAF is no exception. Indeed, the three recent articles in this journal Vol 30 N3 - “The Transformation of Airpower”, “Airpower in Non-Conventional Operations” and “Airpower in Ops Iraqi Freedom” are proofs of a serious rethink and re-orientation of the application and scope of airpower in today’s security environment. Each article has provided sound and cogent arguments to advance their case. Put together, all the three articles present one central thesis: Airpower, whether transforming or transformed, will continue to be an applicable instrument of military force for both conventional and non-conventional operations; and, that the RSAF is either formulating or has even formulated a roadmap to this end.

The thesis is valid. Of concern, however, is that while each of the three papers has demonstrated the application of airpower in different combat domains; they have inadvertently omitted the key issue that really matters in the transformation process - the political relevance of airpower in the contemporary security environment. The transformation of airpower - regardless of whether it alters airpower’s physical attributes i.e. precision and pervasiveness; or, a process to effectively orchestrate people, technology and concepts; or, even the mode of airpower application in either conventional or non conventional environment; becomes inconsequential if the transformation is politically irrelevant. Airpower, being a component of military force, is an instrument of policy. Hence, the success of the airpower transformation effort must necessarily be measured in terms of political rather than operational and tactical outcomes; and, this is a fundamental reality that airpower transformation advocates, can neither wish nor assume away.

This think piece, therefore, suggests that it is the political relevance of airpower rather than its physical attributes or process, is the most significant driver for successful airpower transformation. It is based on the observation that a strong correlation exists between political relevance and airpower development; and, that the extant security environment has a large determining influence on the political relevance of airpower. Indeed, there is strong historical evidence to support the case that the first ‘independent’ air forces gained their ‘wings’ due to their political relevance to their sponsor regimes rather than through the physical attributes of airpower or the intellectual rigour of classical airpower theory. The origins of the Royal Air Force (RAF), Reggia Aeronautica and the United States Air Force (USAF) are cases in point.

The RAF survived its fledgling status because Trenchard made the RAF politically relevant in two aspects: one, ‘strategic bombing’ provided Great Britain with the required political deterrence; and, two, he positioned the RAF as a cheaper option of ‘imperial policing’ as compared to the Army. The same argument holds for the Reggia Aeronautica which was established to position Italy ’s international status - as a leading aircraft designer; and, subsequently, as an imperial power. Conversely, the USAF was designated as an independent service when airpower became the politically relevant instrument for the delivery of nuclear weapons. In all three instances, airpower was politically relevant although they clearly lack the physical attributes and technology and the appropriate concepts to deliver on their promise.

A deeper analysis further indicates that the political relevance of airpower is intimately tied to the nature of the extant security environment. This observation is corroborated in the different development pathways between the RAF and the Reggia Aeronautica; with that of the USAF. The RAF and the Reggia Aeronautica emerged to meet the inter-war challenges of a politically tense multi-polar security environment characterized by mutual distrust and imperial competition between geographically proximate countries. The USAF, on the other hand, only gained its “independence” until after the Second World War when the United States became an active player in the security environment across the Atlantic . Airpower, given its physical attributes, provided the U.S. with its initial nuclear weapon delivery capability. This made the USAF politically relevant as a USAF-based nuclear force provided for political deterrence ‘on the cheap’; which served the administration’s requirement of a balance budget; and, also to address the Cold War military balance.

This quick overview of airpower history offers two preliminary insights as to what would constitute a politically relevant transformation of airpower; and, how both these would possibly apply to the Singapore context. Firstly, the contemporary security environment must warrant a role for airpower. In this regard, airpower will remain politically relevant for Singapore context so long as three key conditions are met. One, political deterrence continues to be the

pillar of Singapore's national security policy; two, a requirement exists for political deterrence to be responsive and physically defined in terms of speed, range, elevation, lethality and flexibility; and, three, no viable substitute to these physical characteristics exists. Similarly, then, 'transformational' concepts i.e. Homeland Air Security, Air Dominance, Dominating from the Air; and 'transformational' technologies i.e., unmanned technology, network technology and sensor technolog - although operationally significant - must add up to political deterrence to be politically relevant. Over the long term, a possible transformation trajectory is to explore how airpower may be extended beyond political deterrence into 'new' areas that may be politically relevant should ASEAN evolve into a post-modern entity.

Secondly, politically relevant airpower necessarily implies greater comparative costs efficiency – politically and financially - vis-à-vis land and maritime power. While airpower, by virtue of its physical attributes, continues to hold a monopoly on dynamic political deterrence, it will need to revisit its comparative costs efficiency vis-à-vis the navy and the army. Traditionally, airpower, when compared to land and maritime power, had offered their political sponsors a superior political cost position since its superior protective i.e. low observable and stand-off attack capabilities promise lower casualties; and, hence lower political costs. Thus, airpower-based 'surgical strikes' have often been the military instrument of choice for purposes of political coercion. This comparative advantage, however, may be gradually eroding as the same 'transformational' technologies are also being proliferated to the navy and the army.

