

POINTER

The Journal of the Singapore Armed Forces

Features

The Fighter Aircraft and the Future of Airpower: Reflections on the Southeast Asian Landscape

by MAJ Mark Lim, MAJ Ronald Tong and CPT John Samuel

The Future of Singapore's Ground-Based Air Defense

by LTC Ong Tiong Boon, MAJ Joseph Peh and CPT Daxson Yap

Engineering and Logistics: Powering the Third Generation RSAF

by SLTC Low Chung Guan, MAJ Davis Lee, ME5 Neo Junjie and CPT Lynn Lee

Expanding the Discourse of C4ISR

by MAJ Lim Yu Sing, MAJ Chia Zhiming and ME5 Lee Hwee Kiat

Managing Strategic and Tactical Uncertainty: Mission Command in the Third Generation Army

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QUOTABLE QUOTES

Editorial

In this first issue of *POINTER* for 2014, we are pleased to feature four essays from the Republic of Singapore Air Force (RSAF) with the theme “Sustaining the Third Generation SAF for Mission Success.” This theme highlights the importance of sustainability as the RSAF forges ahead in the second spiral of its Third Generation RSAF transformation journey. This collection of essays explores how the RSAF must adapt in the new environment and covers issues related to fighter aircraft, Ground-Based Air Defence (GBAD), logistics and Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) remain key to enabling the RSAF to soar to ever greater heights of mission success.

“The Fighter Aircraft and the Future of Airpower: Reflections on the South-east Asian Landscape” is by MAJ Mark Lim, MAJ Ronald Tong and CPT John Samuel. In this article, the authors highlight that the global trend of replacing fighter aircraft with alternate technologies and concepts such as Unmanned Aerial Vehicles (UAVs) and ground-launched precision strike capabilities will be an unrelenting trend in military aviation development. Nevertheless, they contend that the maneuverability, speed and payload of manned fighter aircraft will still remain unmatched by most UAVs for a while yet. As such, they argue for the cardinal need to retain manned fighter aircraft while harnessing integrated air operations between fighter aircraft, other manned aircraft, UAVs, ground launcher and even satellite-based sensors. The authors conclude that while the UAVs and alternative ground-launched strike options will continue to be developed, especially for dangerous missions and close range strikes, they cannot effectively replace manned fighter aircraft in all its mission roles. In the long run, what we will see is closer integrated air operations.

LTC Ong Tiong Boon, MAJ Joseph Peh and CPT Daxon Yap wrote “The Future of Singapore’s Ground-Based Air Defence.” The article surveys the strategic relevance of air defence capabilities, examines the potential future threat landscape and capability gaps, before identifying the challenges in developing a GBAD system for Singapore. The authors point out that with an understanding of Singapore’s strategic situation comes a realisation that air superiority and the presence of a robust air defence are vital for a nation’s survival in war. These imperatives will drive our investments in air defence capabilities. To deal with the strategic need for a robust air defence system amidst an expanded spectrum of potential air threats, the RSAF must undergo a paradigm shift in our GBAD operations. According to the authors, there are clear trends in a widening spectrum of threats and a pressing need to build a sustainable force across the peace-to-war continuum. This will require the RSAF to overcome a number of challenges unique to our geography and operational environment, in order to continue safeguarding the peace and security of Singapore.

The third article, “Engineering and Logistics: Powering the Third Generation RSAF” by SLTC Low Chung Guan, MAJ Davis Lee, ME5 Neo Junjie and CPT Lynn Lee stresses that to achieve mission success, the RSAF must not only possess a sharp front line fighting force but also a capable backend logistics support. The logistics support system thus needs to be sufficiently resilient and able to withstand surges in operational demand at a single point. This essay examines the role of logistics in military capability and airpower, the demands and challenges of a strong logistics system for the Third Generation RSAF, and the RSAF’s approach in overcoming the challenges to sustaining its Third Generation capability.

MAJ Lim Yu Sing, MAJ Chia Zhiming and ME5 Lee Hwee Kiat in their article on “Expanding The Discourse of C4ISR” seek to explore new challenges and concepts within C4ISR development and highlight noteworthy considerations for the RSAF, as the SAF focuses on C4ISR development and integration in the next spiral of transformation. Specifically, the exploitation of C4ISR would enable seamless information dissemination and ensure high information quality production to reduce the friction, if not lift the fog in the Information Operations (IO) domain.

Besides the RSAF articles, we are pleased to present our three top prize-winning essays from the Chief of Defence Force Essay Competition 2012/2013. Our top prize winning essay by CPT Alvin Chan is entitled “Managing Strategic and Tactical Uncertainty: Mission Command in the Third Generation Army.” This essay examines the role of mission command in managing strategic and tactical uncertainty as the Army transforms into a Third Generation force. The essay revisits the origins of the philosophy and assesses its relevance in the current strategic landscape. It proposes some key initiatives for the proliferation of the mission command philosophy in the Third Generation Army before concluding that the adoption of mission command, though challenging, enables the Army to better transform into an integrated and networked force that remains relevant in an increasingly unpredictable environment.

LTC Aaron Beng Yao Cheng’s essay on “Submarine Procurement in Southeast Asia: Potential For Conflict and Prospects for Cooperation” is the second prize winner. According to LTC Beng, the acquisition of submarines by the various Southeast Asian countries

represents the proliferation of a new undersea capability throughout the region. The growing operationalization of submarines by the regional navies will no doubt raise questions relating to trust and transparency. Notwithstanding this, LTC Beng adds that significant prospects for cooperation among the submarine operating countries also exist, most tangibly in the areas of water space management, as well as submarine emergency and rescue. He concludes that the establishment of these collaborations would assist in lowering insecurities and anxieties, and help to diminish the potential for further escalation of any arms dynamic.

The third prize winner is MAJ Benjamin Kwan Shee Kong, who wrote “Developing A Strategic-Level Commander: Requisite Skills and Attributes.” In his article, MAJ Kwan emphasises that a strategic commander helms the organisation by setting the vision, allocating resources to essential areas, and collaborating with the political side and other stakeholders to achieve national goals. His essay first frames the main challenges of the Contemporary Operating Environment (COE) before highlighting the distinguishing aspects of a strategic-level commander’s role and identifying the required personal skills. MAJ Kwan concludes that the success of a military organisation depends on the strategic commander’s ability to tackle the challenges that arise while ensuring that the military remains relevant as an instrument of political will to shape a secure future.

The *POINTER* Editorial Team

The Fighter Aircraft and the Future of Airpower: Reflections on the Southeast Asian Landscape

by MAJ Mark Lim, MAJ Ronald Tong and CPT John Samuel

Abstract:

The trend of replacing fighter aircraft with alternate technologies and concepts such as Unmanned Aerial Vehicles (UAVs) and ground-launched precision strike capabilities has been relentless. The maneuverability, speed and payload of fighter aircraft remain unmatched by most UAVs and this essay seeks to address the cardinal need to retain fighter aircraft while harnessing integrated air operations between fighter aircraft, other manned aircraft, UAVs, ground launchers and even satellite-based sensors.

Keywords: Airpower; Fighter Aircraft; RSAF; UAV

INTRODUCTION

On 6 September 2013, the Predator Unmanned Combat Aerial Vehicle (UCAV) successfully struck and killed a senior leader of the Islamist terror group known as the Haqqani Network.¹ In 2012, Lockheed Martin delivered the 200,000th Guided Multiple Launch Rocket System (G-MLRS) rocket, a combat proven all-weather precision strike capability boasting ranges up to 70km. The trend of replacing fighter aircraft with alternate technologies and concepts such as Unmanned Aerial Vehicles (UAVs) and ground-launched precision strike capabilities has been relentless. Does this mean that the fighter aircraft will no longer be relevant in the modern Air Force arsenal? This article will make an assessment of the truth behind this trend, and reflect in particular on the South East Asian landscape.

CONTINUED RELEVANCE OF MANNED FIGHTER AIRCRAFT

Competing Developments

Recent conflicts such as the 2006 Lebanon War reveal a shift in airpower's center of gravity away from fighter aircraft. During the war, the use of small UAVs by the Israelis in Bekaa Valley led to an overwhelmingly



Two F-22s during flight testing, the upper one being the first EMD F-22, "Raptor 01."

favorable kill ratio of nineteen SAM batteries and 86 Syrian aircraft to one Israeli aircraft.² This shift was fueled by two main reasons: 1) prohibitively high and escalating *costs* of fighter jets paired with the increased public scrutiny of government military spending,³ and 2) the development of *alternative technology and concepts* to the fighter aircraft such as the Unmanned Aerial Systems/Vehicles (UAS/UAVs), and ground launched strike capabilities such as the G-MLRS and ballistic/cruise missiles.

Rising Cost

Today the cost of an F-22 Raptor is a staggering US\$377 million. This includes development and production spending costs divided by the 187 jets built, but does not include the lifecycle cost—the price of fuel, spare parts and maintenance during the jet’s projected 40 year lifespan. Adding the life cycle cost would mean that each F-22 costs US\$678 million to design, produce and operate.⁴ This stands in stark contrast to the US\$18.8 million and US\$31.1 million per unit cost of the F-16C/D Fighting Falcon (or Viper) and F-15E Strike Eagle respectively.⁵ It is the escalating and prohibitive cost of fighter aircraft that drives governments to look at cheaper alternatives, especially if the political will for a capable military force wanes.

Increased Scrutiny on Military Spending

Singapore has always placed unwavering political will behind the need for a capable defense force. Then-Prime Minister Mr. Lee Kuan Yew led the Singapore Government to commit up to 6% of Singapore’s GDP on defense, citing the cardinal need for defense as the cornerstone for sovereignty and socio-economic success. In practice, this commitment has not faltered. In 2013, the Ministry of Defense (MINDEF) was allocated a budget of SG\$12.34 billion,⁶ more than 4% of the 2012 GDP.⁷

However, there are indications that the commitment to defense spending may be increasingly questioned by many Singaporeans. While MINDEF

and the Singapore Armed Forces (SAF) have always adopted a prudent approach of investing only in what is needed, the public may increase their scrutiny of the MINDEF budget in favor of spending on socio-economic areas. During the 2012 Committee of Supply debates on the Singapore budget, some Ministers of Parliament (MP) asked if Singapore could reduce her defense posture and preparations because of the SAF’s previous accomplishments.⁸ While Singapore’s Minister for Defense strongly defended and justified the need for continued commitment towards military spending, there might come a time when this position is untenable in the face of competing national needs and the higher operating costs of advanced military technology, in particular, fighter aircraft. Even the United States (US) Defense Department had to shut down F-22 production in 2012 because of the skyrocketing costs, a decision made by Congress.⁹

Alternatives to Fighter Aircraft

Unmanned Aerial Vehicles, or drones, have become today’s weapon of choice in “dull, dirty and dangerous” missions that fighter aircraft traditionally performed. UAVs are capable of long loiter time and constant surveillance in *dull* missions which fighter aircraft cannot match. The risk of contamination to the pilot in the fighter cockpit means that UAVs are also preferred for *dirty* missions involving possible radiological, chemical or biological contamination. In *dangerous* missions such as probing enemy air defenses or operating over targets where the pilot has a high risk of being shot down, UAVs are also the preferred options.



An MQ-9 Reaper taking off in Afghanistan.

An example of a “dull, dirty and dangerous” mission is *counterinsurgency*. The long loiter time and constant surveillance required to locate fleeting insurgent targets make UAVs preferred over fighter aircraft. In the past nine years, the Pentagon has already increased its drone fleet thirteen-fold and spends at least US\$5 billion a year adding to it. Moreover, the frequency of drone strikes on insurgents in Pakistan’s Federally Administered Tribal Areas has risen ten-fold since George W Bush’s presidency.¹⁰

Besides UAVs, alternative strike options to fighter aircraft such as the Guided Multiple Launch Rocket System (G-MLRS) are also rapidly emerging, with Lockheed Martin delivering the 20,000th GMLRS rocket in 2012.¹¹ With a range of up to 70km, an all-weather and precision strike capability, and a combat reliability rate of 98%, G-MLRS looks likely to replace strike fighters for short-range strikes. The range and accuracy of alternative strike technology is constantly on the rise, with Boeing currently developing a Ground-Launched Small Diameter Bomb (SDB) deployed using MLRS launchers.¹² The development of such technologies and concepts may portend a reduction of the traditional role of fighters in strike missions.¹³

Long-range alternative strike options like ballistic and cruise missiles are also attractive to many nations,¹⁴ because they can be used effectively against adversaries with formidable air defense systems, where attacks with fighter aircraft would be impractical or too costly. In addition, missiles can be used as a deterrent or an instrument of coercion. Even a limited use of these weapons can produce devastating effects when armed with chemical, biological, or nuclear warheads.¹⁵

THE CASE FOR FIGHTER AIRCRAFT

UAVs and alternative strike options may steal some thunder from fighter aircraft, but the fighter aircraft still remains the backbone of Counter Air Operations (including sweep/strike/escort roles). Moreover, it retains relevance in Air Intelligence, Surveillance

and Reconnaissance (AISR) missions, where UAVs have largely established themselves, due to several important advantages.

Situational Awareness (SA)

The fighter pilot can rapidly scan his surroundings with the aid of SA enhancing devices like the Joint Helmet Mounted Cueing System (JHMCS), pick out relevant details, and react in a near-instantaneous and intuitive manner. The fighter pilot’s accumulation of experience also allows him to utilize his SA to make sound and forthcoming decisions in almost any real time situation.

On the other hand, the UAV and its operator have to rely on onboard sensors to reconstruct a virtual situational picture. Besides being blind to anything that lies outside the field of vision of the aircraft’s sensors, they also suffer from lag due to latency. The few seconds of latency between each step of the Observe, Orient, Decide and Act (OODA) loop can be decisive in time critical and reactive missions such as Within Visual Range (WVR) “dogfights” in Counter Air Operations.

Take for example a WVR fight against an unidentified aircraft that pops up in close quarters, a likely occurrence due to the fog of war. In such a scenario, visual identification or identification through airborne sensors like targeting pods is required before an engagement decision is made. The few seconds of lag between identification and engagement is all it takes for the enemy to make their own engagement decision first, resulting in a sure loss scenario. Lag caused by latency in the UAV, coupled with the reduced level of situational awareness, leaves them significantly disadvantaged in a WVR fight.

Maneuverability, Speed and Payload

The maneuverability, speed and payload of fighter aircraft remain unmatched by most UAVs. Most current UAVs are only capable of simple maneuvering. For those with improved maneuverability, more sophisticated flight control systems are necessary, which translates to a heavier overall aircraft weight and shorter loiter time.

In terms of speed, most lightweight UAVs operate below 100kts. The fastest operational UAV is the MQ-9 Reaper which has a max speed of about 260kts. This pales in comparison to fighter aircraft which are capable of speeds in excess of 600kts. A UK firm has promised the world's first supersonic UAV, the Taranis. However, the trade-off between speed and endurance still applies, because the weight of the engine and aircraft structure needed to support supersonic flight significantly reduces the new UAV's endurance.

In terms of payload, current UAVs today carry much less than even the relatively lightweight F-16—the MQ-9 reaper carries a maximum of 3,800lbs as compared to 6,000lbs for the F-16.

However, with advances in technology, it is likely that unmanned platforms will one day match fighter aircraft in terms of maneuverability, speed and payload. Already, fighter aircraft such as the F-4 and F-16 have been converted into unmanned QF-4 and QF-16s,¹⁶ effectively creating UAVs with the same maneuverability, speed and payload as fighter aircraft. Therefore, the more important question lies in the value of making UAVs as maneuverable and high performing as fighter aircraft, because they lose their existing advantage of having a longer loiter time. Eventually, it may boil down to the need for high situational awareness versus the risk of having a pilot in the cockpit.

Survivability

Fighter aircraft are equipped with sophisticated defense mechanisms such as Electronic Countermeasures (Chaff/Flare/Radar Warning Receivers or RWRs), giving them high survivability in combat. UAVs on the other hand are vulnerable with few, if any, defense

mechanisms. UAV survivability is heavily dependent on low profile due to small size. However, as UAVs become bigger in the bid to increase maneuverability, speed and payload—or to put defense mechanisms on board—they will become more detectable and thus more vulnerable. According to statistics, UAV survivability seems to be higher in combat. However, these statistics were gathered when UAVs were deployed over Iraq and Afghanistan—where air dominance was enforced by regular fighter aircraft—which makes them unreliable.¹⁷

Vulnerability in an Electronic Warfare (EW) Environment

With the increased use of EW in combat, fighter aircraft may have their radars or even data links jammed. Nonetheless, fighter aircraft are also equipped with Electronic Countermeasures such as advanced radar modes to counteract the jamming. In the jamming environment, fighter aircraft remain effective through passive sensors like the Infrared Search and Track (IRST) and Electro-Optic/Infrared targeting pods. If all else fails, the jam-proof pilot in the cockpit will still be able to operate autonomously.

On the other hand, UAVs are critically dependent on secure two-way data link communication. If the link is broken or even temporarily disrupted, the remote pilot may lose control of the aircraft. In the EW environment, Global Positioning System (GPS) or data link jamming may result in a loss of connectivity or degrading of sensors that will render UAV ineffective in combat. Even the highly secretive RQ-170 of the United States Air Force (USAF) was supposedly brought down in this manner by the Iranian military.

Fighter aircraft are equipped with sophisticated defense mechanisms such as Electronic Countermeasures, giving them high survivability in combat. UAVs on the other hand are vulnerable with few, if any, defense mechanisms.

Cost Effectiveness

A typical Fifth Generation fighter aircraft may cost over \$100 million, but it has a useful lifespan of 30 years or 40,000 flight hours, and longer if upgraded. This is significantly more than an average UAV's lifespan. UAVs are less technically robust, and some countries accept peacetime losses due to technical problems, loss of command links, loss of control, bad weather and other causes as part and parcel of UAV operations. While such losses may be tolerable for small and inexpensive UAVs, they can scarcely be accepted in the case of sophisticated Unmanned Combat Air Vehicles (UCAVs) which rival manned fighters in cost. This is not to mention the lower survivability of UAVs in combat compared to the fighter aircraft. Against a capable adversary, UAVs are likely to experience high loss rates that quickly nullify the lower unit costs they offer over manned aircraft.

In terms of usefulness, the fighter aircraft is able to autonomously execute a wide variety of missions. In contrast, even the most advanced UCAV currently available can only perform a very limited range of missions. A single MQ-9 Reaper UCAV costs about US\$36 million while the Boeing X-45 UCAV is estimated to cost about US\$25 million apiece. Add the costs of the ground control station, satellite data-links and other subsystems essential for combat operations, and the total cost becomes comparable to that of fighter aircraft.¹⁸

An assessment of cost effectiveness between the fighter aircraft and UAVs based on their useful lifespan and range of missions reveals that fighter aircraft are likely to remain the preferred choice for complex and varied missions.

Limitations of Alternative Strike Solutions

Cruise missiles may be preferred over fighter aircraft for long-range strikes because they are difficult to detect. Moreover, they are able to carry chemical, biological and nuclear warheads.

There are political and strategic dangers associated with advocating the use of cruise missiles. Besides creating deterrence by threatening a full-scale retaliation that will inflict irrevocable damage on the adversary, there are very few effective ways of defending against these missiles. Nations must procure even more destructive weapons to threaten the belligerent party, possibly triggering an arms race that will be reminiscent of the nuclear standoff between US and Russia. The world still remembers the day it came to the brink of global annihilation on Black Sunday during the 1962 Cuban Missile Crisis—fortunately, the situation was de-escalated and a series of non-proliferation treaties ensued.

Before cruise missiles rose in popularity, long-range ground launched precision strike technology existed in the form of ballistic missiles. Ballistic missiles carry a payload which descends to the target following a free-fall ballistic profile, whereas cruise missiles are engine powered and cruise all the way to their target.

Today, neither Russia nor the United States produce or retain any medium or intermediate range ballistic missile systems because they are banned by the Intermediate-Range Nuclear Forces Treaty (removing all missiles with a range of 500km-5,500km), which entered into force in 1988. In 2011, the New Strategic Arms Reduction Treaty which limits the United States and Russia to no more than 1,550 warheads each (including those on intercontinental ballistic missiles, submarines, and heavy bombers) entered into force. However, there are no treaties today that cover missiles with a range of less than 500km, which is where cruise missiles come into play. Even in the recent Syrian crisis, the most high profile weapon the US threatened to employ against the regime was the Tomahawk cruise missile.

Alternative strike solutions like ballistic and cruise missiles have proven to be too effective and too dangerous to use, and it is in the interest of every rational nation to avoid opening up the Pandora's

Box and repeating a grave historical mistake. Procurement of these alternative strike solutions is extremely politically sensitive and would likely spark an uncontrolled arms race. While G-MLRS and ground-launched SDBs seem more palatable when compared with ballistic and cruise missiles, they are equally politically unacceptable in regions with close and contested national and geographical boundaries. The dire consequences of relying solely on ballistic and cruise missiles make fighter aircraft the preferred defense solution capable of projecting calibrated levels of deterrence.

REGIONAL FIGHTER AIRCRAFT DEVELOPMENTS AND AIRPOWER LANDSCAPE

Fighter aircraft have been a mainstay in the airpower landscape of regional Air Forces and will remain so for at least the next three decades. Regional Air Forces have not seen a significant overhaul of their fighter orbit in the past two decades, attributable to the limited defense budget of each nation as well as the high costs of the aircraft. Nevertheless, the varied combination of Generation 2 to 4 fighters (see Table 1 for classification) covers a wide spread of roles that still form the bulk of the region's airpower equation (see Table 2 for details).