The political relevance of airpower, in financial terms, increases if it is able to deliver greater combat capability per defence dollar vis-à-vis the other military instruments - as was the case with the RAF during the inter-war years. This is the area in which 'transformational' concepts, particularly, "Dominating from the Air", and 'transformational' technologies articulated in all three articles will exert the greatest leverage on whether airpower remains politically relevant. It will be as long as airpower remains the 'cheaper' option vis-à-vis the land power and maritime power alternatives. The transformation imperative, therefore, is not just to highlight the emerging technological or conceptual trends in the literature; but, to identify and harness the developments that will ensure that airpower remains the most cost effective instrument of military power per defence dollar.

This think-piece has been a limited attempt to offer an alternative to the current transformation literature that emphasizes the operational and technological outcomes; with little, if any, original thinking on the political relevance of airpower transformation. It has sought to restore the political dimension to the ongoing discourse on airpower transformation; and, swing the intellectual centre-of-gravity of the transformation effort away from the operational outcomes towards political relevance. Conversely, it has, in no way, suggested that the process or physical attributes discussed in the three airpower articles are unimportant; but, rather, the intent has been to relate the 'transformational' concepts and technologies mentioned in the three articles in terms of their political relevance.

Ultimately, the impetus for the transformation of airpower must stem from and continue to be driven by the search for greater political relevance in the local context rather than the articulation and pursuit of technology and operational fads. This understanding is fundamental to unraveling the "complex issues in force structure and technological developments, strategy and doctrine, command and control structure and processes, as well as education and training" that Tan, Ng and Foo have identified as major challenges in the transformation effort. Without an understanding of its political relevance, the airpower transformation process will only engender more confusion; incur a greater waste of resources; and, more ominously, spiral the transformation of airpower into an irrelevant instrument of policy.

MAJ Christopher Chan (Branch Head, Air Ops Dept)

# Viewpoints: Political vs Military Deterrence

The author has certainly raised an important point that any military development must be politically relevant, not based on technological or operational fads. That is why during the Transformation process, we should understand and apply principles of military power that transcend technological developments. It is also just as important that we do not reject contrary opinions and new concepts out of hand. The letter and this response are all part of a healthy discussion through which important issues are deliberated. As such, this response is meant to be an expansion of some of the points that have been raised.

I think airpower will continue to be politically relevant to Singapore . Unless the policy Defending Singapore in the 21st Century (DS21) document changes due to extreme changes in the security environment, 'Deterrence' will continue to be one of the twin pillars of defence policy. And on deterrence, one of the components of Political Deterrence is Military Deterrence and airpower forms a key component of Military Deterrence. For the RSAF, the overwhelming capability gap with potential adversaries is significant in forming SAF's Military Deterrence. Though they may not articulate this, regional politicians and militaries acknowledge this gap, cementing the SAF's deterrence factor. If we transform the RSAF capability into one which is heavily in favour of secret-edge Air Force, Army or Navy technologies (transformational as they may be), the perceived military gap will be reduced because secret edge capability does not lend itself easily to deterrence. As such, the adversary military and/or politician's perception can change from one of inferiority to that of equality or superiority. Then, the military deterrence and hence political deterrence is jeopardised. Bearing in mind that no armed force has won a war without Air Superiority, weakening the aerial deterrence weakens the overall deterrence of the whole Armed Forces.

The cost-effectiveness component of the political relevance of airpower is hard to quantify. Indeed it is the physical attributes of airpower that makes it a necessary complement of an armed force. And these attributes - speed, range, lethality and flexibility - do not lend themselves to easy cost-effectiveness computations. New technologies can match one or more of these attributes but would be hard put to match all of them, especially flexibility. Systems that do match many of the attributes would themselves be as complex and expensive as airpower is. That is not to say that such technologies should not be a part of the SAF's portfolio of capabilities but we should be careful to have a balanced portfolio, rather than one that may look cost effective but neglects the operational costs of a possible lack of flexibility.

MAJ Ho Peng Yung

(Staff Officer, Air Ops Dept)

# Book Review: Remembering and Debating The Malayan Campaign and the Fall of Singapore

by Mr Toh Boon Kwan

*Brian Farrell and Sandy Hunter, eds. Sixty Years On: The Fall of Singapore Revisited (Singapore: Eastern Universities Press, 2002).*

*Henry Frei, Guns of February: Ordinary Japanese Soldiers' Views of the Malayan Campaign and the Fall of Singapore 1941 - 42 ( Singapore: Singapore University Press, 2004).*

*Karl Hack and Kevin Blackburn, Did Singapore Have to Fall? Churchill and the Impregnable Fortress ( London: Routledge- Curzon, 2004).*

The sixtieth anniversary of the Fall of Singapore on 15 February 2002 was marked by major commemorative events to remember this significant historical episode. An international conference hosted by the Department of History, National University of Singapore brought world-renowned military historians to debate the Malayan Campaign and the Fall of Singapore. The conference papers were subsequently collated, edited and published as Sixty Years On: The Fall of Singapore Revisited.

The late Swiss academic Henry Frei had presented a paper at the conference but did not live to see his article in print, dying shortly after the conference. Frei's conference paper and his research on the Imperial Japanese Army (IJA) eventually went into print as Guns of February: Ordinary Japanese Soldiers' Views of the Malayan Campaign and the Fall of Singapore 1941 - 42.

The third book reviewed in this article originated with a Singapore Tourism Board project to develop a new tourist site, Johore Battery, in Changi. A replica of the Battery 's famous 15 inch monster guns, originally part of Singapore 's pre-war coastal defences, was built and opened to the public to coincide with the sixtieth anniversary commemoration. Research material compiled by two Singapore-based academics, Karl Hack and Kevin Blackburn, on these monster guns for the tourism project was subsequently expanded into a book length treatment and appeared in print as Did Singapore Have to Fall? Churchill and the Impregnable Fortress.

Reflecting a growing trend of incorporating Japanese perspectives into English language historical treatments of the opening phase of the Pacific War,1 the editors and authors of all three books have made commendable efforts to use Japanese sources to provide a more holistic perspective of the tumultuous events of late 1941 and early 1942.

Sixty Years On provides new insights of the Japanese soldier at both command and tactical levels. Akashi Yoji has written an excellent biography of General Yamashita Tomoyuki, conqueror of Malaya and Singapore . But Akashi tends to be an apologist for Yamashita's actions. The most glaring example was Akashi 's attempt to minimise Yamashita's personal responsibility for sanctioning the Sook Ching atrocity perpetrated against the predominantly Chinese civilian population in the wake of Japanese victory. Without doubt, Yamashita would have been hanged for this war crime if he had been transferred to British custody at the end of the Second World War.

Frei, on the other hand, focuses on the Japanese soldier operating at the sharp end of war. He offers an intimate account of the ordinary Japanese soldier's combat experiences during the battle for Singapore that is often lacking in English language historical treatments. The individuals featured in Frei's article exhibited complex emotions of humanity, brutality, callousness and contrition. This sensitive treatment is evident in his book Guns of February. Frei's account goes beyond the conventional view of the Japanese soldier as a fanatic ready to die in the service of the Emperor. Frei profiles Private Miyake and First Class Soldier Mori as examples of individuals who did not share the same zeal of dying for Emperor and country, were pacifist in outlook and hated the military. Frei writes of the helplessness of Japanese soldiers who were forced to obey military orders to commit atrocities against the Chinese civilian population during the Sook Ching massacre. Frei notes that some of them, in their old age, have expressed remorse and contrition for perpetrating the atrocity. Notwithstanding Frei's sensitive treatment of his subjects, the absence of moral courage among his subjects to defy unlawful military orders showcased the moral degradation and depravity of the IJA.

The Sook Ching massacre also features prominently in Did Singapore Have to Fall. Hack and Blackburn chronicles

the attempts by Singaporeans to commemorate their civilian war dead in the face of colonial opposition. For Singaporeans, 15 February marks the beginning of immense suffering. It is also a reminder why we, alone, are responsible for our own defence. On the other hand, British authorities were eager to remove any references to their humiliating defeat, preferring to subsume memorial activities under Remembrance Day events held traditionally on 11 November and to commemorate 12 September, the day of Japanese surrender to victorious Britain at the end of World War Two. In contrast, Australian veterans viewed 15 February with pride, noting how they had fought valiantly against overwhelming odds despite being let down by Britain . Using the many falls of Singapore, Hack and Blackburn highlights the politics behind the various choices of a commemorative date, illustrating how history is subject to constant reinterpretation.

All three works have not flinched from tackling controversial subjects that continue to dog the Malayan Campaign and the Fall of Singapore. Frei has attempted to portray the Japanese soldier more sensitively as discussed above. But his account also provides evidence of the callousness and brutality of the Japanese soldier. In one instance, Imperial guardsmen had mistakenly fired on Malayan civilians. Instead of rendering first aid to the badly injured survivors, the guardsmen systematically finished them off one by one on dubious mercy killing grounds. It was clear that the fanatical fighting spirit of the Japanese soldier also inured him to indignities inflicted upon enemy civilians.

Hack and Blackburn devoted one chapter to Fortress Singapore's coastal guns, discussing the controversy among scholars on the effectiveness of these coastal defences. One school of thought argued that the guns pointed the wrong way and were useless in aiding the defence of Singapore when the Japanese attacked via the rear. An opposing school argued that the coastal guns did point landward and fired at the invading Japanese forces but their fire-support was rendered ineffective by the lack of appropriate ammunition.

Hack and Blackburn argues, however, that the truth lay somewhere in between. Some of the coastal gun batteries were able to traverse north to fire at the Japanese invaders, while others were unable to. In some instances, effective fire-support by the coastal guns helped to stabilise a dangerous situation at the frontline but on other occasions had negligible impact on the tactical situation.

Churchill's strategic decisions and priorities come under close scrutiny by Raymond Callahan and Brian P. Farrell.10 Both writers made a strong case to argue that Churchill's strategic decision to take a calculated risk in the Far East was ultimately right. Britain prevailed during the Second World War because it made sound strategic decisions unlike its German and Japanese adversaries. In Farrell's succinct words:

The apparent vulnerability of Singapore revealed only a window of opportunity that was in itself an illusion. It could only be opened by bringing on the very clash of titans all but certain to destroy those who dared try.