Before proceeding further, we need to first clarify a Douhetian misconception: airpower does not equate only to strike missions, nor does it refer only to fighter aircraft. Airpower is in fact a large equation that denotes 1) a projection of power or influence 2) using aircraft, helicopters, UAV or missiles that traverse the medium of air (including space),¹⁹ 3) to achieve strategic, operational or tactical objectives (including supporting land and naval services).

While non-fighter platforms are also part of this equation, fighters cover almost all the major roles in airpower in this region—Counter Air Operations (CAO), including sweep, strike and escort missions), Counter Surface Operations (CSO) both on land and sea (Close Air Support, Battle Air Interdiction, Maritime Air Interdiction and Maritime Close Air Support), Reconnaissance, and Air Defense missions.

Second, we need to understand the most widely accepted categorization of fighter aircraft—by generations. Generation is not assigned by time frame, but by the capabilities that the fighter aircraft design possesses:

Based on this classification, it is observed that the region's fighter aircraft orbit spans Generations 2 to 4: We can see that regional nations are also keen to continue employing fighter aircraft as their "teeth," given their respective Next Generation fighter programs such as Indonesia's development partnership with South Korea on the KF-X program, Malaysia's Multi-Role Combat Aircraft (MRCA) program and Singapore's security cooperative partnership in the F-35 program. These programs will bring in more Generation 4 to 5 fighters into the region within the next twenty years, as well as corollary capabilities and concepts.

These new aircraft and their accompanying capabilities and concepts enhance the fighter aircraft's effectiveness in performing its role in the airpower equation. These concepts notably include stealth/low observability, data link/networks, advanced electronic warfare suites and advanced fighter aircraft munitions.

The key to stealth is the ability to penetrate heavily defended radar networks and employ precision weapons on strategic targets.

Stealth

Stealth technology is touted to enter the region within the next ten years via the F-35 and KF-X. Malaysia's MRCA may also bring in the Generation 4+ Eurofighter Typhoon or Rafael, which boasts a reduced Radar Cross Section (RCS) although not fully stealth capable. The Sukhoi PAK FA T-50 and China's J-20 and J-31 are also wild cards that may bring stealth to the region.

Generation	Characteristics	Examples
1	Jet propulsion	F-80, German Me262
2	Swept wings; range-only radar; infrared missiles	F-86, MiG-15
3	Supersonic speed; pulse radar; able to shoot at targets beyond visual range	“Century Series” fighters such as F-105; F-4; MiG-17; MiG-21
4	Pulse-Doppler radar; high maneuverability; look-down, shoot-down missiles	F-15, F-16, Mirage 2000, MiG-29
4+	High agility; sensor fusion; reduced signatures	Eurofighter Typhoon, Su-30, advanced versions of F-16 and F/A-18, Rafale
4++	Active electronically scanned arrays; continued reduced signatures or some “active” (waveform canceling) stealth; some super cruise	Su-35, F-15SG
5	All-aspect stealth with internal weapons, extreme agility, full-sensor fusion, integrated avionics, some or full super cruise	F-22, F-35
6 (potential)	Extreme stealth; efficient in all flight regimes (subsonic to multi-Mach); possible “morphing” capability; smart skins; highly networked; extremely sensitive sensors; optionally manned; directed energy weapons	–

Table 1: Fighter Aircraft by Generation²⁰

Country	Generation 2	Generation 3	Generation 4	Future developments
Thailand	Alpha Jet, L-39ZA/ART	F-5E/F/T	F-16A/B, Gripen	F-16 upgrades and possible Su-30 buy
Malaysia	BAE Hawk 208	F-5E/F, RF-5E	F/A-18D, Mig-29N/UB, Su-30MKM	Su-30, Rafael, Typhoon, Gripen, Super Hornets to replace Mig-29 ²¹
Indonesia	EMB 314 Super Tucano, TA-50, Hawk 209,	F-5E/F	F-16A/B Blk 15, F-16C/D Blk 30s, Su-27, Su-30MK	50 KF-X, more Su-30MK2
Vietnam	Yak-130, MiG-21, Su-22	-	Su-27, Su-30	More Su-30s, low cost 4th Generation fighter to place Mig-21s
Singapore	-	F-5ST	F-16C/D Blk 52/+, F-15SG	Next Generation Fighter

Table 2: Regional Fighter Aircraft

Stealth technology is postulated to be a game changer for the fighter aircraft and the airpower landscape, verified by the USAF's experience of employing the F-117 stealth ground attack aircraft in Operation Iraqi Freedom as the first operational stealth aircraft used in combat. The US concluded that stealth did not change warfighting concepts fundamentally, but it enhanced the existing fighter roles tremendously.

The key to stealth is the ability to penetrate heavily defended radar networks and employ precision weapons on strategic targets. It gains the initiative because of the element of surprise, agility because the aircraft can afford to be proactive as opposed to reactive against threats, and depth because it allows high altitude ingress with impunity. Stealth is also more efficient because it requires less airborne support from escort and sweep fighters, midair refueling, and electronic warfare support from dedicated jammers. In one example from Desert Storm, eight non-stealth strike aircraft and 30 escort aircraft were required to strike one target, compared to 21 F-117 which took down 37 targets.²²

Besides being a very effective tool for Offensive Counter Air (OCA, including strike and sweep missions) and Suppression of Enemy Air Defenses (SEAD), stealth technology can also be used effectively in Close Air Support (CAS) missions. It reduces the effectiveness of enemy air defense surveillance, fire control and target destruction—giving the stealth aircraft greater survivability. Stealth also grants fighters the advantage of first look and first kill in aerial warfare.

Despite stealth technology's immense potential, the non-stealth fighter aircraft will remain the primary choice of regional nations seeking to improve their airpower capabilities. This is because of the high costs associated with stealth technology and the relatively small defense budgets of countries in the region. Thus, only small numbers of stealth aircraft will be used hand-in-hand with a largely non-stealth fighter fleet.

Networks

Network or data link technology refers to the linking of fighters and other military assets by means of a high frequency, high-speed wireless connection. This technology was first introduced into the region through the Generation 4 fighter aircraft such as Thai Gripen's Tactical Information Data Link System (TIDLS) and the F-15SG's NATO-standard Link 16 data link system,²³ and will continue to be introduced through newer fighter aircraft.

Data link technology greatly enhances the fighter pilot's situational awareness: while he was previously limited by the power and capability of his own aircraft radar, he now sees the entire battle space picture stitched together from the radar returns of other airborne fighters, Airborne Warning And Control Systems (AWACS), and ground-based radars.

Data link information, however, is only as good as the fidelity of the radars contributing the 'donated' tracks. While AWACS and ground-based radars provide numerous data link tracks from their wide coverage radars, they merely provide cueing for the fighter radar. It is the fighter radar that provides the greatest accuracy for weapons employment.

Data link technology ultimately enhances the situational awareness and thus lethality of fighters, and will eventually become a baseline for all fighter aircraft in the region. Fighter aircraft which are not data link capable will fall well behind those that are, because they will have to rely on rudimentary voice communication and individual aircraft sensors to build situational awareness. Data link capable aircraft, on the other hand, have access to donated tracks which appear on their situational displays and have no need for single voice transmissions, giving them great situational awareness. It is likely that this stark difference would drive nations towards building a fully data link capable fighter force.

Electronic Warfare

Electronic Warfare (EW) can be split into Electronic Protection (EP), Electronic Support (ES) and Electronic Attack (EA).²⁴ ES systems detect and analyze electromagnetic emissions. Examples include Radar Warning Receivers (RWR) and Missile Warning Systems (MWS). EP systems refer to capabilities which increase aircraft survivability in a hostile environment, such as chaff and flare. ES and EP systems are currently widely available in the region's Generation 2 to 4 fighter aircraft, because they are a baseline requirement for enhancing fighter aircraft survivability in combat.

The most sensitive aspect of EW is EA, more commonly known as jamming, because of its offensive capability. From Generation 3 onwards, fighter aircraft have become heavily reliant on radar and data link technology, which are susceptible to jamming. Nevertheless, fighter aircraft can still function with degraded fighting capabilities—it will simply resemble a Generation 2 aircraft lacking these features.

In the region, EA technology is still in its nascency. The Thai Gripen C/Ds come with provisions for a Self-Protection Jammer (SPJ) pod.²⁵ The future Gripen NG boasts three internal jammers.²⁶ The F-35s may potentially come with the Next Generation Jammer (NGJ) that will complement the jamming capabilities of its Active Electronic Scanned Array (AESA) radar,²⁷ as power and agility of AESA beams also have the potential to be used for jamming purposes.²⁸

Advanced Munitions

Munitions have evolved from “dumb” General Purpose (GP) bombs to Precision Guided Munitions (PGMs, guided by laser and/or GPS) used in Operation Iraqi Freedom, to Precision Stand-Off Weapons (PSOWs, boasting further ranges) such as the Small Diameter Bombs (SDB), and finally to even unique munitions such as the loiter-capable Delilah Missile.

There has been a worldwide increase in the popularity of SDBs because of the global trend towards asymmetric warfare. The events of 9/11 and its ensuing

mayhem rudely awoke traditional armed forces that were trained for large-scale high intensity warfare to review their effectiveness against asymmetric threats. Asymmetric warfare is particularly unforgiving in terms of collateral damage, while demanding flexibility and time criticality in employment. SDBs, which are half the weight of previous “standard” 500lbs bombs, precisely fulfill these requirements. They allow a fighter aircraft to carry double the amount of weapons (thus more targets per sortie), with reduced collateral damage estimates due to smaller size and destructiveness. It fits into the internal carriages of stealth fighters like the F-35, and can be employed by UCAVs and potentially even ground launchers.

Thus far, the use of UAVs in the region has been restricted to Air Intelligence, Surveillance and Reconnaissance missions performed by light-weight UAVs, and this trend looks set to remain in the near future.

Air Forces in the region generally lag behind in this global trend toward advanced munitions. They primarily operate with GP or “dumb” bombs—what the Generation 2 to 4 fighters are capable of employing. The Generation 4 Fighters in the region are a notch above though, and are capable of employing PGMs such as F-15SG's Laser Joint Direct Attack Munitions (LJDAM) with appropriate upgrades. PSOWs are also likely to proliferate quickly among Generation 4+ fighters and beyond, because of the greater flexibility they offer.

Alternatives: UAVs

For years, Singapore has been a pioneer of UAV operations in the region, operating the Scout, Searcher II, Hermes 450 and Heron-1. Indonesia also operates the Searcher II, while other nations generally operate locally made UAVs.²⁹ Thus far, the use of UAVs in the region has been restricted to Air Intelligence, Surveillance and Reconnaissance (AISR)

missions performed by light-weight UAVs, and this trend looks set to remain in the near future. There have been no indications of larger and more capable UAVs orUCAVs entering the region due to political sensitivity.

Alternatives: Ground-Launched Strike Capabilities

Ground launched strike capabilities were introduced in the region when Thailand procured the ASTROS II Multiple Launch Rocket System (MLRS), and Malaysia purchased the same system soon after.³⁰ Thereafter, Singapore purchased the region's first ground launched precision strike capability—the GPS-guided M-142 HIMARS. Thailand is still modernizing her MLRS systems by developing the DTi-1G (Guided) which is said to have a range of up to 180km. If the region continues in this direction, these technologies will complement or eventually replace fighter aircraft for short-range strike missions (<100nm). As for ballistic or cruise missiles, it is highly unlikely that any nation in the region will procure them due to the dire political consequences of possessing such systems.

THE FUTURE TACTICAL BATTLE

“You feel the adrenaline rushing as the jet engine cranks up. Your large touch-screen glass displays light up, showing that the engine parameters are good. As the data link comes online, you receive updated mission orders that you have been re-roled to strike multiple terrorist cells inside Redland, who is supporting the terrorists. You acknowledge your orders with a touch of the screen.

Your electronic warfare, avionics and sensor suite goes through its BIT test and your helmet mounted display sight brightens up, revealing all critical flight parameters. The ground crew arms your mixed load of Small Diameter Bombs, GPS and laser-guided LJDAMS, and the chaff/flare suite. With all systems green and armed, you taxi out. You check your wingman's aircraft and see that all the bomb racks carrying various weapons are now retracted for take-off in your stealth jets. Before take-off, you have full situational awareness of the most up-to-date battlefield picture through data link tracks donated by airborne AWACs and fighters. Through the

data link situational display you know that your blue forces are still fighting for air superiority. Few targets remain within 100nm as they have largely been taken out by the Guided-MLRS employed by the Blue Army. After a stream of artillery fire, you are cleared for takeoff.

Airborne, you track deep into Redland as you avoid the threat rings of numerous Surface-to-Air threats. Glancing at the data link situation display, you know that you will have to penetrate a set of threat rings, but as a stealth fighter, you are confident of success. With all sensors in passive mode, you and your wingman are as silent as the wind. Your electronic warfare suite shows that you are not being targeted by Red radars.

You receive an updated target photo from integrated Air ISR UAV and satellite sensors, and you realize that four of your twenty targets have shifted their location, while two are still on the move. The data link network automatically updates the target coordinates, while two forward launched UAVs track the two mobile targets.

Surrounding your targets are numerous surface to air threats, but you know that the range of your stand-off SDBs will keep you out of harm's way. Once within range of your targets, you and your wingman pickle off your SDBs, each assigned to a particular Desired Point of Impact (DPI). As the bombs come off the rack, your momentarily “dirty” (non-stealthy) configuration allows the enemy to detect you on his sensors and your Radar Warning Receiver (RWR) issues an immediate alert. You and your wingman immediately egress back to Blueland, deploying electronic countermeasures in the form of chaff, before quickly accelerating for supersonic cruise out of enemy territory. The RWR goes silent, showing that the enemy is no longer able to track you. At the same time, the Air ISR sources report the Battle Damage Analysis that all your targets have been successfully hit. Mission success.

On your way back, your data link reveals that Redland has launched a volley of retaliatory strike fighters towards your homeland and your air defenders require support from all airborne assets. Sure enough, you

receive mission orders to be re-rolled for air defense but you are already prepared. You turn your sensors to active mode and your AESA radar immediately picks up the nearest airborne threats. One-by-one, the missiles come off the rail on multiple red strikers. Your data link shows that your wingman has also targeted the remaining few strikers with missiles. Your helmet mounted display cues you in on the positions of all the enemy fighters, and you verify the missile hits through small explosions in the distance, except for one target.

Your RWR lights up again with a missile launch warning, this time from the lone surviving fighter. On top of that, you see that your radar is now jammed by Redland. To survive, you jump into a notch maneuver (a 90-degree out turn). Your jammer automatically directs jamming against the surviving fighter and you notice that your RWR no longer lights up. You know that the jamming is effective but you decide to stay in the notch for improved survivability. Your wingman is out of missiles, but he supports you by providing a radar lock on the remaining fighter. Through your helmet mounted display, you pick a tally on the red fighter. You quickly cue your remaining high-off-boresight infrared missile to the fighter, and with a good tone and missile lock-on, you fire off your last missile. The lone fighter bursts into a ball of flames before he can employ further weapons against you.”

CONCLUSION – THE SKIES AHEAD

As painted in the above scenario, fighter aircraft will still remain a formidable weapon of airpower worldwide in the days to come. Given the current trends in development, this predication should also hold true in the region. The cardinal requirement of SA and flexibility in air combat, and the continued developments in fighter-complementing technology such as stealth, data link technology, advanced munitions and electronic warfare, support the above notion. Although UAVs and alternative ground launched strike options will continue to be developed, they cannot effectively replace fighter aircraft in all its mission roles, except for several areas such as “dull, dirty and dangerous” missions, and close range strikes.

However, the escalating cost of fighter aircraft, as well as the utility of UAV and ground launched strike capabilities mean that fighter aircraft will not soar alone in the skies ahead. Instead, we will see integrated air operations between fighter aircraft, other manned aircraft, UAVs, ground launcher and even satellite-based sensors.³¹ Data link makes this integration possible by providing a unified operational picture of the battlefield. This allows commanders to harness the strength of all their assets to maximize the projection of power or influence to achieve strategic, operational or tactical objectives, that is, airpower. 🌐

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The Future of Singapore's Ground-Based Air Defense

by LTC Ong Tiong Boon, MAJ Joseph Peh and CPT Daxson Yap

Abstract:

Understanding Singapore's strategic situation leads to a realization that air superiority and the presence of a robust air defense are vital for our survival in war. These imperatives drive our investments in air defense capabilities. To deal with the strategic need for a robust air defense system amidst an expanded spectrum of air threats, the Republic of Singapore Air Force (RSAF) must undergo a paradigm shift in our Ground-Based Air Defense (GBAD) operations. This article aims to outline the strategic relevance of air defense capabilities, examine the future threat landscape and capability gaps, and identify the challenges in developing a robust GBAD system for Singapore.

Keywords: Airpower; GBAD; RSAF

INTRODUCTION

Contemporary conflicts around the world have brought Ground-Based Air Defense (GBAD) capabilities into mainstream military discourse. North Korea's testing of long range missiles, Iran's pursuit of nuclear weapons and the asymmetric use of rockets in the Middle East exemplify this trend. Even as offensive capabilities, represented by strike aircraft, Unmanned Aerial Vehicles (UAV) or even cyber attacks, continue to capture the public imagination, defensive capabilities against this expanding spectrum of airborne threats are seen by political and military decision-makers as increasingly relevant.

As we examine the strategic context of Singapore and the expanded spectrum of aerial threats, it is clear that these air defense systems continue to be critical for our defense. Singapore is a very small country with no geographic depth. Cheap and easily available munitions can be launched on our key installations from within neighboring territories with



Advanced weaponry like the Aster surface-to-air missile allows the Formidable-class stealth frigates to provide effective air defense over a large area.

almost no warning. The Republic of Singapore Air Force (RSAF) must provide vigilant and robust island air defense, 24 hours a day, seven days a week, to ensure the sovereignty of our territorial air-space.¹ The mission of air defense is therefore central to the overall mission of the RSAF and indeed the Singapore Armed Forces (SAF) as a whole.

This article aims to outline the strategic relevance of air defense capabilities, examine the future threat landscape and capability gaps, and identify the challenges in developing a robust GBAD system for Singapore.

WHY AIR DEFENSE?

In the history of military conflict, modern warfare is probably best characterized by the introduction of the aerial dimension. Attacks from the air can surprise, overwhelm, and destroy ground forces in a way that surface operations cannot. Therefore, the ability to control the aerial domain quickly became a crucial ingredient for victory. Denial of key terrain, in this case the air, through a network of air defense systems, became an important strategic aim. Singapore's geography means that we have no depth with which to absorb a surprise attack, nor warning time in which to mobilize our defenses. More than most other countries, Singapore requires a constant and persistent air defense.

History has also proven the importance of air defense. The Israeli parry of the Syrian air offensive in June 1982 showed that a sound and well-organized air defense can inflict high losses on the enemy and go a long way towards achieving air superiority. The more recent deployment of the Iron Dome system by

the Israel Defense Force (IDF) in Operation Pillar of Defense also demonstrated the strategic utility of such a capability.² Other geopolitical hotspots such as the Korean Peninsula and Iran further underscore the necessity of air defense.

THE THREAT LANDSCAPE

Understanding Singapore's strategic situation leads to a realization that air superiority and the presence of a robust air defense are vital for our survival in war. These imperatives drive our investments in air defense capabilities. We must be able to detect threats at great distances and marshal firepower to engage those threats in order to safeguard our security. There is urgency in this effort as the threat spectrum has widened greatly in the past two decades—not only

have the capabilities and precision of munitions increased, but also their prevalence across the peace-to-war continuum.

Peace and Troubled Peace

Following the events of 9/11, it has become clear that we cannot afford to

discount peacetime air threats. The possibility of a hijacked airliner or even light aircraft being used to attack our population centers would certainly result in high civilian casualties and severe damage to critical infrastructure. In addition, many terror groups are also able to easily obtain man-portable surface-to-air missiles (SAMs) and improvised rockets and mortars which can disrupt civil air traffic and threaten our civilian population. During a period of troubled peace, these threats can also arise from asymmetric tactics taken by adversary states.

Wartime

Militaries in the Asia Pacific are modernizing steadily against a backdrop of healthy economic growth. Coupled with the commoditization of

Attacks from the air can surprise, overwhelm, and destroy ground forces in a way that surface operations cannot. Therefore, the ability to control the aerial domain quickly became a crucial ingredient for victory.



Air Defence Artillery operators checking the alignment of the I-Hawk missiles during loading.

technology and the shrinking European defense market, the access to advanced weapon platforms by regional militaries is expected to increase. Given the quick procurement cycle for advanced munitions in particular, the RSAF must be cognizant of the potential range of air threats in a conventional war scenario. These include (1) traditional airborne threats such as fighters, UAVs and the advanced munitions they carry, (2) Rocket, Artillery and Mortar (RAM) threats, and (3) potentially, stand-off threats such as tactical ballistic missiles or cruise missiles.

Aircraft Threats. We are likely to face more aircraft of better quality and fitted with more advanced weaponry in future. The increasing competition in the global defense market means that most sales today and tomorrow will be bundled with advanced air-to-air and air-to-ground weapons such as Standoff Land Attack Missiles (SLAM), Joint Standoff Weapons (JSOW) and Joint Direct Attack Munitions (JDAM). Many of these are capable of

attacks from long range—outside the effective range of our own GBAD systems. In addition, unmanned aerial vehicles will become increasingly affordable, initially in surveillance and intelligence-gathering capacities, but possibly graduating to strike roles in the future.

RAM Threats. RAM systems are inexpensive and readily available weapons, pose a disproportionate danger to Singapore due to our small size and high density. These systems can deliver an overwhelming volume of fire that will severely hamper our ability to generate combat power to defend our sovereignty. Their mobility also makes them difficult to find and destroy at the source.