Farrell also debunked critiques of Churchill's decision to send fighting equipment to the Soviet Union rather than Malaya . First, Britain lacked sufficient shipping to supply the equipment to reach Malaya in time to meet the Japanese onslaught. Second, Malaya needed formations of trained men, not equipment, to have a reasonable chance of stopping the Japanese attack.12 Notwithstanding the differing interpretations of Churchill's decisions, this creative tension among competing interpretations enables the student of history to achieve a better understanding of the tumultuous events of yesteryear.

What are the lessons that the SAF could draw from the three studies listed above?

First, for deterrence to work, it must be credible. Britain failed to deter Japan from attacking Malaya because Japanese intelligence successes unveiled British defence weaknesses in the Far East . Japanese willingness to go to war with America indicated that Japan was undeterrable. Immediate deterrence in Malaya failed because Japan dismissed the potential power of the Allied coalition arrayed against it. Hence, it is critical that the SAF continues its transformation to become a third generation military organization that gives more bang for the buck and has strong defensive capabilities if deterrence fails.

Second, successful deterrence is dependent on displaying resolve and commitment. It is not enough to maintain military budgets in a time of financial stringency. Our military professionals and citizen soldiers must take our training and responsibilities seriously. This is imperative with the recent shortening of National Service obligations, lest it is perceived as a slackening of commitment. Cultivating a strong fighting spirit is crucial but neither do we wish to carry it to excess like the IJA. A strong fighting spirit can co-exist with respect for international law and the human rights of enemy combatants and civilians.

Thirdly, successful deterrence requires effective communication to potential enemies that we stand ready to defend this island we call home. The successful conduct of operations during multilateral military exercises and the display of military might at National Day parades demonstrate our readiness to tackle any challenges that may arise.

The current globalisation of violence lends resonance to the old Chinese proverb that it is the duty of every citizen to defend his homeland. The failure of deterrence more than sixty years ago led to grievous losses among our forefathers. It is our duty to ensure that it never occurs again.

The abovementioned titles are available for borrowing at the SAFTI MI Library. The catalog references are:

Sixty Years On: The Fall of Singapore Revisited
Brian Farrell and Sandy Hunter, eds.
D767.55 SIX

Guns of February: Ordinary Japanese Soldiers' Views of the Malayan Campaign and the Fall of Singapore 1941 - 42
Henry Frei
D767.5 FRE

Did Singapore Have to Fall? Churchill and the Impregnable Fortress
Karl Hack and Kevin Blackburn
D767.55 HAC

**Endnotes**

1 See Mark R. Peattie, Sunburst: The Rise of Japanese Naval Air Power 1909-1941 ( Annapolis , Maryland : Naval Institute Press, 2001); Ian Gow, Yoichi Hirama & John Chapman, eds. The History of Anglo-Japanese Relations, 1600-2000, Volume III: The Military Dimension ( Basingstoke : Palgrave Macmillan, 2003).

2 Akashi Yoji, “General Yamashita Tomoyuki: Commander of the Twenty-Fifth Army”, in Sixty Years On, eds. Farrell & Hunter, pp185- 207.

3 Ibid., p199. Hack and Blackburn notes that there were some Malay victims as well. See Did Singapore Have to Fall, p94.

4 Henry P. Frei, “The Island Battle: Japanese Soldiers Remember the Conquest of Singapore ”, in Sixty Years On, eds. Farrell & Hunter, pp218-239.

5 Frei, Guns of February, pp17-18, 38-39.

6 See Hack and Blackburn , Did Singapore Have to Fall, chapter 6.

7 Frei, Guns of February, pp64-66.

8 Citing the example of Imperial guardsman Tsuchikane, Frei notes that Tsuchikane’s company had shrunk to a platoon after suffering grievous losses, but still retained its fighting spirit. See ibid., p137.

9 See Hack and Blackburn , Did Singapore Have to Fall, chapter 5.

10 Raymond Callahan, “Churchill and Singapore ”, in Sixty Years On, eds. Farrell & Hunter, pp. 156-172; Brian P. Farrell, “1941: An Overview”, in Sixty Years On, eds. Farrell & Hunter, pp173-182.

11 Farrell, “1941: An Overview”, p181. Luttwak offers a similar argument in his treatment of Japanese grand strategy. Luttwak argues that Pearl Harbour constituted a tactical and operational victory but utter strategic loss. See Edward N. Luttwak, Strategy: The Logic of War and Peace, Revised and Enlarged Edition ( Cambridge , Massachusetts : The Belknap Press of Harvard University Press, 2001), pp247-248.

12 Farrell, “1941: An Overview”, pp177, 179.

13 Hack and Blackburn , Did Singapore Have to Fall, pp186-187.

Mr Toh Boon Kwan is currently a Senior Human Resource Executive in Prime Minister’s Office, Public Service

Division. He received a B.A. (2nd Class Upper Honours) in History from NUS in 1999 and is winner of the Wong Lin Ken Memorial Medal and Book Prize 1998/1999. He was awarded the Singapore Technologies Engineering Ltd Scholarship to read the M.Sc. (Strategic Studies) at IDSS, NTU in 2003 and is winner of the Tay Seow Huah Book Prize 2003/2004. He is currently an Nsman serving with SAFTI MI.