Stand-off Threats. Tactical Ballistic Missiles (TBM) and Cruise Missiles (CM) are increasingly accessible technologies. While there is no evidence that these capabilities have been introduced in the

region, these missiles could be procured rapidly and potentially pose a significant threat to Singapore. They are difficult to intercept even with state-of-the-art technology, and could be a relatively cheap and quick asymmetric counter against a large conventional fighter aircraft fleet.

RETHINKING SINGAPORE'S AIR DEFENSE

The RSAF regards air defense as one of the highest priority missions. Without an air defense that can protect Singapore from a debilitating surprise attack, there will be no air campaign to speak of. To achieve a robust and formidable defense system, a multi-layered air defense system was designed. It is a carefully calibrated model, comprising an array of sensors, shooters and command and control (C2) systems. These elements are networked to provide enhanced air situation picture and allow fast and effective responses to attrite aerial threats. Should the adversaries leak through the multi-layered air defense, our passive defense measures, such as camouflage and concealment technologies, will further reduce the effectiveness of the residual strikes.

The future of Singapore's air defense systems must be anchored on the principles of sustainability from peace-to-war and effectiveness against the full spectrum of threats. This is of particular importance in view of the future resource constraints in manpower, land and budget.

However, against today's threat environment and the emergence of new technologies, there is a need for a paradigm shift in our air defense capabilities. Our current air defense systems will find it challenging to meet the expanded spectrum of aerial

threats that include a complex mix of aircraft and munitions by state and non-state actors. While some of the existing air defense systems remain effective, new capabilities will be required to address the expanded threat spectrum. Our airborne fighters will continue to be required for anti-aircraft operations, but there is also a pressing need to induct new GBAD systems, capable of both anti-aircraft and anti-munitions functions, to protect our key national installations and preserve our ability to generate combat power.

Air Defense Concepts of Other Established Militaries

To meet Singapore's unique operational and resource challenges, we can look to other advanced militaries for possible capability development trajectories and operational concepts. For instance, the United States (US) has rekindled efforts in developing the Theatre Missile Defense (TMD). The TMD, intended to protect the US and its allies from missiles threats, comprises three layers of defense. The first layer is known as the boost-phase defense that targets missiles during the powered phase of their flights. The upper-tier defense is the second layer of defense that is designed against missiles high in the atmosphere. The lower-tier defense forms last defense line against aircraft as well as missiles travelling low in the atmosphere. The TMD has demonstrated to be a capable system with 56 successful hit-to-kill intercepts in 71 missile defense flight tests since 2001.³

HARNESSING NEW CAPABILITIES

The combination of an expanded threat spectrum, a lack of geographical depth, and high population density means that Singapore's air defense systems must continue to provide overlapping, multi-tiered protection against the entire range of air threats. However, this must be tempered with an understanding of our unique constraints. The future of Singapore's air defense systems must be anchored on the principles



The crew onboard RSS Stalwart's Combat Information Centre (CIC) monitoring the contacts on the radar screen.

of sustainability from peace-to-war and effectiveness against the full spectrum of threats. This is of particular importance in view of the future resource constraints in manpower, land and budget.

The RSAF fighters remain the backbone of our anti-aircraft operations and the vanguard of our multi-layered air defense system. To maintain this edge, they will need to keep pace with technological advances through weapons and avionics upgrades. However, to reduce our vulnerabilities to new threats, there is a pressing need to equip the RSAF with new GBAD systems, capable of guarding against these threats at various ranges.

Medium to Long-Range Capabilities

The importance of medium to long-range GBAD is demonstrated by the successful employment of the Raytheon MIM-104 Patriot in many combat scenarios.⁴ It is developed primarily for the use of the US Army to defend against aircraft and most munitions threats at 70km, as well as ballistic missiles albeit with a shorter range of 20km. Currently, software upgrades to the Patriot are continuing and will allow the Patriot to detect, track, and intercept various kinds of missiles.⁵ Despite having been in service for nearly 20 years, its proven track record will make it a key contender for the medium to long-range weapon system of the RSAF's future GBAD systems.

Another candidate is the MBDA Missile Systems and Thales Aster-30 SAMP/T.⁶ It is a land-based air defense system effective against high-speed threats ranging from missiles to combat aircraft and UAVs. The SAMP/T systems in French service have been operational since 2010, but have yet to be tested in combat. Nonetheless, its range makes it a potential candidate for our future medium to long-range GBAD systems.

Short-Range Capabilities

The air defense system is incomplete with merely the medium to long-range GBAD weapons. As they are specially designed for medium to long-range interceptions, these GBAD systems are generally inaccurate in the initial boost phase of up to 20km and thus using these systems to engage low-level threats over Singapore can endanger the populace. Furthermore, the higher price-per-shot of such medium to long-range missiles means that these systems are not cost-efficient for use against shorter-range threats such as helicopters and UAVs.

With these considerations in mind, the medium to long-range GBAD weapons must be complemented with a suite of short-range weapons that are capable against both aircraft and munitions threats. The RSAF has already taken delivery of the short-range PYTHON and DERBY (SPYDER) Air Defense system to replace the Rapier system.⁸ The SPYDER system has demonstrated effective against conventional and unmanned aircraft, and against missile threats with low radar cross-section (RCS).⁹ It fires two different missiles that have proven track records—the Python-5 that is guided by electro-optical/infrared (EO/IR) sensors,¹⁰ and the Derby that has an active radar seeker.¹¹ These provide the operator with the flexibility of missile choice depending on weather conditions. With an interception range of 15km, batteries of SPYDER systems can be deployed to provide overlapping low-level air defense coverage

and serve as a perfect complement for the medium to long-range systems.

There are also other developments that parallel the capabilities of the SPYDER. Most notable are the Raytheon's Surface-Launched Advanced Medium Range Air-to-Air Missile (SL-AMRAAM),¹² and the Norwegian Advanced Surface to Air Missile System 2 (NASAMS 2).¹³ Both these systems fire the AIM-120 AMRAAM and are as capable as the SPYDER. These systems can also be considered in our future platform renewal plans.

Very Short Range Air Defense (v-SHORAD) Capabilities

Even as the significance of short, medium and long-range GBAD systems grow in prominence, v-SHORAD systems, such as the RSAF's RBS-70 and Mistral, are still relevant and important for providing the last-mile defense against aircraft. There have been several key developments for v-SHORAD systems in the past few years. Since 2011, Saab and Bofors have been developing the RBS70 New Generation (RBS70 NG), which will be equipped with improved sighting system that facilitates visual acquisition and identification, even in low visibility conditions. Concurrently, the development of v-SHORAD systems with "4th Generation" infrared (IR) sensors is also underway. For example, Raytheon's new Stinger Block 2 missiles are designed to incorporate advanced guidance and sensor systems to improve performance. These are potential candidates for our future v-SHORAD systems.

Anti-RAM Capabilities

Most GBAD systems worldwide are still ill-equipped to deal with RAM threats. Their flight trajectories are ballistic in nature and their time-to-target is usually measured in seconds rather than minutes. As such, current conventional GBAD weapons are not designed to intercept RAMs. While the need to provide comprehensive protection against RAM threats is a long-standing requirement, the capability

to do so has eluded most advanced militaries for many years due to high costs of production and operation, and poor anticipated results on the battlefield.¹⁴

Only recently have anti-RAM capabilities returned to the spotlight, including the Mobile Land-Based Phalanx Weapon System (MLPWS),¹⁵ Raytheon Centurion Guns,¹⁶ and Oerlikon Skyshield C-RAM System.¹⁷ A more recent success case is the employment of the Iron Dome interceptor system to protect Israel from short range artillery and rockets launched by Hezbollah and Hamas. During Operation Pillar of Defense in November 2012, the Iron Dome was deployed to protect several major Israeli cities, including Tel Aviv and Beersheva. In total, Iron Dome made 421 interceptions,¹⁸ with an estimated success rate of 85%.¹⁹

With the disproportionate effects that such easily-available RAM systems can have on Singapore, it is vital that our future GBAD systems be equipped with anti-RAM capabilities. The RSAF must consider suitable acquisitions to provide protection for our critical SAF installations and civilian infrastructure against RAM threats.

The key challenge in the future will be to ensure that the suite of sensors and shooters that constitute our future GBAD capabilities is supported by a robust Command, Control, Communications, Computer, and Information network.

FUTURE CHALLENGES

Our strategic constraints, operational challenges and capability gaps point to the characteristics that our future GBAD capabilities must possess: effectiveness against the full spectrum of threats with remaining responsive across the peace-to-war continuum. The key challenge in the future will be

to ensure that the suite of sensors and shooters that constitute our future GBAD capabilities is supported by a robust Command, Control, Communications, Computer, and Information (C4I) network. The concept of Cooperative Engagement Capability (CEC),²⁰ which advocates the principles of composite surveillance and tracking, and precision cueing followed by coordinated, cooperative engagements, is particularly important for Singapore. However, building an integrated suite of ground-based air defense systems is not a simple undertaking, given our geography and resource constraints. There are a number of challenges that we must overcome.

Airspace Management and Fratricide Prevention

Due to Singapore's lack of geographical depth, the airspace available for operations is extremely limited. As such, all surface-to-air missile engagements must be carefully coordinated with the operations of other airborne assets. To enable that, a high-fidelity composite air surveillance picture must be formed that can process and distinguish the high volume of aircraft and munitions tracks. This requires high-bandwidth connections between the sensors and the central C2 node. Moreover, this composite picture must also be sent to shooters that are dispersed geographically across the area of operations so that tactical coordination can be made to manage the congested airspace and prevent fratricide.

Threats-to-Weapons Matching

As our shooters are optimized for specific threats, it is imperative to ensure accurate and expeditious identification of air threats to allow successful interception. To achieve this, the composite air surveillance picture must also be capable of detailing the characteristics of a threat such as its launch point, predicted impact point and velocity. These are critical in providing clues to its identity and allow the Combat Management Systems to assign the best shooter against the threat. Also, given the short OODA

loop required in engaging missile and RAM threats, the C2 network must be highly responsive. The central C2 node must be able to effect close control by providing weapons-cueing information through the CEC network directly to the shooters.

Collateral Damage

Singapore is one of the most densely populated countries in the world. Hazardous installations, such as Senoko Power Plant and the chemical plants on Jurong Island, are close to populated areas. The CEC must assign shooters that can launch and engage the threat at a safe distance from these installations or the populace. Unfortunately, most long-range GBAD systems have boosters that may jettison over populated areas and cause collateral damage. These are challenges that Singapore's future GBAD system will need to address.

CONCLUSION

To deal with the strategic need for a robust air defense system amidst an expanded spectrum of air threats, the RSAF must undergo a paradigm shift in our GBAD operations. The capability gaps identified point to clear trends in a widening spectrum of threats and a pressing need to build a sustainable force across the peace-to-war continuum. This will require the RSAF to overcome a number of challenges unique to our geography and operational environment, in order to continue safeguarding the peace and security of Singapore. 🌐

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Engineering and Logistics: Powering the Third Generation RSAF

by SLTC Low Chung Guan, MAJ Davis Lee, ME5 Neo Junjie and CPT Lynn Lee

Abstract:

To achieve mission success, the Republic of Singapore Air Force (RSAF) must not only possess a sharp front line fighting force but also capable backend logistics support. Neglecting logistics in a military is foolish, because without a strong bow to provide energy for propulsion, an arrow would only be a glorified dart. The logistics support system thus needs to be sufficiently resilient and able to withstand surges in operational demand at a single point. This essay will examine the role of logistics in military capability and airpower, the demands and challenges of a strong logistics system for the Third Generation RSAF, and the RSAF's approach in overcoming the challenges to sustaining its Third Generation capability.

Keywords: Airpower; Military Logistics; RSAF

INTRODUCTION

Airpower has been described as the decisive factor in war.¹ Its speed, range and flexibility give it the *asymmetric* advantage of being able to shape wars and achieve objectives swiftly and decisively. Airpower may not win a war alone, but without it, no modern war can be won. The existence of the Republic of Singapore Air Force (RSAF) and its mission thus forms a key component in the Singapore Armed Forces (SAF) repertoire of combat capabilities. The RSAF's journey towards providing the SAF with airpower has gone through several evolutions, each time reinventing itself to deliver new capabilities and mission sets. The journey began with the establishment of the Singapore Air Defense Command (SADC) in 1968, with the inheritance of basic air defense missiles and systems from the British Royal Air Force and a couple of Cessna trainers, providing rudimentary air defense capabilities for Singapore. Within a short span of 45 years, the RSAF has progressed to a third generation air force with a wide range of technologically advanced capabilities, capable of delivering airpower for full spectrum operations during both peace and wartime.

The Third Generation RSAF operates cutting edge equipment such as modern multirole fighters, sensors and sophisticated air defense systems, integrated together with a robust command and control network. Forming the backbone of the entire system is a group of well-trained professionals, capable of not only defending the skies of Singapore, but delivering airpower to influence both land and sea campaigns for the SAF. To achieve mission success, the RSAF must not only possess a sharp front line fighting force but also capable backend logistics support. A fighter jet is only useful if it gets airborne with its required fuel and munitions, an air force is only as capable as the strength of its logistics system. Hence, the Third Generation RSAF requires a strong logistics network that is able to shoulder the heavy responsibility of coordinating and organizing equipment, materiel and personnel across a wide spectrum of operations. As such, logistics forms a key component of an air force's capability. While logistics is integral to the mounting and sustaining of operations, it can also limit what is operationally possible. This paper will examine the role of logistics in military capability and airpower, the demands and challenges of a strong logistics



RSAF technicians arming an F-16 during an aircraft arming demonstration at the RSAF Open House 2008.

system for the Third Generation RSAF, and the RSAF's approach in overcoming the challenges to sustaining its Third Generation capability.

LOGISTICS AND AIRPOWER

Logistics is often seen as less glamorous in contrast to the sophisticated aircraft systems and explosive firepower. What many do not realize is that in projecting strategic airpower and capability, an agile and robust logistics tail is essential. Without a sound acquisition model, strong supply chain, and robust engineering and maintenance capability, it would be impossible to raise and sustain a military capable of delivering airpower effectively. Using the bow and arrow as an analogy, aircraft and weapon systems are akin to the arrows that bring about destruction to targets. Most people would be interested in the design of the arrow, in particular the sharp tip, which determines the type and extent of damage that the arrow inflicts on the target. However, without the bow, the arrow itself is ineffective as a weapon. The design and capability of the bow has a great impact on the overall performance of the bow and arrow as a system as it helps determine how fast and far the arrow can fly. Using an improved crossbow would allow the arrow to go further, while a multiple-launch crossbow would allow more arrows to rain destruction on a target. Logistics, in this sense, is the bow that imparts propulsive energy to an arrow and powers it towards the target to achieve its intended objective.

Hence, logistics can be likened to the engine that provides the energy to drive airpower, forming an essential and integral component of military capability.

Logistics is often seen as less glamorous in contrast to the sophisticated aircraft systems and explosive firepower. What many do not realize is that in projecting strategic airpower and capability, an agile and robust logistics tail is essential.

History shows that every successful war was largely determined by logistics. The US Pacific campaign during the Second World War was an example of a successful logistics strategy combined with an operational strategy to secure victory. In the Pacific War, United States (US) forces planned a long-range logistics and operational strategy which utilized amphibious warfare to secure and establish a string of island bases spanning from California to Australia that allowed supplies to continually be pushed to the frontline to fuel the offensive campaign.² In contrast, the conflict in Vietnam, although dubbed as one where the rules of conventional warfare did not apply,³ was a sobering lesson on the importance of logistics. Under the strategy of a protracted war, the Communists developed a series of trails—most notably the Ho Chi Minh Trail—that allowed troops and supplies to be sent from North to South constantly over a long period. The Communists also integrated local logistical support, where through a “well-organized system of taxation, commerce, forced labor, local transportation networks and clandestine industries” in the South,⁴ the needs of the Communist fighters continued to be met when foreign forces disrupted the usual supply lines. The combination of extensive networks and local supply that powered the Communist forces eventually wore the foreign forces

out. Logistics is a critical capability of any military campaign and it governs the tempo and power of operations.

The mentioned examples have been illustrative of the considerations—a logistics network with extended reach and the utilization of local resources for strategic intent—in delivering capabilities in the sea and land domains. While the above fundamental principles are important, delivering airpower in the air campaign, however, has other considerations. Airpower is manifested in aircraft that are airborne and are able to deliver their mission objectives—air strikes, air-to-air warfare or airdrops, to name a few. It is flexible and can be easily maneuvered to achieve strategic objectives in a quick and timely manner. To support the demands of airpower, the logistics support system has to be similarly responsive and nimble. As most air systems are technologically advanced and complex, technical capabilities are equally important in delivering airpower effectively. Furthermore, by virtue of the need for aircraft to launch from an air base, airpower requires concentrated logistics support at a single location. The logistics support system thus needs to be sufficiently resilient and able to withstand surges in operational demand at a single point.

DEMANDS AND CHALLENGES OF THIRD GENERATION RSAF LOGISTICS

Given the importance of logistics in military operations and its unique characteristics in the projection of airpower, logistical demands for the Third Generation RSAF are not as straightforward as merely managing and organizing the flow of supplies. Today, the Third Generation RSAF operates state-of-the-art weapon systems, integrated to form a potent force, not only to win the war in the air, but also to influence and dominate the land and maritime campaign from the air. The modus operandi of the Third Generation RSAF demands system level integration, and deep system and



The first of four G550-AEW jets arriving at Tengah Air Base in February 2009.

equipment engineering expertise. Instead of relying on the aggregate of individual weapon capabilities, integrating the broader capabilities of the whole system allows the RSAF to harness the strength of each weapon to enhance both the effectiveness and efficiency of its war machines.

To achieve this, the entire Air Force must work together as a well-integrated system of systems. Individuals will need to think and work as a system. They must not only be the best in their own professional area, but also understand how they can better contribute towards the overall capability of the system, even if it means sub-optimizing at the individual level at times. Returning to the illustration of the bow and arrow: by the laws of physics, higher tension in the string of the bow translates to greater propulsion energy for the arrow. However, just because the string can be stretched beyond what the bow can withstand, does not mean it should be done. If the bow is not strong enough to withstand the maximum tension of the string, the string should only be tensioned to the bow's limit so as to avoid breaking it and rendering the arrow ineffective. The string cannot maximize its inherent potential without due concern for the capabilities of the other parts of the system. Hence, just like the bow and arrow, the various parts of the air force, logistics and operations, must work in unison for it to be an effective fighting system.

The RSAF is one of the most modern and advanced air forces in the region. To deliver airpower effectively, the Third Generation RSAF capitalizes on high tech aircraft and weapon systems, as well as complex command and control networks. The operation of such advanced equipment creates a need for deep engineering expertise. The RSAF is no longer simply inducting proven capabilities but is also becoming a pioneer adopter of some of the latest technologies being developed and fielded, for example the Gulfstream 550-Airborne Early Warning aircraft and M346 next-generation fighter trainer. As pioneer users of such sophisticated equipment, it is imperative that the RSAF's logistics community possesses the engineering knowledge to be able to exploit and maintain the equipment, and the expertise to troubleshoot complications that no other user may have encountered.

They must not only be the best in their own professional area, but also understand how they can better contribute towards the overall capability of the system, even if it means sub-optimizing at the individual level at times.

This capability is particularly important to a small air force like the RSAF.

The Third Generation RSAF leverages on key technologies as force multipliers. Integrating advanced technologies into weapon systems enhances their operability, thereby making better use of available resources. As such, engineers and technicians in the RSAF must develop deep engineering knowledge to exploit the full potential and capabilities latent in these new technologies.

In so doing, the RSAF engineers and technicians can help improve the way the RSAF operates in all kinds of environments.

In addition to the operational demands on logistics, demographic and societal changes also challenge the



RSAF ground crew loading an AIM-9X Sidewinder onto the F-15SG during an arming demonstration.

ability to deliver complete logistics support for the Third Generation RSAF. The low fertility rate among Singaporeans makes recruiting sufficient numbers of engineers challenging. The RSAF also has to compete with the local aviation industry to recruit the best and brightest engineering minds in Singapore.

Amidst the new operational demands and the external challenges, the RSAF has to find new and creative ways to organize its logistics functions and improve work processes in order to power the Third Generation RSAF to greater heights. We will now examine how the RSAF can achieve this through the three areas of Concept, People and Technology.

POWERING THE THIRD GENERATION RSAF: CONCEPT – MAXIMIZING FULL POTENTIAL

With the limited weapons and capabilities available, the primary focus of the first generation RSAF was simply to defend the skies of Singapore. Today, the Third Generation RSAF is a full spectrum air force with increased mission sets and a wide plethora of capabilities. In peacetime, the RSAF must carry out the daily activities to safeguard our airspace. It must also be ready to serve the nation when called upon for peacetime contingency operations such as Humanitarian Assistance and Disaster Relief (HADR) and Peace Support Operations (PSO). In war, the RSAF must not only deliver in the air campaign by securing Singapore's skies, it must also contribute to the land and maritime campaigns by dominating from the air. With the manpower challenges highlighted above, the RSAF must look for innovative ways to maximize its potential to fulfill its expanded scope of mission demands.

To achieve this, the key concept to maximize the full potential of the Third Generation RSAF is to increase its "teeth-to-tail ratio." The basic idea is to reduce the "tail" or the support functions, so that more resources can be channeled to the "teeth" or the

core capabilities. Returning to the crossbow analogy, rather than using several crossbows to launching one arrow each, one can launch the same number of arrows with a single multiple-launch crossbow. With multiple-launch crossbow technology, resources can be saved on crossbows and invested in more arrows.

Faced with the demand for deep engineering expertise and the challenge of a shrinking workforce, the concept of logistics for the Third Generation RSAF must be organized and operated in a way that achieves the highest "teeth-to-tail ratio," requiring the lowest amount of resources (the "tail") to effectively support and supply each combat soldier (the "teeth"). Through organizational restructuring and training, the RSAF retains its required core capabilities and strengthens them to build depth in engineering expertise. Concurrently, by partnering with members of the wider SAF and the larger defense ecosystem, the RSAF is able to tap on their potential and expand its network of logistics capability and create breadth in engineering support for its systems.

Core logistics capabilities, broadly classified into engineering and maintenance support, are "frontline" capabilities that enable the RSAF to respond swiftly across the entire range of operational demands. Engineering support is the aspect that assures the operational performance of aircraft, weapons and systems. It includes airworthiness, capability integration and systems engineering. On the other hand, maintenance support focuses on the routine maintenance and general health of equipment for daily operations. In other words, engineering support is the backroom support that handles capability development and complex system integration which requires a longer lead time, while maintenance support is the front-end support that deals with the daily grind of maintaining equipment serviceability and resolving minor maintenance issues that have a short turn-round time.

For the RSAF, deep engineering expertise is required to provide support for advanced technologies like multi-role fighters, precision-guided munitions and data-linked networks. In peacetime, highly skilled engineering support develops and sharpens the RSAF's airpower capabilities through engineering improvements that improve performance and increase reliability. To develop depth in engineering expertise, a structural reorganization of the Air Logistics Organization (ALO) into the Air Engineering Logistics Organization (AELO) was carried out in late 2012.⁵ The reorganization introduced a dedicated engineering group that housed specialist branches and systems engineering in a "matrix" organization. Such a structure allows air force engineers to delve deeper into their respective areas of specialization, thus providing engineering support for the complex platforms and equipment that the air force operates, while still remaining available for cross-functional collaboration.

Maintenance support keeps equipment fit and ready to perform their intended functions. Well-maintained aircraft and equipment are readily deployable and capable of delivering designed functions. Such responsiveness requires the capacity to deal with surges in demand. Under the previous logistics organizational structure, first line tasks (aircraft launch and recovery) and second line tasks (aircraft maintenance) were accomplished by separate groups of personnel trained in their specific tasks in different units. This was necessary to ensure dedicated focus on their roles and responsibilities, and to allow better operational-logistical integration at the first line. Given the limited number of manpower in the first line of each unit, the previous organization structure only allowed the generation of a fixed amount of daily aircraft sorties. To address the surge in demand, the RSAF recently amalgamated the first and second line tasks under the Integrated Maintenance Flight (IMF), which consolidates manpower and improves personnel availability. This allows manpower to swing from launch and recovery tasks to maintenance work depending on

the immediate need. Although the previous structure was less efficient in terms of manpower employment, the impetus for better integration between operations and maintenance crew was important in the 1990s when it was first implemented. Over many years, the operational-logistical relationship between the operational and maintenance communities has matured and is expected to remain strong, allowing the RSAF to transit to the IMF structure, where first and second line tasks are consolidated under a single unit and every crew is trained to perform both first and second line tasks competently, thus improving their versatility and increasing the RSAF's capacity to respond to high tempo operations swiftly and seamlessly.

The concept of logistics for the Third Generation RSAF must be organized and operated in a way that achieves the highest "teeth-to-tail ratio," requiring the lowest amount of resources (the "tail") to effectively support and supply each combat soldier (the "teeth").

To achieve even higher "teeth-to-tail ratio," the RSAF has also explored working with partners in the other services in the SAF, organizations in the larger defense ecosystem, and government-linked and private contractors to capitalize on their competitive advantage. Inter-service cooperation is evident in the management of ammunition by the RSAF and the SAF Ammunition Command (SAFAC), and ground transportation support by the Combat Service Support Command (CSCOM). Such collaboration across the entire SAF creates capacity for the individual services to concentrate on developing their own core capabilities. The RSAF also works closely with organizations such as the Defense Science Organization (DSO) and Defense Science and Technology Agency (DSTA) in the larger defense ecosystem to further increase its depth of engineering expertise in the

areas of aircraft systems, network and IT systems, and in engineering support for building and infrastructure.⁶

The RSAF has also capitalized on the capabilities of government-linked and private contractors, to provide required services at a more cost-effective rate via commercial agreements. Such commercial contracts range from aircraft maintenance and upgrades, to training, to services such as catering which are not core RSAF's functions. The most prominent contract is the RSAF's strategic partnership with local contractor, Singapore Technologies Aerospace (STAE). STAE provides a range of services for the RSAF, including aircraft maintenance,⁷ aircraft upgrading,⁸ and the provision of aircraft for aircrew training.⁹ By leveraging on commercial partners to perform routine maintenance and upgrades in areas where in-house RSAF capability will not offer much value-add potential or enjoy economies of scale, the RSAF's engineering force remains lean and its engineers can focus on more critical operational requirements, which include capability developments in peacetime or battle damage repairs during war.

In recent years, the RSAF has been exploring new models of outsourcing contracts like the Public-Private Partnership (PPP) and Performance-Based Logistics (PBL) which allow the air force to leverage on the experience, expertise and networks of private contracts to assimilate and operationalize new capabilities quickly into the RSAF. The RSAF's PPP with Lockheed Martin was to provide a training package for the RSAF using the PC-21 trainer aircraft.¹⁰ Under the contract, the private contractor would manage and provide an agreed level of serviceable aircraft for the RSAF to conduct pilot training, and would also provide and manage the suite of training simulators, software and systems. Such an arrangement allowed the RSAF to focus its resources on training (the RSAF's value-add), while also leveraging on Lockheed's ability to keep up with the latest developments in training technology.

Another type of contract, the PBL, is a long-term agreement with the system supplier to deliver performance outcomes to an agreed performance metric over the entire life-cycle of the system. As new technologies are integrated into the latest advanced platforms, the cost to maintain these technologies also increases. Hence, complete life-cycle support service is becoming an increasingly attractive option over piecemeal logistical support. Rather than the RSAF stocking up on its own shelves of component spares, life-cycle support service is a better predictive model, whereby the private contractor manages the supply chain, systems and parts. With data from its global network of customers, the contractor is best positioned to understand aircraft serviceability, forecast inventory state and initiate service or upgrades on aircraft before parts or systems wear out. PBLs thus effectively increase system availability and reliability at the lowest possible cost for the contractor, supplier and the RSAF.¹¹ The availability of engineering and supply support from the contractor reduces the time required for the RSAF to learn the engineering characteristics of a system. This makes PBL a viable option in shortening the learning curve for the RSAF, because it allows our people to develop deep engineering expertise, while simultaneously reducing manpower requirements.

POWERING THE THIRD GENERATION RSAF: PEOPLE – THE KEY ENABLER

People are needed to take a concept from idea to reality. To achieve the fullest potential of the high "teeth-to-tail ratio," the RSAF requires people who are skilled, understand system level thinking and are able to fit into defined roles. Manpower is a scarce resource in Singapore; overcoming the demands of deep engineering expertise, while facing the challenge of a shrinking workforce is a herculean task. However, there are opportunities which the RSAF can benefit from.

In the area of developing deep engineering expertise, the Singapore society presents the RSAF with some opportunities. The Singapore government's emphasis on education, particularly in math and science, has developed a well-educated and talented pool of potential RSAF recruits. Furthermore, the development of Singapore as a Maintenance, Repair and Overhaul (MRO) and aviation hub has also increased interest in aviation-related fields of study. Hence, while the RSAF used to recruit only engineering diploma holders, certain Institute of Technical Education (ITE) courses can also provide the necessary skill sets required by the RSAF. These opportunities, coupled with the RSAF's people development model, will serve to develop the necessary logistics community to generate effective support for airpower.

For an air force that operates highly advanced and complex equipment and systems, engineering and logistics support is much needed and specialized field of expertise. In order to recruit, develop and retain capable and committed people who will power the RSAF's airpower capability, nearly all of the RSAF's engineers and technicians are recognized under the Military Domain Experts Scheme (MDES). Implemented in 2010, the MDES recognizes the requirement for deep expertise in the Third Generation SAF and allows SAF regulars to specialize in key military domains such as engineering.¹² Their expertise is also greatly valued by the SAF and is evident in the MDES' longer career span—between five to ten years longer than other career schemes for SAF regulars. As part of their career progression in the SAF, MDES personnel are also given broad exposure to various specializations. This can include cross-postings within the RSAF across engineering domains or with other organizations like the DSTA. These postings broaden an individual's perspective and also strengthen his understanding of his specialist domain in the system, which allows him to better contribute to the entire system. Furthermore,

the MDES also permits and sponsors the pursuit of further education to doctorate level in specialized military engineering domains. The opportunities represented in MDES thus help in the development and retention of deep engineering expertise within the RSAF.

Besides running a leaner organization to overcome the constraints of limited manpower, the RSAF has also explored other methods to increase its capacity. Leveraging on new training technologies and pedagogies, the RSAF is able to effectively train people in a shorter period of time and employ them in operations sooner than before. The use of computer-based learning programs allow trainees to learn at their own pace, while the use of maintenance training simulators enable trainees to put their learning into practice in a near-realistic simulation, at their own time, in a benign environment. In effect, these new training methods shorten the learning time and give trainees greater exposure and experience—virtual, but useful nonetheless—before real-life application. In addition, simulators are also used for continual training. Exposing crew to a wide spectrum of operational scenarios which would otherwise be opportunity-based in real-life keeps maintenance personnel current in their skills and knowledge. These enhancements to the RSAF's training help lay a strong foundation for the engineering and logistics personnel, and increase opportunities for them to develop professional competencies.

Notwithstanding the various initiatives that the RSAF has implemented to develop engineering capability and to optimize manpower, one of the most valuable latent resources it possesses is the National Service (NS) population. Being highly educated and tech savvy, Full-Time National Servicemen (NSFs) and NSmen are assets to the RSAF. Through a combination of new training methodologies that shorten training time and empowering them with

more authority, NSFs and NSmen are allowed to contribute to the RSAF's mission and to the security of Singapore. The RSAF has begun to see the fruits of this approach with NSF engineers volunteering to extend their National Service term in order to take part in the RSAF's air combat exercises.¹³ Similarly, NSmen engineers accompany the regulars on overseas exercises and are a part of the team, demonstrating the RSAF's operational readiness and competency.¹⁴ In the past, it was thought impossible to employ the NS population in maintaining aircraft due to the long training requirements. However, it has become a reality in today's RSAF, and indicates that more can be done to tap the latent NS resource pool.

POWERING THE THIRD GENERATION RSAF: TECHNOLOGY – FORCE MULTIPLIERS

In military parlance, force multiplication is a dramatic increase in operational effectiveness, in which the required effect can be achieved with greatly reduced numbers. The US Department of Defense defines a force multiplier as "a capability that, when added to, or employed by, a combat force, significantly increases the combat potential of that force, and thus, enhances the probability of successful mission accomplishment."¹⁵ In the context of engineering and logistics, it is about achieving the same outcome with fewer resources, and consequently more with the same amount of resources. The most tangible force multipliers relevant to the RSAF are technologically driven. The employment of technology enhances fundamental capabilities and efficiencies which in turn enhances operational effectiveness. Against a backdrop of new operational demands and human resource constraints, the RSAF has been experimenting and adopting emerging technologies to boost productivity and to do more with less. Besides utilizing technology such as simulators and computer-based learning programs in training, the RSAF has also been harvesting technologies in operational settings as force multipliers to meet new operational demands while also overcoming manpower constraints.

As increasing integration requires platforms in the RSAF to become increasingly sophisticated, there will be a decrease in linearity between the root causes of failure and failure symptoms, resulting in more time needed to conduct failure investigation and analysis. To prevent long delays in platform availability, maintenance methodology has had to evolve accordingly to include new techniques like condition-based maintenance and prognostics, and health management, whereby performance is monitored with improved instrumentation equipment and failure rates predicted with models. These processes utilize high-tech diagnostic tools and software that identify point faults at an early stage for rectification, so that faults can be corrected quickly and an entire system need not be rendered unusable because of maintenance issues. Some examples of using technology to improve maintenance processes in the RSAF include the use of digital X-ray for non-destructive inspection of helicopter airframes, and the use of computerized diagnostics tools to download fighter engine data and parameters for timely troubleshooting and maintenance through accurate diagnostics and fault detection.

Other ways that technology has been used to increase productivity include the use of digital manuals and the automation of maintenance and logistics processes. The introduction of electronic Technical Data Manuals has helped to enhance efficiency by enabling engineers to access information faster, comprehend them better and find solutions through the use of interactive media. For example, step-by-step written instructions for removing and replacing a component can be supported by videos of 3D models and colored wiring diagrams. Automation of logistics processes takes the form of auto-identification and radio-frequency identification (RFID) tags on spares and equipment which serve to ease the workload and eliminate human errors in inventory and asset management. While the use of automation in maintenance and logistics has largely been limited to inventory and asset management, technological

developments may see the introduction of robotics in the conduct of maintenance and logistics tasks. In fact, robotics has already been explored as an avenue for stripping and applying paint to fighter aircraft.¹⁶ Soon, the use of robots in military logistics may even extend to aircraft inspections and the performance of basic maintenance and repair tasks.

Besides being used to manage processes, technology has also been used to boost the resiliency of the logistics support system. One of the unique characteristics of airpower is that its logistics support system is highly concentrated at a single location—the air base. In order to sustain the air force's ability to support continuous airpower over a wide range of operations, the air base logistics system has to be sufficiently robust and resilient to withstand surges in demand and hostile environments. Sensors and software can thus be used to monitor performance along the logistics pipeline. When compared against a model of optimal performance, it allows logistics personnel to address bottlenecks or excesses to ensure a smooth running system. In terms of air base survivability, technology has been utilized to support capabilities that permit undisrupted projection of airpower. Advanced equipment used in runway repair, refueling systems and maintenance of supply chain integrity all contribute to greater efficiency and productivity. This allows the RSAF to achieve the required standards of support with less manpower and within a shorter amount of time.

CONCLUSION

It is evident that logistics is a key capability of the RSAF that powers the delivery of effective airpower. Without engineering and logistical support, it would not be possible for the RSAF to sustain a high tempo in daily training and operations or meet the high demands of war time operations. Critical to a good logistics system are flexibility, responsiveness

and resilience. However, faced with the need for deep engineering expertise and the challenge of a smaller workforce, the RSAF has had to refine its concept of logistics to keep up with new demands. By reviewing the logistics concept of operations to achieve a higher "teeth-to-tail ratio," the RSAF can not only retain its core engineering and maintenance capabilities that directly affect the responsiveness and flexibility of airpower delivery, but also increase its combat capability by freeing up resources to be rechanneled. By leveraging on partners within the SAF, the larger defense ecosystem and the private sector, the RSAF has been able to strengthen its network of logistics support while still preserving depth in much-needed engineering expertise. People development has also been a focus in the RSAF's approach towards strengthening logistics as concepts alone are not realizable without people and technology. Finally, by leveraging on technology, the RSAF has been able to assuage the challenges of human resource constraints, while still being able to meet its operational needs. An air force would only be as capable as its ability to deliver airpower, which in turn is generated from the potential residing within a strong logistics system. Neglecting logistics in a military is thus foolish, because without a strong bow to provide energy for propulsion, an arrow would only be a glorified dart. dart. 🌐

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Expanding the Discourse of C4ISR

by MAJ Lim Yu Sing, MAJ Chia Zhiming and ME5 Lee Hwee Kiat

Abstract:

The proliferation of information technology is palpable in today's society. It is essential that militaries learn to exploit what is on offer in this "age" in order to achieve information superiority. The Republic of Singapore Air Force is harnessing the full potential of Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) through expansion to enhance the strategic utility of air power.

Keywords: Airpower; C4ISR; RSAF

INTRODUCTION

Since the first application of airpower (in the form of aerial bombing) during the Italo-Turkish War of 1911, airpower has been used with varying degrees of success.¹ In the two Gulf Wars, we have seen how the speed, reach and flexibility of air power contributed towards the success of the campaigns. However, in the Kosovo war, we have also witnessed that airpower alone cannot secure victory. Although air power is a crucial determinant to winning the modern war, it cannot do so by itself. More importantly, they remind us that war is a continuation of politics by other means, and that the military instrument (and by extension, airpower) is not a panacea to all military problems—only politics can end wars. Nevertheless, the military instruments of the state, and the Republic of Singapore Air Force (RSAF) in particular, can be reasonably expected to provide useful options to facilitate the political processes of peacemaking and war fighting.

Against the backdrop of what we understand today as the "information age" of the 21st century, militaries (and air forces) have to learn to exploit what is on offer in order to continue providing useful options. In fact, well-known thinkers like Joseph Nye postulated almost two decades ago that "knowledge, more than

ever before is power ... [and that a nation's] comparative advantage [in] its ability to collect, process, act upon, and disseminate information ... can help deter or defeat traditional military threats at relatively low cost."² At this juncture, it is useful to review the characteristics of the "information age." As Papp and Alberts note in their anthology, "information age" is a "characterization of our time [and] is based on the widespread proliferation of emerging information and communication technologies and the capabilities that those technologies provide ... [so that] humankind [is able] to overcome the barriers



An operator from the 3rd Singapore Infantry Regiment uploading the pre-planned routes to the Skyblade III from the ground control station. The Skyblade III transmits information to the control station via a digital radio link.

imposed on communications by time, distance, and location [as well as overcome] the limits and constraints inherent in human capacities to process information and make decisions.”³ At the same time, many other observers like Webster, Kupfer and Achenbach have also cautioned,⁴ almost two decades ago, against over-simplistic perspectives on what the information age entails. This is because “information” in itself is meaningless and we must always consider the quality of the information being conveyed. This is still the case today.

This is because “information” in itself is meaningless and we must always consider the quality of the information being conveyed.

In the military, it is clear that the “information age” is a double-edged sword. To be able to “put useful options on the table,” militaries have to harness the new opportunities of the age. At the same time, militaries also have to deal with the increasingly complex, dynamic and time-sensitive operating environment that the information age brings. The military’s discourse on mastering this double-edged sword has been expressed through many forms; with the descriptive amalgam of “Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance” (C4ISR) being one of the more recent manifestations. However, we should not be distracted by these label, since their substantive purpose remains consistent.

This essay will first outline the premise and value proposition of “C4ISR” in the military discourse. This will then be contextualized by taking stock of the extent to which the RSAF and the Singapore Armed Forces (SAF) has been exploiting C4ISR for mission success for “sense to shoot.” It will be argued that while the RSAF’s current exploitation of C4ISR undoubtedly delivers superior “sense” and “last-mile shoot” capabilities, the RSAF can better unlock the

potential of C4ISR by expanding the boundaries of its discourse. In doing so, the essay hopes to invest meaning in the RSAF’s discourse in “C4ISR” beyond “sense-to-last-mile shooting” in order to better articulate the useful options that air power can put “on the table.” Specifically, we have identified two possible new areas—“sense-to-generate” and “sense-to-influence”—to expand the discourse.

C4ISR IN SAF DISCOURSE

In the Clausewitzian sense, the “genius” of the Commander is critical in devising ways to win a war. The two key enablers are a reduction of uncertainties by “seeing through the fog of war,” and the ability to have decisions acted upon properly through the “friction of war.” Effective exploitation of C4ISR facilitates this. Essentially, it allows the Commander to make informed decisions faster and also be able to translate these decisions into actions more precisely and rapidly than our adversary. In language familiar to the air power discourse, we can think of this in terms of John Boyd’s “OODA Loop,”⁵ albeit at a systems level. Effective exploitation of C4ISR should essentially serve to enhance the military’s war-fighting OODA loop *vis-à-vis* our potential opponent’s.

At the heart of this lies a fundamental principle of effectively exploiting C4ISR. This is basically concerned with delivering information flow to enhance battlefield awareness and informed decision-making. This is what we need to make explicit in our discourse on C4ISR. “Command Control Communications Computers Intelligence Surveillance and Reconnaissance” is meaningless in itself as a descriptive amalgam. It needs to be effectively exploited. But what we really desire from its effective use is to enhance our own war-fighting OODA loop.

C4ISR is fundamentally about sensing and sense-making of the battle-space and the operating environment. The effective exploitation of C4ISR



An Unmanned Aerial Vehicle (UAV) is being prepared for launch by a technician. UAVs provide persistent video telemetry to support the Division Strike Centres (DSC) in integrated strike operations.

would shorten the RSAF's war-fighting OODA loop by producing superior information dissemination and information quality that reduce "friction of war" and "lift the fog of war." The exploitation of "C4" as an enabler overcomes the traditional time-and-space barriers imposed on communications and generates a shared awareness that is able to reduce the "friction of war." It allows the RSAF to fight as a networked force because vast amounts of information can be stored, processed and then disseminated to multiple users in a short span of time. In the same breath, effective exploitation of "C4" and "ISR" generate quality information to enhance human capacities in order to process information and make decisions. This is done through the fusion and sense-making of intelligence and information into actionable knowledge, followed by rapid dissemination to support the decision-making and actions of commanders and operational users. More specifically, operationally useful knowledge is generated upfront where collection and processing takes place, and then pushed to the right operational user without waiting for user demand. In essence, this "forward-leaning" generation of operational knowledge seeks to establish "information superiority" for the fighting force as a whole, and serves to militate against the perennial "fog and friction of war." Not only can users and commanders at all levels act faster, more

decisively and more precisely with "information superiority," timely generation and push of useful operational knowledge also frees up capacity of the commanders to undertake more high-value decision making, such as those involving judgment calls and higher order assessments of tradeoffs and payoffs.