# Featured Author: Henry P. Frei

Henry P. Frei (1947 - 2002) was a Swiss scholar on Japanese history during the Second World War (WWII). He received his doctorate on History from the Institute of International Relations at Tokyo's Sophia University. He had taught at the National University of Singapore as well as the Tsukuba Women's University in Japan.

Frei was noted for his groundbreaking study of Japan's role in the Pacific and her relations with Australia in Japan's Southward Advance and Australia: From the Sixteenth Century to World War II (1991). Frei drew upon a diverse set of source materials: old world-maps, pamphlets, monographs, histories, biographies, memoirs, newspapers, and government policy papers to provide a broad historical evaluation of Japanese-Australian relations over four hundred years. In this book, he inquired into the origins of the Nanshin or Southern Advance. Frei asserted that Japan 's foray into Southeast Asia and Australia during WWII can be better understood in light of her early maritime and migratory experiences in the Western Pacific which preceded two hundred and fifty years of Tokugawa isolationism. Frei's treatment of Japanese pre-isolationist interest in the Pacific region, and his focus on it as a precursor to the Nanshin phenomenon, narrowed a gap in Western historiography. It also provided a new perspective on Japanese motives and perceptions which complemented his focus on Australia as a target of Nanshin.

Frei contributed to our understanding of the less well-known aspects of the Pacific War in papers like "Why the Japanese were in New Guinea " and " Japan 's Reluctant Decision to Occupy Portuguese Timor, 1 January 1942 – 20 February 1942 ". In the former work, he revealed the inadequate preparations of the Japanese for their New Guinea campaign whose strategic significance was realised belatedly. It was at New Guinea that the Japanese advance was blunted. Over the course of three years, 350,000 Japanese troops were pinned down in New Guinea and they suffered 220,000 casualties. The latter paper explored the controversy over the occupation of neutral Portuguese Timor by the Australians and then by the Japanese. Australian forces had occupied the island to pre-empt the Japanese. Tens of thousands of Portuguese Timorese lost their lives as a result of the violation of their neutrality. While official Allied war histories perpetuated the belief that Japan would have invaded whether or not Australian troops landed on Portuguese Timor, Frei had argued that the Japanese political and military leadership were still debating the issue then.

In "Japan Establishes An International System of Its Own: 1941 - 1945" (1999), Frei drew on the international relations theory of Harald Kleinschmidt and Barry Buzan but used a historian perspective to examine the military, political, economic and cultural centres of Japan during this period. He argued that Imperial Japan had deliberately developed an alternative conception of the international system. Predicated on the idea that the Japanese, led by their Emperor, were at the apex of Eastern civilisation, they would use force to dismantle the post-Westphalian interstate system imposed by "decadent" Western civilisation. This book was also an instructive study on bureaucratic politics. It showed how the Foreign Ministry, representing Western concepts of conducting international relations, was emasculated in favour of a Greater East Asian Ministry, the government apparatus for implementing policies necessary for Imperial Japan's international system.

His last book, Guns of February: Ordinary Japanese Soldiers' Views of the Malayan Campaign and the Fall of Singapore 1941 - 42 (2004), was published posthumously. In it, Frei addressed the issue on an individual and personal level, and attempted to offer insights into the minds and experiences of the Japanese soldiers in the Malayan campaign. Based on memoirs, war diaries and interviews with surviving military personnel, he presented a compelling account of the images, memories, and emotions of the individual soldiers. This account contradicted popular conceptions of the Imperial Japanese Army (IJA) soldiers as self-sacrificial and fanatical. Through his research, he exposed the life of ordinary IJA soldiers: young men, far from home and fighting for survival, yet adventurous and curious about the countries and cultures they experienced, and also remorseful about the lives they destroyed. Frei's treatment of the humanity of the ordinary Japanese soldier helps us better understand the complex and multifaceted nature of militarist Japanese society. However Frei did not seek to excuse the atrocities committed by the IJA and called on readers to reflect upon how institutional and ideological forces could drive the Japanese to commit discrimination, persecution, cruelty and massacres, especially against the Koreans and Chinese. Frei's approach was unique among scholarly literature on the Japanese occupation. Few books in English on this subject have made use of Japanese sources, and or examined the subject from the Japanese perspective.

Frei has contributed much to the historiography of Japanese history and WWII through his work, with his unique interpretation of historical phenomena and his exploration of social forces which remains relevant today. His treatment of the subjects have challenged popular misconceptions and set the record straight about Japan 's true intentions toward Australia and the human face of the IJA conscript soldier.