Nevertheless, the above perspective is not entirely novel in the SAF's discourse. As early as 2003, then-Chief of Defence Force (CDF) LG Lim Chuan Poh articulated Integrated Knowledge-Based Command and Control (IKC2) as an area of focus in the SAF's force transformation.⁶ The concept centered on "seeing first and seeing more through Data and Information Superiority ... understanding faster and better to attain Knowledge Superiority ... deciding better and faster for Decision Superiority ... acting faster and more decisively in order to achieve Effects Superiority." As such, we can be sure that our current discourse on C4ISR is founded on at least a decade of development and thinking across the SAF.

TAKING STOCK OF C4ISR DEVELOPMENT: SUPERIOR "SENSE-TO-SHOOT"

The SAF and the RSAF have astutely harnessed C4ISR to deliver mission success. In fact, the speed, reach and flexibility of air power ensure that the RSAF is best placed to deliver a responsive C4ISR capability to the SAF. We see a consistent investment to ensure that the RSAF suite of sensors, collection platforms, information sharing and decision support systems remain technologically capable of meeting the full spectrum of the SAF's operational demands. Furthermore, given that technologies and processes are only as good as the people who use them, the RSAF has also placed emphasis on developing our airmen to be competent and professional in exploiting these artifacts.

In terms of capitalizing on advanced technologies to better "sense" the operating environment and battle space, the RSAF has made good progress. For

example, we have shifted from using the Scout and Mastiff Remotely Piloted Vehicle (RPV) in the 1980s to state-of-the-art Unmanned Aerial Vehicles (UAV) such as the Heron-1 and Hermes-450.⁷ These systems have longer range, better endurance and are equipped with better sensors like third generation Forward Looking Infrared (FLIR) systems, thereby allowing the aircraft to effectively perform a wide array of missions including target acquisition and area surveillance operations. The successful operationalization of the G550 Airborne Early Warning capability is another prime example of how the RSAF has assimilated new cutting-edge C4ISR technologies to enhance its ability to provide over-the-horizon “sensing” of the battle-space. In the domain of network systems, we have also exploited technology to enhance decision-making and information flow. A case in point is the Air-Land Tactical Control (ALTaCC) which the RSAF has consistently fielded in Exercise Wallaby since 2008 for enhanced air-land operations.⁸ In the past, the army and the air force could only use preplanned procedures and voice communications to track and coordinate friendly movements and fire missions. This resulted in a lengthy OODA loop that could not deliver the operational flexibility to meet the high-tempo demands of modern air-land battle. Today, ALTaCC digitally fuses and disseminates the real-time air picture to equip our commanders and operators with superior battle space situational awareness and allow them to act more rapidly, decisively and precisely in coordinating the air-land battle.⁹

In tandem with effective exploitation of technology, the RSAF has also done well in growing a core of professional and competent airmen and women to better exploit the different facets of C4ISR in order to deliver superior “sense-making” capabilities

for the SAF. Firstly, the RSAF implemented the Intelligence Officers (Air-Intelligence) scheme in 2008, embedded within RSAF and SAF C4ISR exploitation processes and structures. This scheme allows its officers to grow their military intelligence instinct at an early stage of their career, as well as provide them with the structure to share and learn knowledge and experience from other intelligence communities within the SAF.¹⁰ Secondly, the RSAF launched the Air Operations and Systems Experts (AOSX) vocation in 2010, which allows our servicemen and women to specialize in the niche area of Integrated Knowledge-based Command and Control (IKC2).¹¹ Compared to the past where Air Operations System Specialists mainly conduct operational-level maintenance on C2 systems and coordinate air operations, the people in the AOSX vocation can move up the value chain to specialize in IKC2 and leverage on their knowledge and deep expertise to enhance air or SAF operations. Thirdly, even as the SAF consolidates its “sense” capabilities by forming the SAF Command, Control, Communications, Computers and Intelligence (C4I) community in 2012,¹² the RSAF has also kept pace with these developments to push its boundaries to be useful and capable within the SAF’s system-of-systems fighting capabilities. In 2012, the RSAF formed the Air Imagery Intelligence Expert (AIRIX) vocation to raise train and sustain a core group of airmen and women who could value-add to the “sense” capability that the RSAF delivers to the SAF. The AIRIX will focus on analyzing real-time images collected by the AISR platforms in order to generate operationally useful knowledge and intelligence that would then be passed to relevant agencies for action.¹³

In tandem with effective exploitation of technology, the RSAF has also done well in growing a core of professional and competent airmen and women to better exploit the different facets of C4ISR in order to deliver superior “sense-making” capabilities for the SAF.



The ground crew prepares an Unmanned Aerial Vehicle (UAV) for launch. UAVs provide persistent video telemetry to support the Division Strike Centres (DSC) in integrated strike operations.

The RSAF's delivery of a superior "sense" capability to the SAF serves the function of "shoot" primarily in the "last-mile." State-of-the-art airborne and land based platforms are used to responsively "sense" the battle-space in detail and at great ranges while well-trained domain experts value-add by "sense-making" and pushing "forward-leaning" operational knowledge to commanders and users in a timely manner. These would then allow superior SAF and RSAF "shoot" capabilities to bear fruit. As seen in SAF-level integrated strike exercises during Exercise Forging Saber and Exercise Lightning Warrior,¹⁴ the SAF's "sense-to-shoot" capability is not only well-integrated across the air-land domain, but the "integrated fires" are also highly responsive and precise.¹⁵ At the RSAF level, its suite of advanced airborne and land-based shooters are also networked with its "sense" and "sense-making" capabilities to deliver mission success in its air defense and air combat missions.

We have deliberately conceptualized the targeting or sense-and-strike cycle as "sense-to-shoot" (specifically last-mile shooting) because we would like to highlight the idea that "sensing" (and "sense-making") is able to serve purposes other than "last-mile shooting." As highlighted earlier, the effective exploitation of C4ISR would shorten the RSAF's war-

fighting OODA loop by producing superior information dissemination and information quality that "reduces the friction" and "lift the fog of war." In this, we observe that airpower-enabled C4ISR need not and should not be limited to "sense-to-shoot in the last mile." In fact, for the RSAF to be able to continue putting useful options "on the table," we should be looking at how C4ISR can be better exploited to enhance the system-of-systems fighting capabilities of the RSAF and the SAF. In this vein, we have conceptualized C4ISR for the air force as comprising "sensing" (and "sense-making") to "generate" as well as "sensing" (and "sense-making") to "influence."

EXPANDING THE C4ISR DISCOURSE: "SENSE-TO-GENERATE"

From an air power system-level perspective, we have effectively exploited C4ISR in our employment of the "teeth" of air power in "sense-to-shoot in the last mile." However, we must not neglect the fact that the "tail" of air power generation is just as important as the "teeth." "Sense-to-shoot in the last mile" is only as lethal as the ability to "generate-to-shoot." At the simplest level, if the shooter platform cannot be configured and launched responsively to engage its target, the operational knowledge generated of the target and the accurate shooter-to-target matching done by planners would be futile. Presently, there is good focus on operations-intelligence (Ops-Int) integration throughout air forces worldwide. This is seen in tightly expressed operating concepts, such as the "F2T2EA" targeting cycle. It is also seen in technological capabilities, such as when one sees a UAVs like the *Predator* and *Reaper* that are capable of performing the ISR and strike functions. In the SAF and the RSAF, the close Ops-Int collaboration is also seen in the setup of the C4I community as well as with the establishment of the AIRIX vocation. However, "generation" or, more commonly, "logistics," features at the receiving-end of Ops-Int, rather than upfront where the Ops-Int integrates. If we acknowledge that "sense-to-shoot" is only as lethal as the ability to "generate-to-shoot," then it would perhaps be prudent to better integrate "generation" upfront where the "sense" takes place, rather than to place

it passively awaiting for information to generate the required shooter.

In the previous article entitled “Logistics: Powering the Third Generation RSAF,” the analogy of the arrow and crossbow was used to represent the link between aircraft/weapons systems and logistics respectively. Without the crossbow (logistics), the arrow (aircraft) cannot launch and the “teeth” of airpower would be useless. Extending that analogy in our context, “sense” in generation of air power is about selecting the arrow with the most suitable tip for the mission and loading it onto the crossbow. By enhancing the “sense” at this end, our loading and reloading of the arrow onto the crossbow would be greatly increased, giving us an edge over any potential adversary. To frame it differently—if the effective exploitation of C4ISR would shorten the RSAF’s war-fighting OODA loop by producing superior information dissemination and information quality that “reduces the friction” and “lift the fog of war”—then “sense-to-generate” would essentially be about generating the right combat resources and right configuration at the right time and right place through superior information dissemination and information quality in an air power generation battle.

Specifically, exploitation of C4ISR would enable information dissemination and ensure high information quality production to reduce the friction and lift the fog in the information operations battle.

If the ground crew commander is able to understand and share upfront the intelligence that is generated on a target, preparations to configure the aircraft could be done in advance. If C4 systems onboard the aircraft can convey weapons load and fuel data to C4 systems in the command post, preparations could also be made in advance on the ground to ensure quicker aircraft turnarounds. At the same

time, C4 and surveillance systems could help our base commanders better fight the air power generation battle by providing better situational awareness of various aspects of the air power generation battle. These include real-time battle damage assessments of critical infrastructure within the air bases and resource utilization rate. Furthermore, if the ground commander is equipped with up-to-date operational knowledge about the threats to our airbases upfront, force protection and platform operability operations could also be conducted more responsively when under fire. These would enable the ground commander to better prioritize and deploy resources for repairs and base defenses to responsively meet the particular kind of threat.

Overall, “sense-to-generate” presents some broad possibilities where C4 and ISR could potentially be better exploited to enhance the system-level war-fighting OODA loop of the RSAF (as illustrated in Figure 1 below).

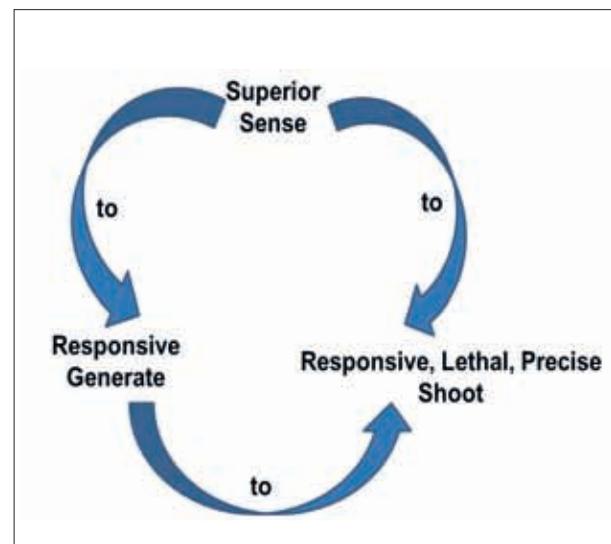


Figure 1: RSAF OODA Loop

EXPANDING THE C4ISR DISCOURSE: “SENSE-TO-INFLUENCE”

While we can think of the effective exploitation of C4ISR as enhancing the system-level war-fighting OODA loop of the air force, we can also think of the effects of C4ISR exploitation in more strategic terms.

At the beginning of this essay, we postulated that militaries are expected to provide useful options to facilitate the political processes of peace-making and war-waging. Against the backdrop of the “information age,” we also postulated that militaries had to learn to exploit what is on offer in this “age” in order to be able to continue providing these useful options. This ability to continue “putting options on the table” is what makes the endeavor strategic.

In this light, we would argue that effective exploitation of C4ISR would also enable the RSAF to continue providing options through the idea of “sense-to-influence.” As the “information age” brings forth an increasingly complex, dynamic and time-pressured operating environment where mass-media user-generated narratives can hurt the credibility and even blunt the operational effectiveness of militaries, the military must have the capability to put out its own narratives and counter-narratives. Specifically, exploitation of C4ISR would enable information dissemination and ensure high information quality production to reduce the friction and lift the fog in the information operations (IO) battle.

For example, the US-operated EC-130J *Commando Solo*, capable of intercepting and broadcasting television and radio signals on all communications bands, lies at the forefront of how C4ISR technologies could be exploited for the IO battle.¹⁶ Without the need for such dedicated platforms, the RSAF’s superior “sense” capabilities could also play an important role in this battle to “influence” perceptions for strategic gains. The RSAF’s C2 recordings of its air defense and air combat operations, its UAV surveillance footage, along with footage from shooter gun-cameras and missile-cameras, all provide valuable visual and audio resources to counter misinformation and support our cause. C4 systems on the other hand would provide the platforms to responsively collect, store process and eventually disseminate these resources to meet the demands of catching a high-tempo mass media cycle.

History is replete with examples of how these C4ISR resources have or have not been exploited to support narratives of *Jus Ad Bellum* and *Jus In Bello* in military operations. Specifically, C4ISR resources have proven especially important for hedging against potential fallout from controversial combat operations, such as those conducted in religious compounds, or those involving civilians in hostage rescues and raids on houses. We have heard of how combat camera footage in a United States (US) battalion’s battle over a mosque in Iraq helped vindicate the unit accused of murder.¹⁷ Moreover, we have also seen on YouTube, the footage from a loitering Israeli UCAV (accompanied with voice recordings of the operators), exhibiting how an extremely precise air strike leveled a part of a house, only after its occupants evacuated. On the other hand, we have also seen that even though the Israeli raid on the Turkish civilian flotilla (delivering aid to Palestinians in 2010) was filmed on combat camera and airborne platforms, the ISR resources of the raid were not effectively utilized to build its narrative of legitimate use of force. Overall, these would point to our argument that “sense-to-influence” also presents some broad possibilities where C4 and ISR could potentially be better exploited to enhance the strategic utility of the RSAF.

CONCLUSION

To ensure our lead over our potential adversary in the current information age, we need to continue to harness C4ISR to unlock the full potential of air power. The exploitation of C4ISR enhances our OODA loop, allowing us to establish “information superiority” and hence enabling us to apply our airpower more decisively and more effectively. Thus far, the RSAF has done well in exploiting C4ISR to enhance its OODA loop of “sense-to-shoot in the last mile.” However, if the effective exploitation of C4ISR shortens the RSAF’s war-fighting OODA loop by producing superior information dissemination and information quality that reduces the friction and lift the fog of war, then it could also reap payoffs in “sense-to-generate.” This would entail conceptualizing it as generating

the right combat resources and right configuration at the right time and right place through superior information dissemination and information quality that reduces the friction and lift the fog of the air power generation battle. At the same time, exploitation of C4ISR would also enable information dissemination and ensure high information quality production to reduce the friction and lift the fog in the information operations (IO) battle. This would expand the utility of the military instrument in the political processes of peace-making and war-waging. Overall, these are perhaps two new areas in which we can leverage on C4ISR to enhance the systems-level effectiveness and strategic utility of air power. As Sun Tzu famously said, "If quick, I survive. If not quick, I am lost. This is death." This is reflected as a truism for air power employment, regardless of its "teeth, tail or strategic utility." 🌐

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Managing Strategic and Tactical Uncertainty: Mission Command in the Third Generation Army

by CPT Alvin Chan

Abstract:

This essay examines the role of mission command in managing strategic and tactical uncertainty as the Army transforms into a Third Generation force. Mission command represents a decentralized command philosophy whereby superiors communicate their intent effectively and permit subordinates to crystallize their operational plans independently. This essay revisits the origins of the philosophy and assesses its relevance in the current strategic landscape. It continues to suggest key initiatives for the proliferation of the philosophy in the Third Generation Army before concluding that the adoption of mission command, though challenging, enables the Army to successfully transform into an integrated and networked force and remain relevant in an increasingly unpredictable environment.

Keywords: Military Strategy; Maneuver Warfare; Mission Command; Third Generation SAF

INTRODUCTION

Diverse are the situations under which an officer has to act on the basis of his own view of the situation. It would be wrong if he had to wait on orders at times when no orders can be given. Most productive are his actions when he acts within the framework of his senior commander's intent.

– Field Marshal Helmut von Moltke¹

The Revolution in Military Affairs (RMA) has been prominently featured in recent years, with the main concepts revolving around information dominance, disengaged battle, synergy and civilianization of conflict.² The culmination of these concepts is an exponential rise in scope and complexity of military operations, leading to the dispersion of forces and expansion of the physical battlefield. In response, modern militaries in the information age have transformed to become highly integrated and networked forces in order to conduct a wider

spectrum of operations. Information-based networked structures undoubtedly facilitate dispersed and diverse forces operating seamlessly and synergistically across vast distances. However, to support these complex networked systems, militaries are compelled to enhance command and control methodologies that increase autonomy at the lower rungs of the command structure.³ The desire for greater leader initiative and impetus for decentralization of decision making have never been greater due to the increased tempo and uncertainty of future warfare.

As the Army embarks on its journey to become an integrated and network-centric force, the continued development of command and control methodologies is paramount. Mission command represents a decentralized command philosophy whereby superiors communicate their intent effectively and permit thinking subordinates to exercise initiative and derive tactical decisions of their own accord.⁴ This

allows the Army to be a flexible and agile force that empowers its people to operate efficiently in an environment of continuous flux. This essay examines the role of mission command in managing strategic and tactical uncertainty as the Army transforms into a Third Generation force. The essay traces the origins of mission command and assesses its relevance in the current strategic landscape. It continues to suggest key thrusts to proliferate the philosophy in the Army before concluding that the adoption of mission command, though challenging, enables the Army to transform into a networked force successfully and remain relevant in an increasingly unpredictable environment.

ORIGINS OF MISSION COMMAND

Mission command provides a framework for freedom of action and thereby fosters initiative by subordinate commanders during the execution of their assigned missions.⁵ The Prussian Army noticed during the Austro-Prussian War of 1866 that the improved lethality of weapons induced greater dispersion of forces in the battlefield. Commanders realized that they could no longer observe or control their forces as effectively as before and junior commanders were forced to make decisions in the absence of specific instructions from superiors. This drove the development of initiative in leaders at all echelons through mission command, which became the new culture in the Prussian Army. The decentralization of decision making to subordinate commanders at lower levels was the logical solution, whereby junior commanders would have to make independent decisions and execute them based on the astute interpretation of their commander's intent.⁶

In World War I, the Germans enjoyed success at the tactical level owing to the development of elastic defense and assault tactics that paved the way for greater initiative and creativity in leaders amidst fluid situations. The German Army eventually institutionalized the development of leaders who were willing and able to take prudent, independent action

to handle the unexpected.⁷ This evolved to become *Auftragstaktik*, which is most commonly translated as mission command. Mission command is widely considered to be the premier command philosophy of maneuver warfare and is extremely crucial to the practice of maneuver warfare. Maneuver warfare arose as a direct response to increases in battlefield firepower. With a weaker industrial base as a consequence of World War I, the Germans formulated tactics based on maneuver rather than attrition, creating the first truly non-linear tactics that sought to bypass and dislocate the enemy at his centre of gravity.⁸ Maneuver warfare as a war fighting philosophy was further validated in World War II, where the Germans applied it to great effect in *Blitzkrieg*.⁹ Maneuver warfare is characterized by movement, craft and the human dimension of war.¹⁰ It actively seeks to pre-empt, dislocate and disrupt the enemy in order to defeat his will to fight and render defense untenable. Above all, psychology forms the basis of all concepts of the maneuver theory, which capitalizes on the strengths and weaknesses of the human will.

RELEVANCE OF MISSION COMMAND IN THE EVOLVING STRATEGIC LANDSCAPE

Fourth-Generation Warfare (4GW), which is characterized by the complex mix of political, economic, social and military realms, has contributed greatly to the evolving strategic environment.¹¹ The asymmetric nature of recent conflicts in Iraq and Afghanistan has largely supported this notion and reinforced the *Clausewitzian* dictum that uncertainty is an inherent part of warfare.¹² Fluid scenarios, fleeting targets and chaotic environments requiring rapid decision making under a veil of unpredictability is evident today and would only be accentuated in future. The speed of decisive action, the fundamental rationale for mission command, is integral to mission success on the contemporary battlefield.¹³ In Operation Iraqi Freedom, the application of mission command and maneuver warfare was apparent in the deep armored penetrations towards the centre of gravity in



An Officer Cadet Platoon Commander and Platoon Sergeant discussing strategies.

Baghdad. These “Thunder Runs” validated the doctrine of speed and maneuver by exploiting “surfaces and gaps” in the area of operations, leading to a swift and decisive victory with minimal attrition.¹⁴ Maneuver warfare was also demonstrated in the Yom Kippur War, where outnumbered Israeli forces initiated a counterattack deep behind the Syrian defensive lines that caught their adversaries off guard and shook their will to fight.¹⁵

Maneuver warfare and its command philosophy are especially relevant to the Singapore Armed Forces (SAF) and will serve the organization well in its Third Generation transformation. The SAF has adopted maneuver warfare as a war fighting philosophy because it overcomes several constraints unique to Singapore.¹⁶ In geographical terms, Singapore lacks strategic depth and the SAF is required to defend potential aggressors within a complex geographic architecture. Coupled with population and budgetary

constraints, the SAF is compelled to conduct a short decisive war while being outnumbered and outgunned. With limited resources and time at hand, the SAF needs to generate a streamlined force and a fighting concept that empowers it to punch above its weight and muster effects that are highly disproportionate to the sum of its size and capabilities. Maneuver warfare as a war fighting philosophy provides an effective framework to defeat the enemy rapidly with minimal attrition. The military agility that maneuver warfare provides is articulated succinctly in the United States Department of the Army Field Manual:

Agility—the ability of friendly forces to act faster than the enemy—is the first prerequisite for seizing and holding the initiative. Such greater quickness permits the rapid concentration of friendly strength against enemy vulnerabilities. This must be done repeatedly so that by the time the enemy reacts to one action, another has already taken its place, disrupting his plans and leading to late, uncoordinated, and piecemeal enemy responses.

It is this process of successive concentration against locally weaker or unprepared enemy forces which enables smaller forces to disorient, fragment and eventually defeat much larger opposing formations.¹⁷

The approach for mission command is based on the realization that “no plan survives first contact with the enemy,” and therefore a good plan encapsulates a central idea that allows maximum freedom to decide and act according to the emerging situation and changing circumstances.¹⁸ As such, mission command has remained relevant despite sweeping changes to military warfare over the past decades and will continue to be congruent to future modes of warfare.

FRAMEWORK FOR PROLIFERATION OF MISSION COMMAND IN THE ARMY

The proliferation of mission command must be deliberate and institutionalized as part of a comprehensive framework for the Third Generation Army to become a network-centric force that is competent, confident, cohesive and committed to the cause. Four key initiatives have been identified for executing the framework:

- Decentralization of Decision Making
- Inculcating a Culture of Boldness
- Effective Communication of Intent
- Forging Superior-Subordinate Relationships

DECENTRALIZATION OF DECISION MAKING

The changing security landscape has seen a widened spectrum of threats that are transnational and non-conventional in nature. At the strategic level, governments have recognized the need to strengthen their defense architecture and network amongst nations to address this paradigm shift. Militaries operating in coalition with allies as well as other non-military agencies in a whole-of-government approach will become increasingly prevalent. Intrinsic to coalitions and joint efforts are the wide ranging nationalities, cultures, doctrines, agendas and goals

of various players. Imposing a rigid and centralized command style in a multicultural or multi-discipline environment will inevitably induce friction and cause a factious atmosphere that hinders command and control. Instead, these variables imply the need for a decentralized framework for command and control that would facilitate the accomplishment of overarching objectives. Decentralization of decision making allows for effective integration and provides competent sub-organizations the freedom and flexibility to operate without unnecessary constraints.

The approach for mission command is based on the realization that “no plan survives first contact with the enemy” and therefore a good plan encapsulates a central idea that allows maximum freedom to decide and act according to the emerging situation and changing circumstances.

In the information age, large organizations are flattening their rigid hierarchy into looser conglomerates of subordinate offices that are bound by a unifying vision of success.¹⁹ Likewise, the Army faces an evolving and increasingly complex mix of joint and integrated warfare that necessitates the decentralization of decision making. As organizations strive to become leaner and more efficient, flattening a hierarchy leads to economy in operations by removing superfluous echelons of authority which cannot be afforded in modern military operations. More importantly, precious time is saved by dispensing with the inefficient referral of decision making up and down the hierarchy.

Mission command has gained greater traction since the introduction of new digital command and control (C2) systems to mitigate the effects of



A midshipman (second from right) firing the 76mm Oto Melara gun under the watchful eyes of the seasoned RSS Endurance crew in the Combat Information Centre.

micromanagement.²⁰ Senior commanders may have a propensity to micromanage as it is now technically feasible to monitor and direct low-level activities at the frontlines. However, as conflicts grow in intensity and complexity, the ability to divide one's attention across many fronts diminishes. The chaos associated with modern warfare has to be ameliorated by technology and transfer of authority to the lower echelons. A coordinated information flow made possible by advanced information systems enables decisions to be made at the appropriate level. This empowers lower levels of authority to make informed decisions rapidly. William Lind, who helped develop the maneuver theory, advocated the psychological benefits of "creating an unexpected and unfavorable operational strategic condition, not to kill enemy

Subordinates must not be relegated to just followers, but be regarded as leaders in their own right who are able to make independent judgments and influence the battlefield.

troops or destroy their equipment."²¹ Effective fighting in the midst of a chaotic battle requires combatants to be consistently faster than their adversaries in the decision making process through the Observation-Orientation-Deciding-Acting (OODA) loop.²² This cycle enables a force to evaluate and determine actions rapidly, causing the adversary to make decisions based on circumstances that have changed.²³ In a dynamic environment where the enemy's strong and weak points cannot be accurately predetermined, authority must be delegated down so that commanders are able to find gaps and exploit them without delay.²⁴

INCULCATING A CULTURE OF BOLDNESS

Boldness and willingness to take risks are attributes that are highly valued in mission command. Mission command is not simply a technique of issuing

orders, but a type of leadership.²⁵ Subordinates must not be relegated to just followers, but be regarded as leaders in their own right who are able to make independent judgments and influence the battlefield. Under conditions of uncertainty, there is no perfect solution. Boldness and willingness of the commander to take action in the absence of specific orders must be encouraged. In maneuver theory, speed outweighs precision. A quick and fundamentally sound plan that is executed decisively at an opportune moment is superior to an immaculate plan that is performed much later.²⁶ Sun Tzu captured the essence of this idea when he wrote, “what is of greatest importance in war is extraordinary speed; one can-not afford to neglect opportunity ... An attack may lack ingenuity, but it must be delivered with supernatural speed.”²⁷

In order to inculcate boldness and enterprise in our leaders, they should be given the latitude to make decisions, especially in the context of mission-based exercises. In fact, inactivity in situations should

be denounced and considered worse than judgment errors made in the right spirit of taking the initiative. Inaction is equivalent to yielding the initiative to the enemy. The maxim, “initiative disrupts synchronization and obedience preserves order,” is a traditional mental model that retains little validity today. Given the current strategic environment, preservation of order in an inherently disordered and chaotic environment is futile. Thus, prudent risk-taking by a thinking soldier in appropriate situations should be encouraged and be incorporated as a cultural norm in the Army. Junior commanders should be granted scope for initiative to cultivate a will to action. The widespread exercise of initiative by leaders will help carry the battle and win the war in the face of confusion and ambiguity.

EFFECTIVE COMMUNICATION OF INTENT

Communication of intent plays an important role in the eventual implementation of assigned tasks. The commander should articulate what is to be accomplished but not how to accomplish them.



80/10 Officer Cadet Course Commissioning Parade: Cadets from the Artillery in a march-past at the parade.

Adequate resources must be provided for mission success with constraints explicitly stated. The desired outcome is to provide subordinates the freedom of action as the situation demands.

The ideal effect of the commander's intent is a concise expression of the commander's vision of the operation that focuses subordinates on a common goal. In the process of issuing orders, the intent gives context to the mission and provides a vision of the desired endstate. The commander's intent provides unity of purpose and effort in dynamic situations which deviate from plans and expectations. Effective communication of intent should fulfill the following criteria:²⁸

- Clear, to avoid misinterpretation and be easily comprehensible two levels lower on the command chain.
- Concise, to eliminate ambiguity and ensure priorities are defined.
- Compelling, to provide impetus for subordinate leaders to act when the opportunity arises.
- Complete, to inform subordinates on the task and purpose (what and why).

Freedom of action empowers the subordinate, allowing him to be a leader and take ownership for his actions. Empowered subordinates derive greater pride and satisfaction in performing their duties and show greater determination in completing them. Independent leaders are better equipped to handle confusion in battle, where swift and decisive action must be taken to capitalize on small windows of opportunity. The collective alignment of intent in a unit results in unity of purpose and effort, which is crucial in modern operations where war fighting resources are scarce.

FORGING SUPERIOR-SUBORDINATE RELATIONSHIPS

Trust between superior and subordinate is the cornerstone of mission command. A superior who

trusts his subordinate empowers him to exercise his judgment and act as the situation dictates while achieving the desired endstate.²⁹ The subordinate executes in faith that his actions will contribute to the mission and will be supported by his superior. The amount of confidence placed in the subordinate stems from the intimate relationship between superior and subordinate. A relationship built on trust is crucial to the implementation of mission command.

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Through quality relationships between the superior and subordinate, the concept of imparting presence can be achieved. Imparting presence is the process of developing subordinates' decision making frameworks so that they respond the same way the senior commanders would if they were able to view the situation through their own eyes.³⁰ Imparting presence is a tall order for a conscript army due to the amount of training time available but establishing a healthy command structure can help to overcome this limitation. Commanders should seek to impart presence from the day they assume command and explicitly state their *modus operandi*. Superiors should constantly instruct their subordinates on what and not how to do tasks. Certain boundaries must be established up front to provide subordinates with the freedom to act and the knowledge of what is acceptable and what is not. This is particularly applicable to ensuring peacetime training safety. In addition, unit integrity must be maintained as much as possible to facilitate the forging of superior-subordinate relationships. The importance of unit integrity is amplified in a conscript Army, where valuable training opportunities

are limited for the operationally ready force. The synergy between superior and subordinate must be built on a strong foundation and would be a prized attribute in operations.

CONCLUSION

This essay has argued for the requirement to incorporate mission command as the pre-eminent command and control principle in the Army. Mission command has proved elusive in practice even in established militaries due to doctrinal and cultural dimensions that stem from national character and organizational traditions.³¹ Hence, mission command must be built upon the values and principles that the Army has cultivated over the course of its history. It is not easily quantified and institutionalized but four initiatives have been suggested to aid the adoption of the philosophy. As our operating environment evolves into a more complex and uncertain state, it is imperative to develop thinking soldiers who are able to cope with variables to respond to unanticipated situations and endeavor to achieve their commander's intent under the proverbial "fog of war." Grooming such leaders under the philosophy of mission command drives soldier development, doctrinal development and improves battlefield effectiveness. Mission command seeks to maximize the potential of every soldier, which could be an effective conduit to enhance "Last-Mile Leadership" and instill the culture of "Every Soldier a Leader." The emphasis on mission command galvanizes the Third Generation Army by developing people with steadfast dedication and commitment to the cause. The leadership initiative exemplified by mission command translates intent into reality and engenders an enduring leadership that will carry the Army to the next generation. 🌐

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Submarine Procurement in Southeast Asia: Potential for Conflict and Prospects for Cooperation

by LTC Aaron Beng

Abstract:

The acquisition of submarines by so many Southeast Asian countries represents a sudden proliferation of a new capability throughout the region. Fuelling this dynamic is a lack of trust and transparency. As Southeast Asian countries that possess submarines continue to cooperate on different naval operations, including areas of water space management, as well as submarine emergency and rescue. Eventually, establishment of these collaborations would assist in lowering insecurities and anxieties, and help to diminish the potential for further escalation of arms dynamic.

Key words: Arms Race; Military Modernization; Southeast Asia; Submarine Warfare

INTRODUCTION

A spate of recent submarine acquisitions in Southeast Asia, together with declarations for future purchases, could result in at least five nations operating submarines by 2020.¹ The end of 2012, saw Indonesia, Singapore and Malaysia already operating submarines. Vietnam has placed orders for submarines and Thailand has also made clear its intentions to pursue the purchase of a submarine capability. Other than submarines, major arms purchases such as fighter aircraft, helicopters, coastal defense systems and armored vehicles have resulted in Southeast Asian defense expenditures rising by 13.5 per cent to nearly US\$24.5 billion between 2010 and 2011.² While some observers have warned of the potential for an arms race in the region, the majority of analysts have concluded that the conditions for a full-blown arms race have not yet developed.³ Instead, the current defense spending spree has been characterized as a period of modernization for Southeast Asian militaries,⁴ in which

new platforms are not being bought “in numbers large enough to seriously affect the regional balance of power,”⁵ and where most of these “acquisitions could also be perceived as inherently defensive in nature.”⁶

However, the acquisition of submarines by so many Southeast Asian countries represents a sudden proliferation of a new capability throughout the region. Also, a pattern of tit-for-tat buying appears to be developing with regard to submarines and anti-submarine warfare (ASW) capabilities, fuelled by a mutual lack of trust and suspicion about the intended use of submarines in the region. At the same time, given the nascent stage of submarine operations within Southeast Asia, there also exists significant potential for cooperation among the Southeast Asian nations. This, in turn, could serve as a platform for confidence-building among Southeast Asian nations and help to remedy the mutual suspicion and lack of trust, which has limited the potential for further stability within Southeast Asia.

EXAMINING THE SUBMARINE PROCUREMENTS OF SOUTHEAST ASIAN NATIONS

Indonesia

The Indonesian Navy (*Tentara Nasional Indonesia Angkatan Laut* or TNI-AL) has been continuously operating submarines since the 1960s and is the oldest submarine operator in Southeast Asia. As part of its current fleet, the TNI-AL operates two *Type 209* boats, which were commissioned in the early 1980s.

Developing a conventional surface navy of sufficient size and capability to ensure deterrence over the country's vast maritime territory will take many years and a large financial investment. However, the submarine's stealthy nature provides an ability to be viewed as a credible deterrent with a much smaller force.

With more than 17,000 islands and vast interconnecting archipelagic waterways, Indonesia's focus on building up a strong navy is understandable. Although the TNI-AL operates a relatively large number of platforms compared to its neighbors, its fleet is considered inadequate for patrolling Indonesia's vast coastline and internal waters. As far back as 2004, former Indonesian Navy chief of staff Admiral Sondakh told his parliament that the navy had 117 ships of all types and readiness status, but that effective security of the country's huge maritime expanse required 762 ships.⁷ While budgetary and financial considerations have previously led to delays and postponement of force renewal projects desired by the TNI-AL leadership, a slate of project acquisitions since 2009 indicate that the seeds of the green-water capability are being sown, and that Indonesia is trying to play catch-up and secure its maritime territory.

This includes three *Chang Bogo*-class submarines, to be delivered by 2020.⁸ An eventual complement of 10 submarines has been articulated. This is the number of boats deemed necessary to sustain patrols throughout the nation's waters, with additional boats to be used as backup and for training.⁹

Developing a conventional surface navy of sufficient size and capability to ensure deterrence over the country's vast maritime territory will take many years and a large financial investment. However, the submarine's stealthy nature provides an ability to be viewed as a credible deterrent with a much smaller force. This is because submarines can be discreetly deployed, *en masse* if needed, to various locations within the archipelago. Unlike the surface fleet, which needs to be visible in order to deter, submarines can threaten a potential adversary by their mere presence. Thus, having a small but capable submarine force will allow the TNI-AL to quickly leapfrog its current inadequacies and provide an interim solution to fulfill its mission of protecting territorial integrity while it continues to build-up and modernize its remaining force structure.

Singapore

The uniqueness of Singapore's geostrategic predicament is that despite its miniscule size and small territorial boundaries, the island's area of concern stretches much further across the expanses of water on its East (the South China Sea) and West (the Malacca Strait) where most of its trade and imports flow from. The stated mission of the Singapore Navy is to "to provide for the seaward defense and ensure the safety and security of Singapore's vital Sea Lines of Communication (SLOCs)."¹⁰ Of note, the Republic of Singapore Navy (RSN) is the only Southeast Asian naval force to include SLOCs, and not merely its own maritime territory, within the scope of its mission, due to the island's heavy reliance on trade. Some observers have described the RSN's force structure as having



The RSN crew returning to Karlskrona, Sweden, after a training exercise on board the Swedish training submarine, HMS Östergötland.

undergone a “golden era” since the beginning of the twenty first century.¹¹ Significant acquisitions have included six *Formidable*-class frigates with significant anti-air, anti-surface and anti-submarine capabilities, and *Seahawk* S70B Naval helicopters which extend the Frigates’ ability to conduct standoff ASW and anti-surface warfare.

But the most noteworthy acquisition was of two second-hand Swedish submarines of the *Vastergotland*-class.¹² These boats join Singapore’s ex-Swedish *Sjoorman* submarines which were purchased in the mid-1990s and operationalized in the early-2000s. Beginning with its force modernization in the late-1980s and early-1990s, and continuing to its more recent acquisitions, the RSN has continually improved its capability to project presence in the South China Sea and the Straits of Malacca and Singapore.¹³ The recent acquisition of the ex-*Vastergotland* submarines to supplement the ex-*Sjoorman* boats is in line with this development trajectory. Indeed, the primary stated purpose of Singapore’s submarines is to “enable the RSN to better fulfill its mission of protecting Singapore’s sea lines of communication and territorial integrity.”¹⁴

Coupled with deterrence, the second pillar of Singapore’s larger defense policy is diplomacy. Unique among the current submarine operators in

Southeast Asia, the Singapore Navy’s submarines have participated in a number of bilateral exercises with India,¹⁵ the United States,¹⁶ as well as multilateral exercises with countries including Malaysia, New Zealand, the United Kingdom, Australia, Japan and the Republic of Korea.¹⁷ This indicates that Singapore’s submarines, like its other platforms, are not merely viewed as a deterrent capability, but also as a means of engaging and increasing interoperability with its friends and partners, and to build confidence with other militaries.¹⁸

Malaysia

The core mission of the Royal Malaysian Navy (RMN) is to prepare and deploy naval forces to protect Malaysia’s maritime interests in peacetime and in times of conflict.¹⁹ Malaysian maritime territorial claims contested by other nations include the Spratly Islands (with China, Brunei, Vietnam and the Philippines), the Ambalat Island Block (with Indonesia), and the Ko Kra and Ko Losin Islands in the Gulf of Siam (with Thailand).²⁰ Of note, Malaysia has maintained a military presence on the Ardasier Bank, Mariveles Reef, and the Swallow Reef in the Spratlys where they built an air strip and diving resort on the Swallow Reef.²¹ This may signal the importance which Malaysia attaches to its claims in the Spratlys.

The RMN’s two French-built *Scorpene*-class submarines, acquired in 2002, returned to Malaysia between 2009 and 2010. Even before the introduction of the submarines, the RMN already operated a well-balanced and capable naval force including frigates, corvettes and next-generation patrol vessels with a credible capability to project power and enforce its maritime claims. On the submarine acquisitions, then-Malaysian Defense Minister (now Prime Minister) Najib Tun Razak said, “This is a new capability for the RMN. It will not only allow our navy to have the capability

to operate in a sub-surface dimension but more importantly will allow us to play a more significant role in ensuring our national sovereignty and national interests are protected ... [it] should also be seen as our contribution towards peace, security and stability.”²²

The basing of both submarines at Kota Kinabalu Naval Base in Sabah, East Malaysia, indicates that one key mission is to protect Malaysia’s sovereignty in the South China Sea. They provide an alternative to projecting presence and assert its maritime claims. This makes sense given that many countries lay claim to territory in the South China Sea and these disputes are unlikely to be resolved soon.

Vietnam

Vietnam is one of two Southeast Asian nations that have engaged in major naval confrontations with China over disputed territory in the South China Sea (the other nation being the Philippines).²³ Vietnam’s worries over incursions into its territory were articulated in its 2009 national defense policy which states that territorial disputes in the East Sea (the term which Vietnam uses to refer to the South China Sea) have been increasing and thus have “seriously affected many activities and the maritime economic development of Vietnam.”²⁴ However, until recently, the Vietnam People’s Navy (VPN) only had a limited capability to protect its territories in the South China Sea, especially compared to the naval strength of China. Underscoring this point in comments made following Vietnam’s thirteenth National Assembly, Defense Minister General Phung Quang Thanh said

This is perhaps the clearest indication of the emergence of an unintended consequence—the security dilemma which occurs when an “arms acquisitions by one state, even if it has no desire to threaten its neighbors, can often lead to anxieties and insecurities being felt by nearby states.”

that building up a modern navy was a priority, but this would require time and significant amounts of capital.²⁵

In 2009, Vietnam signed a comprehensive defense deal with Russia, which included six Kilo-class diesel-electric submarines to be delivered between 2013 and 2020. In addition to torpedoes, it has been reported that these boats will be fitted to operate the Club anti-ship missile.²⁶ This submarine purchase comes on the heels of a slew of recent naval acquisitions including corvettes, frigates and patrol crafts. Similar to Indonesia, Vietnam’s acquisition of a significant submarine force has been a way to develop an interim deterrent capability rapidly. This can be used to enforce, and if needed, contest its sovereignty in the South China Sea. Even with the operationalization of all its recent surface platform acquisitions, the VPN will still be significantly inferior to China’s naval forces. The ability to deploy submarines provides the VPN with a means to undertake a sea denial strategy against China in the disputed territory, instead of having to go into head-to-head in a naval conflict.

Thailand

The Royal Thai Navy (RTN) has responsibility to provide littoral and Exclusive Economic Zone (EEZ) maritime security because of Thailand’s significant maritime interests, including the protection of offshore oil and gas reserves, counter-terrorism, counter-piracy and countering illegal trafficking in its territorial waters.²⁷ The RTN operates a capable

maritime force, one of the largest in Southeast Asia in terms of number of platforms, with assets including an aircraft carrier, frigates and offshore patrol vessels.

To add to its force structure, the RTN has been pursuing the purchase of submarines since at least the early-1990s.²⁸ However, budgetary concerns have hampered the RTN's ability to obtain funding approval for their recent purchases. The latest acquisition plan is centered on the purchase of two ex-German Navy *Type 206A* diesel-electric platforms.²⁹ Interestingly, unlike the other Southeast Asian nations, Thailand's need to acquire submarines is not articulated as a capability requirement to achieve a specific mission. Instead, it is framed as a response to the submarine acquisitions of Thailand's neighbors. Thailand's Deputy Prime Minister Suthep Thaugsuban, who is in charge of national security affairs, said that submarines were "necessary for the Royal Thai Navy because countries in the immediate region—who could pose a threat—all have submarines. If we don't [acquire] submarines it will be difficult to protect our sovereignty and we will be at a disadvantage. We have natural resources and interests at sea that need protecting."³⁰ However, the RTN has not yet been able to convince the lawmakers of the need for this acquisition, and to obtain funding approval for this latest purchase because of the Thai cabinet's concerns over the cost of this purchase relative to the requirement for this capability.

THE ARMS DYNAMIC FRAMEWORK

The arms dynamic framework is useful to examine framework to examine the arms purchases between the Southeast Asian countries. At one end of the arms dynamic spectrum is an arms race, which denotes the "most extreme manifestations of the arms dynamic when actors are going flat out or almost flat out in major competitive investments in military capability."