# Personality Profiles: World War II North African Theatre: Rommel vs Montgomery

To commemorate the 60th year of the end of World War II, POINTER is profiling some of the great commanders who were involved in this historic event. Commencing from this issue, we will compare and contrast two renowned commanders from the four major theatres of World War II: Africa , Western Front, Russian Front and Asia . For this issue, the featured personalities from the North African campaign are the Desert Fox (Field- Marshal Erwin Johannes Eugen Rommel, 1891 - 1944) and Monty (Field- Marshal Viscount Bernard Law Montgomery, 1887 - 1976)

**Introduction**

From 1940 to 1942, some of World War II's greatest legends were born, as Erwin Rommel the "Desert Fox" led his Africa Korps against the "Desert Rats" of Bernard Montgomery's 8th Army. The open expanses of the North African desert made possible a dramatic confrontation, not only of operational doctrine, but of national character. In the context of World War II, the North African campaign in 1940 meant a great deal to Britain as she was suffering reverses on all fronts. It was, however, of minor strategic importance to Germany . Her involvement was primarily to keep Italy in the war and on the Axis side and this set the stage for the encounter between Rommel and Montgomery.

Erwin Rommel was one of the most well known military personalities of Nazi Germany. His military success as Commander of the German Afrika Korps in North Africa made him a celebrity.

After Africa , he took over command of German Army Group B which was responsible for the defence of the Atlantic Wall in Europe . In both theatres, he faced Bernard Montgomery, Commander of the British Eighth Army in Egypt and Allied 21st Army Group in Europe . Not only were they on opposing sides in two different war theatres, but they were also almost complete opposites in personalities and war-fighting doctrines.

**Background**

There were some similarities in the early life and childhood of Rommel and Montgomery. Both were average students who entered military service without any significant military tradition in their families. Rommel entered the Royal Officer Cadet School in Danzig , while Montgomery attended the Royal Military Academy at Sandhurst . These two World War II legends also took part in the previous World War which helped to shape their operational and tactical thinking for the rest of their careers.

Rommel participated in World War I as a junior officer with the 124th Infantry Regiment which was involved in the German Fifth Army's plan to outflank French fortifications around Verdun as part of the Schlieffen Plan. He was wounded in action in September 1914 during fighting around Varennes in France . In January 1915, he led a successful raid in the Argonne Forest against French forces. In July 1915, Rommel was wounded a second time and on recovery was sent to a newly raised unit, the Wurttemberg Mountain Battalion. With this unit, he took part in campaigns against the Romanians on the Eastern Front and against Italian forces in 1917. At the start of World War I, Montgomery was a platoon commander in France . He was severely wounded in the First Battle of Ypres in October 1914 that resulted in staff officer postings for the rest of the war. He served as a brigade-major, GSO2 at divisional and corps headquarters, and as a GSO1 of a division in 1918. Both were decorated for their service during World War I: Rommel was awarded two Iron Crosses and the Pour le Merite (Blue Max) while Montgomery was awarded the Distinguished Service Order.

While these two legends were similarly wounded and decorated in World War I, the lessons they learned from their war experiences could not be more different. Rommel's experiences in the Argonnes, Romania and Isonzo instilled in him a belief in the power of shock action to demoralise and paralyse an enemy rather than waste time on frontal attritional attacks. He has shown that small, well-trained and disciplined teams of soldiers, under dynamic leaders, could infiltrate enemy defences, gain surprise and open up 'lines of least resistance' that could then be exploited using mobility and speed. Monty's staff appointments exposed him to the various levels of planning and executing combined arms operations. The lessons he learned through the bloody battles of the Somme and Passchendaele

were the need for meticulous planning and careful execution, limited and realistic objectives, and respect for the lives of soldiers.

After the war, Rommel was reposted to his original regiment, the 124th Infantry at Weingarten, then the 13th Infantry regiment at Stuttgart , before becoming an instructor at the Dresden Infantry School . In 1933, he took over an elite Jaeger ('hunter' or 'rifle') battalion in the 17th Infantry regiment at Goslar . Two years later, he was posted as an instructor to the War Academy at Potsdam . He was subsequently attached to the Hitler Youth, before being seconded to command the Fuhrerbegleit battailon, Hitler's personal military escort battalion. At the start of World War II, Rommel's 7th Panzer Division took part in the decisive defeat of Allied forces during the Battle of France. In this battle, he was always near the front and also often directly in the line of fire. He displayed a personal bravery that had great influence on his troops, but which put both himself and his staff at great risk. This leadership style was carried into Africa which was the setting for his greatest military triumphs.

After World War I, Monty became a student at the Camberley Staff College in 1920, before becoming an instructor at Camberley and Quetta Staff Colleges . In the inter-war years, he also commanded the 1st Battalion in Palestine and Egypt and in 1939, the 8th Division in Palestine . At the start of World War II, Monty was given command of 3rd Division and sent to France as part of the British Expeditionary Force. Though his Division saw little action, Montgomery 's experience in France convinced him that a purely defensive attitude was fatal and he sought a mobile counter-attack role for his division. In May 1941, he took over command of XII Corps and emphasized the importance of an offensive spirit as well as the need to instil in his soldiers the belief that Germany could be defeated. In December 1941, Monty was earmarked to command First Army which was to take part in the Anglo- American invasion of French North Africa. He was however chosen to replace Gott, the 8th Army Commander when the latter was killed.