At the other end of the spectrum is the "build down," which occurs when weapon systems are being phased out and replaced by new systems of smaller numbers, lower capabilities, or considered less destabilizing. At the mid-point is the normal equilibrium referred to as the "maintenance of the military status quo." Finally, the grey area that is between maintenance of the status quo but below a full-out arms race is termed "arms competition" or "arms build-up." As mentioned earlier, military commentators have generally agreed that the prevailing dynamic in Southeast Asia is somewhere above that of "maintenance of the military status quo" and in the realm of "arms competition."³¹

ASSESSING THE ARMS DYNAMIC

From the review above, it is clear that none of the Southeast Asian nations are "going flat out or almost flat out in major competitive investments in military capability."³² When examined in the context of each country's overall naval force structure, submarines are being purchased in relatively modest numbers, often to address an existing capability gap. As such, the prevailing arms dynamic for submarine acquisitions is less intense than that of an arms race. However, the acquisition of submarines by most of the navies represents the introduction of a significantly new capability and goes beyond the normal rearmament process. As such, it can also be concluded that the prevailing dynamic is not ohne of maintenance. Thus, the state of the arms dynamic lies in the grey area between maintenance and an arms race.

At first glance, one might be tempted to reach the same conclusion as Bitzinger in his general examination of Southeast Asian arms acquisitions. In that study, he concluded that the prevailing dynamic is one of *arms competition*— a state of reciprocal arms acquisitions that is dedicated mainly to the "maintenance of the

status quo.”³³ Supporting this view is the fact that the *expressed purpose (or strategic objective)* for submarine acquisition appears to be stabilizing and non-competitive in nature.³⁴ Submarines are viewed as a means to asymmetrically respond to perceived threats, and provide an alternative to building up a large surface fleet. For Indonesia, the acquisition of new submarines is a means to overcome the inherent limitations of its navy and to protect the country’s large maritime territory, while Singapore’s submarines add to its capability to guard its SLOCs. One could thus argue that the acquisition of submarines is stabilizing as the purchase of a small number of submarine platforms to overcome a perceived capability gap is less destabilizing than the acquisition of a large surface fleet to achieve the same effect.

Cooperation in submarine emergencies and rescue could thus form a second pillar for increased cooperation and confidence building among the Southeast Asian submarine operators.

However, in the Southeast Asian context, it must be understood that the acquisition of submarines has a very different character from the purchase of other weapon systems for two key reasons. First, unlike other defense procurements which serve to upgrade existing military capabilities such as newer fighter aircraft or more modern armored vehicles, the purchase of submarines represents the introduction of a new military technology for almost all of the Southeast Asian nations. From a capability perspective, the acquisition of submarines also provides navies with the means to undertake a sea denial strategy, as opposed to sea control—therefore a more “cost effective” means to secure influence over maritime terrain. While sea control requires the highly

visible presence of ships, flotillas and fleets to enforce the state’s dominance, sea denial only requires the perception of threat to cause unease in an opponent and deter any further hostile actions.³⁵

Second, given their design and capabilities it is difficult to portray submarines as benign platforms. The primary purpose of submarines is to lurk undetected and strike against surface shipping— both naval and merchant. Diesel-electric submarines, the only variety being considered by Southeast Asian nations, are particularly suited to this mission because they are quiet and stealthy, and are armed with heavyweight torpedoes and even anti-ship cruise missiles. Compared to nuclear-powered boats, diesel-electric submarines are more suited to operate in the littoral geography of Southeast Asia, which is characterized by areas of shallower and more confined waters.³⁶ Viewed against the backdrop of maritime competition in the South China Sea, where a number of maritime boundary claims remain unresolved, a maritime arms dynamic centered around submarines significantly increases the risk of an armed naval confrontation. Because of these reasons, the impact of Southeast Asian nations’ submarine purchases must be viewed in a different light from that of other arms acquisitions.

More worrying is the mistrust that has been sown by submarine acquisitions. Thailand has articulated its desire to obtain submarines based on the acquisition of this capability by its neighbors. This is perhaps the clearest indication of the emergence of an unintended consequence—the security dilemma which occurs when an “arms acquisitions by one state, even if it has no desire to threaten its neighbors, can often lead to anxieties and insecurities being felt by nearby states.”³⁷ These findings, coupled with the recent surge of interest in ASW platforms, suggest that a regional tit-for-tat might be emerging, with countries

investing in both submarines for themselves and various means of countering their neighbors' submarine capabilities. Singapore operates six S-70B Seahawk Naval Helicopters, which are configured for ASW missions. Vietnam has reportedly expressed interest in acquiring ASW aircraft, including the Lockheed Martin P-3 and Airbus Military C-295; Malaysia is also seeking to acquire ASW helicopters and is considering the Sikorsky MH-60R and the Agusta Westland AW159.³⁸

Thus, one could conclude that the prevailing arms dynamic for submarines in Southeast Asia, is significantly more intense and destabilizing than that of more generalized arms acquisitions. An accurate characterization could be of *accelerated arms competition*, because of the significant anxieties and insecurities that have emerged and for this reason the prevailing competition has accelerated beyond merely the maintenance of the status quo. While not yet in the realm of an arms race, which is an "inescapable vicious cycle,"³⁹ the potential for this dynamic to evolve into one is significant if concerted efforts are not taken to break or mitigate the cycle.

PROSPECTS FOR COOPERATION

Central to reducing the potential for further escalation of the arms dynamic is the building of trust and confidence to stymie the rise of anxiety and insecurity. Interestingly, the growth in the number of submarines within the region provides opportunities to introduce confidence-building measures through increased cooperation between nations. Water space management and submarine rescue are two areas for potential cooperation.

Water Space Management

If all, or even most, of the countries listed above go through with their submarine procurements, the underwater environment in Southeast Asia has the potential to get very crowded. Coupled with



LTC Jack Nyee, RSS Archer's commanding officer, checking the situation on the surface with the periscope while training in a Swedish submarine.

the presence of submarines from extra-regional powers, the risk of an underwater accident increases significantly. This creates the need for a system to manage the underwater environment and minimize the risk of submarine collision. For example, the countries of the North Atlantic Treaty Organization (NATO) created a Water Space Management (WSM) regime during the cold war to ensure the safety of NATO and allied submarines. Through an established set of protocols and procedures, submarine movements were de-conflicted to ensure that only one submarine operates in a defined area at any one time.⁴⁰

A similar system in Southeast Asia could help to ensure the safe operation of submarines during peacetime. It is important to recognize that there could be sensitivities about implementing such a system as it would require releasing information about a submarine's deployment and location. After all, the keys to effective submarine operations are stealth and secrecy. Thus, there could be strong resistance and reluctance to sharing the intended operating areas of each nation's submarines. However, there are a number of ways to mitigate these concerns and enact a workable system. One would be to try and create a neutral WSM agency, which could be formed by an extra-regional country or as a multilateral regional entity. It is vital that the WSM

agency obtain the trust of all participating nations. To do this, the WSM agency would need to be judicious in the way it discharges its duties, which will include refraining from disclosing information that is not vital to safe submarine operations. Furthermore, effective de-conflicting of submarine operating areas does not necessarily require all participating nations to have full knowledge of the location and positions of all submarines. Instead, an effective set of procedures could be implemented so as to achieve effective de-conflicting without requiring the complete disclosure of sensitive information.

Regardless of the intricacies of the structure and procedures of the WSM agency, the creation of an effective WSM regime would help to increase confidence and transparency among the Southeast Asian submarine operators, and reduce concerns about submarines operations and intentions of other countries. This would go some way to mitigating the anxiety and insecurities fuelling the evolving arms dynamic.

Submarine Emergency and Rescue

Among all the existing and potential Southeast Asian submarine operators, only Singapore has a full-fledged submarine rescue capability. None of the other countries have yet indicated plans to procure or develop a similar capability,⁴¹ possibly because of the high associated cost. Cooperation in submarine emergencies and rescue could thus form a second pillar for increased cooperation and confidence building among the Southeast Asian submarine operators. Pooling submarine rescue expertise and capabilities is common for other submarine-operating nations. For example, the United States (US), which has the world's most advanced submarine rescue capabilities, has entered into submarine rescue agreements with many other countries.⁴² Similarly, there are submarine

rescue agreements among NATO countries, and also between NATO and Russia.⁴³ As part of these agreements, participating countries agree to render assistance and provide rescue services in the event that a submarine is in distress. Participating countries also work on ensuring that equipment is interoperable and establishing common doctrine.

In order to develop and refine common doctrine, many countries also participate in joint submarine emergency and rescue exercises, such as the multinational *Pacific Reach* submarine rescue exercise. This was last hosted by Singapore in 2010 and attended by Australia, Japan, the Republic of Korea and the US. During the course of the exercise, the participating forces focused on working together in different submarine emergency and rescue scenarios. A similar exercise could be enacted among Southeast Asian submarine operators to develop common emergency and rescue procedures, allowing nations to pool resources when an emergency does occur. The development of common operating processes and procedures could subsequently lead to the establishment of a regional submarine emergency response framework covering emergency notification procedures, requests for assistance and the conduct of rescue operations.

The dearth of submarine rescue in Southeast Asia makes having a collective framework to respond to submarine emergencies an urgent requirement for safe submarine operations. Given the sensitive nature of submarines and their capabilities, submarine rescue is perhaps the best type of tangible cooperation: sufficiently benign, yet still able to attract participation from the various submarine operators as a start. Similar to WSM, such cooperation in submarine emergency and rescue would also serve as a platform to increase transparency and trust among the Southeast Asian nations.

CONCLUSION

Having examined the motivations, intended deployment and concerns underlying Southeast Asian nations' submarine procurements, it appears that a worrying state of affairs is developing. Unlike other military hardware purchases, the spate of submarine procurements in Southeast Asia represents the widespread introduction of a new capability in the region that is inherently offensive in nature. Southeast Asian countries appear to be caught in a security dilemma where the purchase of submarines by some states, to address legitimate defense concerns, has resulted in increased anxieties among neighbors. An arms dynamic of *accelerated arms competition* is at play. Fuelling this dynamic is a lack of trust and transparency. Notwithstanding this, significant prospects for cooperation among the submarine operating countries still exist, most tangibly in the areas of water space management, as well as submarine emergency and rescue. The establishment of cooperative frameworks and mechanisms in either of these areas would go a long way in reducing insecurities and anxieties, and help to diminish the potential for further escalation of the arms dynamic. 🌐

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Developing a Strategic-Level Commander: Requisite Skills and Attributes

by MAJ Benjamin Kwan Shee Kong

Abstract:

A strategic commander helms the organization by setting the vision, allocating resources to essential areas, and collaborating with the political side and other stakeholders to achieve national goals. This essay will first frame the main challenges of the Contemporary Operating Environment (COE) before highlighting the distinguishing aspects of a strategic-level commander's role and identifying the required personal skills. The success of the organization depends on the strategic commander's ability to tackle any issues that arise, and to ensure that the military remains relevant in the extension of political wills to provide a secure environment for the future.

Keywords: Military Command; Military Leadership; Military Strategy

INTRODUCTION

A strategic-level commander operates at the rank of service chief and above, where his position directly influences national goals and is accountable for the performance of the military organization.¹ A strategic commander helms the organization by setting the vision, allocating resources to essential areas, and collaborating with the political side and other stakeholders to achieve national goals. A successful strategic-level command is an organization that establishes its purpose, upholds its relevance and achieves national goals. The military's actions are the extension of political will and a strategic-level commander has to be cognizant of the desired political end state to decide on the organization's goals. Indeed, the strategic-level commander's role encapsulates both functions of leadership and management.

Despite developing a repertoire of command skills throughout one's military career, there are vital personal skills and enabling attributes necessary for the commander to ensure the enduring success of his organization. The main assumption made is that the strategic commander has undergone the *rites of passage* from tactical to strategic level,

honing his leadership and management skills. As such, this essay will first frame the main challenges of the Contemporary Operating Environment (COE) before highlighting the distinguishing aspects of a strategic-level commander's role and identifying the required personal skills. It will show that these skills build upon those developed through scaling the military ladder of command. It will subsequently identify the corresponding attributes that enhance the effectiveness of those skills. Thereafter, a development process to equip an operational-level commander with the identified skills and attributes required to undertake a strategic-level post is recommended.

FRAMING THE CHALLENGES FACED AT THE STRATEGIC LEVEL

The challenge faced in the COE is that the security landscape is volatile, uncertain, complex and ambiguous (VUCA),² in which military roles have expanded beyond waging conventional warfare. Intractable problems that are often characterized as "wicked" and defy conventional solutions proliferate the COE.³ Furthermore, the presence of traditional and new media presents a challenge for military action, as outcomes are closely scrutinized and reported,



Exercise Forging Sabre 2011: (Former) Chief of Air Force MG Ng Chee Meng (third from right) chatting with Exercise Director and Commander, Air Combat Command, BG Lim Yeong Kiat (third from left) and other senior military officers after observing the live firing.

and success is often judged by the perceptions of indigenous or global audiences. Consequently, the ability to foresee all outcomes is inhibited, because tactical-level actions may potentially result in strategic ramifications. The greater firepower of modern military units translates into increased repercussions for injudicious employment. In all, there is an increasing demand for the strategic-level commander to make sound decisions in the COE and constantly review the notion of adequately-trained forces that meet the challenges of the evolving security environment.

A strategic commander must possess the cognitive skills to dissect and fully comprehend the causes and effects of “wicked” problems, and strategize and steer the organization through the complexities of an evolving security landscape, all of which require the need for “systems thinking skills.”

The factor that distinguishes a strategic-level commander from those at other levels is that he represents the military in the political arena for the setting of national goals and securing of resources. This emphasis on strategic alignment between the military and the politicians was highlighted by Dreschsler.⁶ Furthermore, management of today’s conflicts requires collaboration with other governments and various non-government agencies.⁷ The onus is on the strategic commander to unite all stakeholders in determining the strategic impetus and direction. He will subsequently approve the corresponding military means for the various levels. This is paramount as “wicked” problems require holistic solutions, some of which might be outside the military’s sphere of influence. In any case, the strategic commander decides on the plan for the organization, while the main role of other levels is to achieve success within their respective areas. In essence, the strategic-level commander accounts for the overall performance, in which he has to make competent decisions, lead effectively and manage efficiently.

Before identifying the skills necessary for success at this level, it is essential to be cognizant of the competencies being highlighted in the literature for contemporary strategic leaders. The United States (US) Army identified competencies in six areas: *identity, mental agility, cross-cultural savvy, interpersonal maturity, world-class warrior and professional astuteness*;⁸ Hitt highlighted that the strategic leader in the corporate world requires competencies in managing human and social capital.⁹ To this end, developing skills in the domains of cognitive, and inter- and intra-organization effectiveness is vital. Firstly, a strategic commander must possess the cognitive skills to dissect and fully comprehend the causes and effects of “wicked” problems, and strategize and steer the organization through the complexities of an evolving security landscape, all of which require the need for “systems thinking skills.” Next, he must have effective inter-organization communication skills, upwards towards politicians to seek approval for his plans, sideward amongst other agencies to achieve collaboration, and downwards in his organization to inspire his people; these translate to the need for “social adeptness skills.” Lastly, for ensuring success and building durable organizations that meet the challenges of the COE, he must leverage on individual abilities, and simultaneously develop and groom his people holistically; this requires effective “human capital management skills.”

IDENTIFIED REQUISITE SKILLS

“Systems thinking” is defined as the ability to understand the various parts that constitute a problem, the intricate links between them, and the perspectives and demands of every stakeholder involved.¹⁰ This

allows one to unite the various efforts of stakeholders to solve the problem. Likewise, Leonard highlighted that the mental agility competency requires one to scan the environment,¹¹ apply the right perspective to understand the situation, and to envisage the various permutations before deciding on the best solution. Jessie also raised the need to be cognitively inclined to decipher lower order effects in solving problems.¹² Systems thinking is required in the setting of a vision

To elevate the ability to think critically and creatively and function at a system thinking level, one must first ensure that all angles have been covered extensively and meticulously. It was highlighted that one's inherent values might result in the filtering of relevant information, which then obscures the full understanding of the issue.

that remains relevant to the evolving landscape which affects the culture of the organization.¹³ The abundance of information in the COE is a double-edged sword; while it may help to disperse the “fog-of-war,” the failure to pinpoint the salient points within the *sea* of information may subsequently lead to faulty judgments and analysis. As such, systems thinking facilitates the identification of the desired information as the issue is distilled into a *palatable* size for in-depth analysis. Systems thinking

can be viewed as higher order critical thinking and creative thinking skills; the former facilitates critique in specific domains, while the latter preaches “thinking out of the box.” System thinking leverages on both skills in the assessment of the internal and external factors, and facilitates the developing of holistic means to tackle “wicked” problems.¹⁴

Social adeptness is the ability to appreciate and work with various cultures, and to build relationships.¹⁵ It is the cornerstone for negotiation and consensus building amongst various stakeholders,¹⁶ both within and outside of military agencies, including foreign ones. Non-military agencies might not be amenable to receiving orders and often possess differing strategic views based on their background,¹⁷ values and vested interests. The strategic commander is thus

required to harmonize the views, requirements, and actions of all involved parties.¹⁸ Social adeptness is similar to interpersonal effectiveness, the difference is the social-cultural aspect that is crucial for effective collaboration with different agencies of distinct cultures, beliefs, mental-models and values. Indeed, the importance at the strategic-level is that misconceived intents engender much greater repercussions and tensions which, hinders the overall collaboration effort. As such, a strategic commander has to first consider the position of the political arena based on their inclination before attempting to convince the politicians of the military's position. Likewise, to collaborate with his peers, other agencies and foreign partners, he must also consider their perceptions and interests. Whereas to build strong and enduring relationships, he has to develop an in-depth understanding of the culture and values that drive their behaviors in order to communicate effectively regardless of their backgrounds and by relating to their needs. Positive relationships will invigorate actions from each stakeholder's end that are also synthesized to the overarching plan. Overall, these underscore the importance of the social adeptness

skill, where the main intent is to build bonds that enhance collaborations between stakeholders to accomplish any given task.

It has also been highlighted that one needs to adopt different engagement styles when addressing the requirements of multinational forces. This means that to achieve consensus, one has to adapt to different operating norms and culture, which might require the compromise of one's beliefs at times.

The human capital management skill aims to leverage on individual expertise, and to develop the organization by grooming future strategic commanders. The complex environment requires people with different expertise, of which a strategic commander may be professional-inclined, but not an expert in areas outside the military sphere; even within the organization, he will be more of a



SAF Humanitarian Assistance for New Zealand: Former Chief of Defence Force LG Neo Kian Hong speaking to the SAF team at the reception.

generalist. It is highlighted that human capital is the strategic resource that drives the knowledge-based organizations operating in the COE.¹⁹ Concomitantly, the wealth of knowledge and expertise that each individual possesses, within and out of the organization, must be harnessed to solve issues. They will supplement the strategic commander with the capabilities that he lacks. The COE has also often illustrated the intricate inter-connection between the strategic and tactical-level, where injudicious tactical actions may create strategic implications.²⁰ Hence, the gravity lies in grooming the operational commanders to understand the strategic intents; he will be the conduit that transmits this down to the other levels to foster a common understanding, as well as ensure that they can relate to the *bigger* picture. One will desire a strategic commander that possesses *Level 5* leadership to build an organization that continues to achieve results even beyond his tenure.²¹ On this note, a strategic commander is appointed from within the military organization as intimate knowledge is required to helm the organization. Hence, it is essential that the strategic commander grooms competent successors.²² To this end, a strategic commander must not only be a skilful manager of human capital who is able to build effective teams that fully harness the abilities of its members, but he must also be able to groom his successors and prepare them adequately for future strategic positions.

IDENTIFIED REQUISITE ATTRIBUTES

With the skills required by a strategic level commander identified, the next step will be to identify the attributes. First, meticulousness and astuteness are a complementary set of attributes crucial for systems thinking. A meticulous person is one who shows extreme care when considering facts and details. It has been mentioned that critical and creative thinking will be honed prior to succeeding as a strategic commander. To elevate the ability to think critically and creatively and function at a system thinking level, one must first ensure that all angles have been covered extensively and meticulously.

It was highlighted that one's inherent values might result in the filtering of relevant information, which then obscures the full understanding of the issue. Hence, being meticulous is paramount in the COE as all facts, considerations, perceptions, linkages, causes and effects have to be examined in finer detail. This attribute works hand-in-glove with astuteness as often the underlying causes might not be forthright or might reside outside the limits of one's knowledge. This then requires one to be astute in rationalizing the crux of all factors that constitute to a "wicked" problem so as to identify the crucial information that is required. Both meticulousness and astuteness are attributes that ensure the overall issue is deliberated extensively in terms of the intricate underlying and accompanying issues. This facilitates the identification of the root causes within the system, which allows one to conceptualize a holistic solution to tackle all plausible ramifications.

To be socially adaptable, one must possess the attributes of cultural sensitivity and tactfulness. Cultural sensitivity is important since a strategic commander has to often operate at the inter-organization level where the organizational culture varies. One has to take into account the vested interests of different parties, as well as the interpretation of one's actions by those who are not imbued with the same culture, especially when dealing with the media.²⁵ Tactfulness is required to build relationships, because thoughtful handling of the engagement engenders trust and respect, which are the bedrock for creating robust relationships.²⁶ This is paramount in inter-organizational dealings as the reporting chains and agendas differ. It has also been highlighted that one needs to adopt different engagement styles when addressing the requirements of multinational forces.²⁷ This means that to achieve consensus, one has to adapt to different operating norms and culture, which might require the compromise of one's beliefs at times. As such, tactfulness coupled with the ability to understand and handle different cultures and their perceptions, facilitate the construction of trusting relationships. To this end,



Chief Guards Officer COL Nelson Yau (right) handing out Guards berets to graduates at the parade.

these attributes engender social adeptness, as one will seek to reach a consensus rather than impose one's will, which is especially important in the COE as it often requires collaborations to deal with "wicked" problems.