**The Campaign In North Africa**

In 1940, Italy attempted to invade Egypt and her forces reached as far as Cyrenaica . This offensive was easily defeated by British forces under Major-General Richard O'Conner. The latter rolled across the Italian front line and advanced almost 800 km to Tripoli . Rommel was then given one armoured and one light division with the mission to recapture Cyrenaica . Within two months, Rommel had achieved his goal and pushed the British back into Egypt but he failed to capture the vital port of Tobruk . He then laid siege to Tobruk and defeated a major attempt by British forces to raise the siege in June 1941 in Operation Battleaxe. Another attempt by the British codenamed Operation Crusader did force Rommel to evacuate from Cyrenaica . Within a month, an audacious German attack enabled them to re-take Cyrenaica . To explain British failure, Winston Churchill commented that "we have a very daring and skilful opponent against us and, may I say across the havoc of war, a great general." This compliment established Rommel's reputation among the British and Commonwealth forces.

Rommel's method of command involved him in taking personal risks and risking losing contact with his command structure. He preferred being at the front or flying around in his Fieseler Torch light aircraft trying to get a feel for the way the battle was developing or visiting some outlying sector. At his best, Rommel embodied the Napoleonic quality of being able to control the timing on the battlefield, and bring together seemingly disparate forces to surprise an enemy. This quality was exhibited in the Battle of Gazala in May-June 1942 where the Germans destroyed over 100 British tanks and launched accurate counter-attacks to send a numerically superior enemy reeling back.

Tobruk, along with 5000 tonnes of captured provisions and over 2000 vehicles, finally fell to Rommel's Afrika Korps on 21st June 1942 . This was perhaps the supreme personal moment for the German commander as Tobruk had become a symbol of Allied resistance. Rommel, with the concurrence of Hitler, decided to press on toward Cairo and Alexander after the triumph of Gazala and Tobruk. Rommel then launched an attack at El Alamein where the British forces had established their defensive line. The latter managed to block the initial German thrusts and by the end of July 1942, both sides were exhausted. In end August, Rommel began another round of attacks at the El Alamein positions. He had hoped to achieve a fluid breakthrough which would end with his armoured formations engaging Allied forces in a mobile battle. However, Enigma intercepts had given Montgomery a very accurate picture of Rommel's plans. The British formations were ordered to fight defensively, and not to engage in a mobile battle. Rommel's attacks ran into problems and he broke off the offensive three days later. By then, the British had achieved decisive air superiority and Rommel often had to take shelter from enemy air attacks during this battle. In fact, some of his own staff were killed and he could have been badly injured. This experience affected Rommel profoundly and he felt that both the mobility of his armoured units and his own movements round the battlefield were seriously restricted by Allied air power.

The next round was an offensive by British forces under Montgomery . His preparations were thorough and involved

a complex deception plan to persuade the Axis forces that the main attack was likely to come in the south rather than the north. British material superiority was great with 1200 Allied tanks facing 530 Axis tanks. The Axis forces made preparations to defend their position with 400,000 mines. The second battle of El Alamein began on 23 October 1942 with an Allied offensive. Though the Germans won a number of tactical victories, their line was stretched dangerously thin and they were drained of men, machines and fuel. In the end, they were unable to counter Montgomery 's final charge and had to disengage from El Alamein . Rommel's retreat along the Egyptian coast through Cyrenaica to Tripoli was masterly. The Axis forces were helped by British insistence on taking no risks - partly because of Rommel's own reputation, and by expert laying of real and dummy minefields. It is often considered that Montgomery missed a crucial opportunity by failing to drive straight across the Cyrenaica 'budge' to cut off the retreating Axis columns, but the British commander was determined to retain his 'balance'. He did not want to give his German adversary the slightest chance to demonstrate his mastery of a fluid battlefield.

Rommel was not impressed by Montgomery 's desert fighting skills. He believed that Montgomery was unable to comprehend the rules of fluid warfare. After the 1st Battle of El Alamein, he commented that "If I were Montgomery , we wouldn't still be here!". Although he ridiculed Montgomery , Rommel feared him and allowed his adversary to capture Tripoli without a fight in spite of overstretched logistics, for he recognized in Montgomery a man who knew how to use Allied material advantages to the full. On another occasion, during the Battle of Kesserine in February 1943, Rommel decided to stop the offensive partly because he expected an attack by Montgomery 's Eighth Army against the Mareth even though he was advised that there were no signs of such preparations by Montgomery 's forces. It did appear to many senior German and Italian officers that Rommel had became defeatist and overly pessimistic in late 1942 and early 1943.

**Commentary**

Both men were representatives of the prevailing military doctrines of their respective nations. Rommel exemplified the German manoeuvre style of rapid movement and exploitation of tactical advantages. Montgomery embodied the British 'school solution' and firepower style of overwhelming force to penetrate defences, and consolidation of tactical gains. As such, they played different roles as generals: Montgomery was a controller - planning and preparing forces by allocating reserves and resources, while Rommel was an executor - manoeuvring his forces to the proper place at the proper time. Their command and control systems were therefore different: Rommel often commanded from the front in the "thrust line" and rode with the lead panzer, to make quick decisions and direct artillery and air support at the decisive moment. Montgomery 's command style relied more on detailed planning and staff action to facilitate his operations.

As commanders, both men knew the importance of combined arms: the integrated employment and cooperation of armour, assault infantry, artillery, and air support. However, Rommel's creation of combined arms effects came from his own organization while Montgomery effected combined arms through detailed plans for cooperation. Rommel also decentralized his artillery to allow it to be available to manoeuvring forces, while Montgomery preferred to maximize firepower through centralized and massed artillery.

Rommel and Montgomery belonged to that rare breed of military men who actually penned their ideas on strategy and tactics. Rommel's book Infantrie Greift An (Infantry Attacks) recounted the tactical lessons he learned in the war, and was read and admired by Hitler - which no doubt was a factor in his selection of Rommel for command of his military escort. In it, Rommel emphasised the importance of relentless pursuit, surprise, protection through movement, speed of attack, and manoeuvre. Montgomery 's writings were in the form of written orders during World War I that included "Instructions for the training of divisions for offensive action", "Instructions for the defensive" and "Instructions for advance in the event of enemy withdrawal". These were detailed instructions on tactical doctrine to be used by his units and served as training and operations standards up to World War II. In 1942, Montgomery distributed his pamphlet "Some brief notes for senior officers on the conduct of battle", which was supplemented by "Some notes on high command in war" in 1943. Both men were equally harsh leaders who demanded perfection from their subordinates and men. Montgomery was known for being insensitive, intolerant, and ruthless in pursuing success while the Desert Fox believed that troops should be led to "the limits of human endurance". Nevertheless, they were both greatly admired by their men and their opponents. Of note was Rommel's chivalry as he was always polite to prisoners and insisted on official conventions being observed. Once, in May 1944 in Europe , he personally interrogated a captured enemy commando and made sure the latter was escorted to a POW camp. This was in violation of Hitler's order that captured commandos be executed.

In the final analysis, their performance in North Africa should be evaluated and compared in the context of their resources and constraints. While history has declared Montgomery the victor, we have to bear in mind that Rommel was undersupplied and under supported by his High Command, which often worked against him by limiting his scope

of operations. An example was Hitler's direct order of no retreat at El Alamein . The Desert Fox had a significant material disadvantage to Montgomery, who also knew the status of Rommel's logistics before their planned operations, and anticipated his actions through the decryption of Ultra communications. It is therefore most remarkable that Rommel won any major victories at all, such as the battle of Gazala and the capture of Tobruk. In fact, it was probably Rommel's characteristic initiative and his quick and unpredictable decisions, often running counter to intercepted orders, which confounded the Allies in North Africa . Though he was the superior tactician and battle manager, his operational objectives were untenable given the state of his logistics and supply resources. His plan to capture the Suez Canal and Allied oilfields was not part of German higher strategy, which placed higher priority, and thus allocated more resources, to the invasion of Russia . Therefore, his failure to link his theatre objectives to German higher strategy limited his operational capabilities and sustainability.

In contrast, Monty's claim to rank among the great commanders rested on his victory at El Alamein and the success of the landings and subsequent operations in Normandy . In both, the effort he devoted to preparation was as important as his actual conduct of operations. It involved planning, from the general concept to intricate details, training and inspiration. He inspired his soldiers with the supreme confidence he had in his own ability to choose the 'right' solution. He knew that morale could not be maintained unless everyone, from the top to the bottom, was confident that they could succeed. However, Montgomery 's characteristic caution and deliberation must be taken into account: it was his over-insurance and caution that allowed Rommel to withdraw his forces from El Alamein all the way back to the Tunisian border unmolested. Monty was fortunate in that in North Africa , circumstances favoured the application of his principles. From the time that he assumed command of Eighth Army in Egypt in August 1942 until the end of the war, he enjoyed an overwhelming superiority of resources over the enemy, and was hardly ever liable to have his plans or operations seriously disturbed by a counter-thrust.

**Contrasting End**

After North Africa, Rommel was involved in the planning for the Axis' defence of Italy . He then returned to Normandy in November 1943 as Commander of Army Group B tasked with defending Western Europe against an expected Allied invasion. He was seriously wounded in an Allied air attack in July 1944. Three months later, suspected of being involved in a conspiracy against Hitler, he chose suicide as opposed to a Nazi People's Court trial with negative consequences for his family. In contrasting fashion, after Africa , Montgomery went on to command the 21st Army Group which was involved in the Normandy landings and invasion of France . His reputation was marred by the launch of a disastrous Operation Market Garden in an effort to expedite Allied victory against Germany . However, this did not affect his career too adversely and he went on to reach the pinnacle of his profession by becoming Chief of the Imperial General Staff in July 1946.

**Bibliography:**

Norman Gelb, Ike and Monty: Generals at War, (New York: William Morrow and Company, Inc., 1994).

Jack Greene and Alessandro Massignani, Rommel's North Africa Campaign, September 1940 - November 1942, (Conshohocken: Combined Books, 1994).

John Keegan (ed), Churchill's Generals, (London: George Weidenfeld & Nicolson Ltd, 1991).

T.L. McMahon, Operational principles: the operational art of Erwin Rommel and Bernard Montgomery, (Fort Leavenworth, KS, U. S. Army Command and General Staff College, 1985).

Dr. John Pimlott (ed), Rommel and his Art of War, ( London : Greenhill Books, 2003).

Desmond Young, Rommel: the Desert Fox, (New York: Harper 1950).