An effective human capital manager requires the attributes of humility and conviction in order to harness and groom his men, which is necessary to prevail in the COE. The tasks of today are often complex, and a strategic commander will potentially lead people in professions he might be unfamiliar with. Consequently, he needs to empower his men to leverage their knowledge and skills.²⁸ Humility allows one to acknowledge the limit of one's abilities and understand the need to share one's power in order to achieve the overarching goal—to complete the task effectively and efficiently. Empowerment facilitates a learning environment where people develop their competencies through experiential learning. It is also noted that a *level 5* leader possesses humility

and the "professional will" that are instrumental to build a successful and enduring organization.²⁹ A *level 5* leader prioritizes organizational success at the forefront, and thus will endeavor to groom his successors to maintain the growth of the organization beyond his tenure. One will concede that developing and grooming are tedious, time-consuming processes that involve both mentoring and coaching roles; this is exacerbated by the fact that strategic commanders are primarily occupied in performing their roles at the strategic-level. As such, conviction is an important attribute because it motivates one to create opportunities and devote time to this important function. Moreover, empowerment involves risks and the strategic commander will be accountable for any failures. Conviction is thus required to undertake mitigated risks, so as to groom his men for the greater good and thus, build a successful and enduring organization. Furthermore, it is also this conviction that ensures insights and experiences are shared to enrich the minds of his men. In all, the attributes

empower the management of human capital by first leveraging on individual abilities to deliver the task, and second, ensuring that people are groomed to assure the enduring success of the organization.

DEVELOPING A STRATEGIC LEVEL COMMANDER

After the identification of the requisite skills and attributes, a holistic development process is required to prepare the operational commander for the demanding role at the strategic level. The first approach is using education to develop the mentality and understanding of the various identified disciplines.³⁰ In this sense, it is important to institutionalize a strategic-level course that broadens their horizons to meet the increased demands at the strategic-level.³¹ Under the ambit of the proposed course, the theories as well as the methodologies for systemic thinking, social dynamics, and human capital management are taught and practiced. Attributes such as meticulousness and astuteness can be honed through simulated scenarios weaved into the curriculum. Another recommendation is the pursuit of an education at civilian institutes such as strategic studies institutions. The value proposition is the integration with non-military students, where discourses facilitate the gathering of insights with respect to the civilian's views and interests when dealing with issues.³² Understanding and appreciating the different perspectives will aid in strengthening the systems thinking skill in terms of the consideration of non-military perceptions. It will also enhance the awareness of different cultural motivational factors, as well as expand communication and relationship-building skills beyond the military domain.

The other developmental approach is training; specifically, to facilitate the application of skills. In this respect, an operational commander should serve tours in joint headquarters, civil agencies, and if

possible, multinational operations, which will allow him to experience a diversity of cultures.³³ All options will facilitate the growth in cultural sensitivity and tactfulness in managing people from distinct backgrounds entrenched with different value-sets. Furthermore, these experiences contribute to the humility attribute, since one is extracted from one's comfort zone and placed to operate in an unfamiliar environment. The challenges of leading and managing people from outside the organization, coupled with the distinctively different knowledge and skills required in the recommended options, will also enforce one's conviction to ensure one's successor is adequately trained and groomed to assume one's role in the future. Being an aide to the strategic commander for specific exercises will allow the operational commander to be directly trained by him. In addition, chairing tasks outside the military context, such as national or international events, will hone his social adeptness skill in managing the different stakeholders.

CONCLUSION

A number of skills are crucial for a strategic commander to achieve success in a contemporary VUCA environment. One essential skill is the ability to exercise systems thinking to solve the "wicked" problems of today. All aspects must be considered before deciding on the course of action that might require collaborations with other agencies to ensure that it is addressed holistically. This prevents repercussions from arising as "wicked" problems that are not holistically addressed might incite other contentious problems. As such, the strategic commander has to inspire his men to surmount the challenges faced in the COE, as well as orchestrate an organized effort amongst all stakeholders when required. This exemplifies the importance of consensus building, negotiation and relationship skills, of which

social adeptness is the essential skill that enables one to effectively perform those skills. The final essential skill is the effective management of human capital. One needs to leverage on the capabilities of one's men to accomplish the challenging tasks in the COE, as well as to develop their understanding of the strategic intents in order to align efforts through the various levels. Furthermore, ensuring that the strategic commander successor is adequately groomed to meet the demands of a strategic-level role cannot be understated. As for the attributes that are required of a strategic commander, they form the crux in enabling the effective application of the identified skills. To achieve all that has been mentioned, a holistic development process, couched under the ambit of education and training to prepare a future strategic commander is recommended. The focus is on acquiring the identified requisite skills and the enabling attributes. Overall, success of the organization depends on the strategic commander's ability to tackle any issues that arise, and to ensure that the military remains relevant in the extension of political wills to provide a secure environment for the future. 🌐

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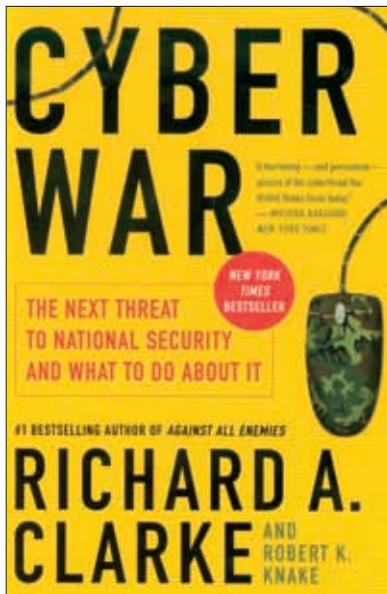
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Book Review



Richard A. Clarke and Robert K. Knake, *Cyber War: The Next Threat to National Security and What to Do about It*, HarperCollins Publishers, 2010, 290 pages.

by **Brandon Koh**

Cyber war is a very real threat to our modern day society. The definition of cyber war is “the use of computers to disrupt the activities of an enemy country, especially the deliberate attacking of communication systems.” Cyber war is not a victimless, clean kind of war that we should embrace in contrast to conventional forms of warfare. The public, civilian population as well as the privately owned corporations that run and own a country’s key national systems is those that will suffer horribly from the aftereffects of a cyber war.

Clarke’s writing is based on the United States (US) and how cyber war is a huge threat to US national security. He clearly defines what a cyber war is and how it might take place in the States, as well as the aftermath of such. Due to Clarke’s background, he discusses mainly about the policies that the US should adopt going forward into preparation or to avoid a cyber

war altogether.

Clarke in his first chapter, “Trial Runs,” gives a brief history lesson or recap of how in the past, countries like North Korea and Russia have experimented with cyber warfare.¹ He explains that there are five takeaways from all these incidents, that cyber war is real, happens at the speed of light, is global, skips the battlefield and that it has already begun.² He also states that he believes that almost any actual wars in the future will be accompanied with cyber warfare as well, further highlighting the severity of the problem.

Clarke’s bottom line in writing the book was that the US is not well prepared for a cyber war at all. He feels that the US will require sweeping new laws, regulations and policies in order to protect itself from this new and upcoming threat. He shows how other countries like China have fairly well prepared and strong

cyber warriors.³ In the case of the US, Clarke points out that the commercial side of networks is not well protected, and this is because they themselves do not want cyber protection by the government. This is enough reason for Clarke to propose that serious actions and measures must be taken to ensure cyber security in the US, and hence he proposes the Defense Triad Strategy.⁴ Clarke goes on to talk about how the US should impose fundamental and structural changes to its system to adopt a defensive strategy.

Clarke also talks about offensive strategies the US can adopt and attempted to transfer strategies previously used in other conventional warfare into usage in cyber warfare. From Exercise South China Sea, a hypothetical exercise made by Clarke based on the 1983 movie about computers and war: *War Games*, Clarke explores the offensive strategies that the US would employ when faced off with a superpower such as China in a cyber war.⁵ Offensive strategies that were effective otherwise, like deterrence, were out of the question as they did not translate well into deterring cyber attacks from other countries.⁶ Of course, this meant that new strategies had to be employed, which is an alarming fact and should serve as

a wakeup call to the US.

Clarke moves on to talk about cyber peace and how measures currently in place to ensure cyber peace, such as arms control in cyberspace, are not entirely effective. Clarke explains that arms control is not valuable and can even be unhelpful when it is largely hortatory, or when the negotiation is seen as an end in itself or a platform for propaganda.⁷ Clarke mentions that there are four ways in which the US is more vulnerable to cyber war than those nations that might use cyber weapons on them. The US has a greater dependency upon cyber-controlled systems, they have more of their essential national systems owned and operated by private enterprise companies and thus has such politically powerful owners and operators, and lastly how the US military itself is highly network centric and is thus extremely vulnerable to cyber attack.⁸ Clarke toys with the idea of completely banning cyber weapons and therefore banning cyber war altogether, but such a concept has many implications and aftereffects, thus making it highly situational. Lastly, Clarke closes off with his idea of an agenda that the US can adopt in order to better its cyber security and keep its people and country

safe from cyber war.

Clarke served in the White House for Presidents Ronald Reagan, George H. W. Bush, George W. Bush and Bill Clinton. He was appointed as National Coordinator for Security, Infrastructure Protection and Counterterrorism. Hence, his insightful comments and remarks are very well thought and his view on how cyber warfare is rising in America and will be grave issue in the future is both credible and believable. While reading the book, I was constantly amazed at the accuracy and intricacy of information being doled out by Clarke, and I would expect no less of someone of his background.

The book is actually very well structured and an easy to understand format. Though some of the principles and attack/defense patterns may be challenging for the uninitiated, Clarke does seek to explain many of the alien concepts and does a good job of setting the groundwork upon which much of the work is built. Being both informative yet engaging, there was never a dull moment reading the book. Clarke not only dishes out substantial facts and figures to strengthen his arguments and points, but at the same time constantly kept me entertained

and interested to find out more by painting a vivid picture of the US and its possible post apocalyptic outcomes if it does engage in an all out cyber war. His outcomes were chilling and enthralling to read, and yet always seemed believable, showing his expertise and knowledge regarding the subject matter. Clarke constantly poses thought provoking questions regarding the state of cyber warfare and questions the readiness of the US to handle such a threat. These questions kept me engaged and constantly thinking of how the US themselves should in turn be preparing to fight or defend against a cyber war. Clarke would offer us his alternatives or solutions at the end and his answers were always succinct, precise and satisfying.

For those not so keen on reading about the US government and their structure as well as policies that should be put in place regarding cyber warfare, Clarke also covers many of the commonly asked or thought about topics; such as "What really is a hacker? What is meant by the term "kinetic" with regards to warfare"? Such topics are also commonly asked by many and thus the book will also cater for light readers who are interested in learning more about cyber warfare and

cyber wars. This book would also be a perfect fit for anyone who is concerned about what might happen to the US if an adversary decides to turn their lights out, take away their computers, cell phones, electronic toys, and destroy their financial systems and their military in less than a day. Despite focusing mainly on the US, such horrifying scenarios can also be applicable to Singapore if we are not vigilant in our cyber protection and defense. The book is a perfect fit for anyone who has concerns about a future cyber war outbreak in the US, or the world for that matter. The book serves as a reality check, both to the US and the world, that cyber wars are very dangerous, and very much real. If you are concerned about cyber attacks and the guarding of cyber space, I would definitely recommend this book to you.

In conclusion, I found *Cyber War: The Next Threat to National Security and What to Do About It* both eye-opening and thought provoking. The book does not reveal any amazing cyber secrets, but the way the applications and agenda of cyber war were explained and written kept me considering the possibilities and repercussions that a huge scale cyber war could bring to the entire world. 🌐

ENDNOTES

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John F. Kennedy

by **Joshua Foo**



John Fitzgerald Kennedy, also nicknamed JFK or Jack, was sworn in as the 35th President of the United States (US) on 20 January 1961.¹ In his inaugural speech he spoke of the need for all Americans to be active citizens. "Ask not what your country can do for you, ask what you can do for your country,"² he said. President Kennedy, together with his wife and two children, brought a new, youthful spirit to the White House. Both Kennedy and his wife had the idea that the White House ought to be a place to commemorate and promote American culture and history. Hence, they often invited artists, scientists, poets, musicians, actors, and athletes to visit them. As the years have gone by and other presidents have written their chapters in history, Kennedy's brief time in office stands out in people's memories for his leadership, personality, and accomplishments. He was most known for the handling of the "Bay of Pigs Invasion," and his policies during the Cuban Missile Crisis. Unfortunately on November 22, 1963, when he was hardly past his first thousand days in office, John F. Kennedy was killed by an assassin's bullets as his motorcade wound through Dallas, Texas. Kennedy was the youngest man elected President; he was also the youngest to die.³

Jacqueline Kennedy shared her husband's interest in American history. Gathering some of the finest art and furniture the US had produced, she restored all the rooms in the White House to make it a place that truly reflected America's history and artistic creativity.

EARLY LIFE

Of Irish descent, he was born in Brookline, Massachusetts, on 29 May 1917.⁴ Graduating from Harvard in 1940, he entered the Navy. In 1943, when his PT boat was rammed and sunk by a Japanese destroyer, Kennedy, despite grave injuries, led the survivors through perilous waters to safety.⁵

John Fitzgerald Kennedy was named in honor of his maternal grandfather, John Francis Fitzgerald, the Boston Mayor popularly known as Honey Fitz. Before long, family and friends called this small blue-eyed baby Jack. Jack was not a very healthy baby, and his mother Rose recorded on his notecard the childhood diseases from which he suffered, such as "whooping cough, measles, chicken pox." On 20 February 1920, when Jack was not yet three years old, he became sick with scarlet fever, a highly contagious and potentially life-threatening disease.

When Jack was three, the Kennedys moved to a new home a few blocks away from their old house in Brookline, a neighborhood just outside of Boston. There was a lot of prejudice against Irish Catholics in Boston at that time, but Joseph Kennedy, Jack's father, was determined to succeed. Making a million dollars by the age of 35 was one of the targets he set for himself, as a benchmark for success. Jack's grandfathers did even better for themselves, both becoming prominent Boston politicians.⁶ Jack, because of all his family had done, could enjoy a very comfortable life. The Kennedys not only had everything they needed, but more than enough to feed future generations.

Jack was very popular student and had many good friends at Choate, a boarding school for adolescent boys in Connecticut. Tennis, golf and basketball were few of the sports that the sport-inclined Kennedy used to play. His friend Lem Billings remembers how unusual it was that Jack had a daily subscription to the *New York Times*, not common in that day and age. Jack had a "clever, individualist mind," his headmaster once noted, though he was not the best student. He was often lazy and unmotivated, not working as hard as he could, except in subjects he was interested in like history and English.

Soon after being elected senator, Kennedy, at 36 years of age, married 24 year-old

Jacqueline Bouvier, a writer with the *Washington Times-Herald*. Unfortunately, early on in their marriage, Senator Kennedy's back started to hurt again and he had two serious operations. While recovering from surgery, he wrote a book called *Profiles in Courage* about several US Senators who had risked their careers to fight for the things in which they believed. The book was awarded the Pulitzer Prize for biography in 1957.⁷ That same year, the Kennedys' first child, Caroline, was born.

MILITARY INFLUENCE

Soon after graduating from Harvard College, Jack joined the Navy. He was made Lieutenant (Lt.) and assigned to the South Pacific as commander of a patrol torpedo boat, the *PT-109*. Kennedy commanded a crew of twelve men whose mission was to deter Japanese ships from delivering supplies to their soldiers. As they patrolled the waters on the night of 2 August 1943 for enemy ships to sink, a Japanese destroyer suddenly appeared traveling at full speed straight towards them. At the helm of his boat, Kennedy made an effort to swerve out of the way, but to no avail. The enormous Japanese warship rammed the *PT-109*, splitting it in half and killing two of Kennedy's men almost instantly.⁸ The others managed to jump off as their boat went up in flames but Kennedy was slammed hard against the cockpit, once again injuring his weak back. Patrick McMahon, one of his crew

members, had horrible burns on his face and hands and was ready to give up. In the darkness, Kennedy managed to find McMahon and haul him back to where the other survivors were clinging to a piece of the boat that was still afloat. At sunrise, Kennedy led his men toward a small island several miles away. Despite his own injuries, Kennedy was able to tow McMahon ashore, a strap from McMahon's life jacket clenched between his teeth. Six days later two native islanders found them and went for help, delivering a message Jack had carved into a piece of coconut shell. The next day, the *PT-109* crew was rescued. Jack's brother, Joe, who enlisted at the same time as him, was not so lucky. He died a year later when his plane exploded during a dangerous mission in Europe.

When Kennedy returned home, he was awarded the Navy and Marine Corps Medal for his leadership and courage.⁹ With the war finally coming to an end, it was time to choose the kind of work he wanted to do. He had considered becoming a teacher or a writer, but with Joe's tragic death suddenly everything changed. After serious discussions with him about his future, Joseph Kennedy convinced him that he should run for Congress in Massachusetts' eleventh congressional district, where he won in 1946. This was the beginning of Jack's political career. As the years went on, Kennedy, a Democrat, served three terms (six years) in the House of

Representatives, and in 1953 he was elected to the US Senate.

POLITICAL LIFE

In 1956, Kennedy was close to gaining the Democratic nomination for Vice President, and four years later was a first-ballot nominee for President. Millions watched his television debates with the Republican candidate, Richard M. Nixon. Winning by a narrow margin in the popular vote, Kennedy became the first Roman Catholic President.

Responding to the ever-growing list of urgent demands, he took vigorous action and put his foot down for the cause of equal rights, calling for new civil rights legislation. His vision of America extended to the quality of the national culture and the central role of the arts in a vital society.

Shortly after his inauguration, Kennedy permitted a band of Cuban exiles who were armed and trained, to invade their homeland.¹⁰ This was an attempt by Kennedy to overthrow the regime of Fidel Castro, but was a miserable failure. Soon thereafter, the Soviet Union renewed its campaign against West Berlin. Kennedy responded by reinforcing the Berlin garrison and increasing the strength of the US military, including new efforts in outer space. Confronted by this reaction, Moscow, after the erection of the Berlin Wall, relaxed its pressure in central Europe.

The Russians sought to

install nuclear missiles in Cuba. When this was discovered by air reconnaissance in October 1962, Kennedy imposed quarantines on all offensive weapons bound for Cuba. While the world trembled on the brink of nuclear war, the Russians backed down and agreed to take the missiles away. The American response to the Cuban crisis evidently persuaded Moscow of the futility of nuclear blackmail.

Kennedy now contended that both sides had a vital interest in stopping the spread of nuclear weapons and slowing the arms race—a contention which led to the treaty of 1963. The months after the Cuban crisis showed significant progress toward his goal of "a world of law and free choice, banishing the world of war and coercion." His administration thus saw the beginning of new hope for both the equal rights of Americans and the peace of the world.

VISION FOR AMERICA

He wished for America to resume its old mission as the first ever nation dedicated to the revolution of human rights. Kennedy brought the American idealism to the aid of developing nations with the Alliance for Progress and the Peace Corps. However, the hard reality of the Communist challenge remained at large.

His Inaugural Address offered the memorable injunction: "Ask not what your country can do for you—ask what you can do for

your country." As the President of the US, he set out to redeem his campaign pledge to get America moving again. His economic programs launched the country on its longest sustained expansion since World War II; before his death, he laid plans for a massive assault on persisting pockets of privation and poverty.

PUBLICATION – WHY ENGLAND SLEPT

Why England Slept, a book written by Kennedy about the 1930s in England: international relations, local politics and national defense.¹¹ The book questions England's lack of prevention against German aggression, and why they pursued a policy of appeasement. In essence, it was Kennedy's evaluation of why it took England so long to realize the threat posed by Germany's rearmament and increasing belligerence during the 1930s. Kennedy incorporates military budget figures, giving the reader a startlingly frank glance at the inaccuracies of myth—the world-spanning Royal Navy only had a slight budgetary advantage over the British Army, and even in 1936 the German military budget dwarfed those of Britain and France combined. Kennedy further drives home the point by noting that Britain's national income was already only a fraction of America's by 1936. There is a tendency in history books to credit World War Two (WW2) with the decline of imperialism and the rise of the two superpowers, but Kennedy's

analysis of prewar Britain demonstrates how vulnerable she already was prior to the war. The time was ripe for America's rise, and if WW2 hadn't taken place, then surely some other event would have served as the catalyst for the end of Empire. Looking at the bigger picture, it is about the relative merits and weaknesses of democracy compared to totalitarian government. He concluded that, while a democratic and capitalistic system is superior over the long term, a dictatorship is more effective in preparing for and prosecuting war at the outset. *Why England Slept* was a very interesting study, especially when readers consider the fact that it was written well before the outcome of WW2 was known.¹²

HIS LEGACY

President Kennedy's death caused enormous sadness and grief among all Americans. Most people still remember exactly where they were and what they were doing when they heard the news. Hundreds of thousands of people gathered in Washington for the President's funeral, and millions throughout the world watched it on television.

Many respect his calm state of mind when faced with difficult decisions—like what to do about Soviet missiles in Cuba in 1962. Others admire his ability to inspire people with his eloquent speeches, with his charismatic personality. His compassion and willingness to fight for new government programs

to help the poor, the elderly and the ill also ranked as one of the more important parts of his career. Like all leaders, Kennedy made mistakes, but he was always optimistic about the future. He believed that people could solve their common problems if they put their country's interests first and worked together. 🌐

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Quatable Quotes

Before you are a leader, success is all about growing yourself.

When you become a leader, success is all about growing others.

– Jack Welch (b. 1935), business executive, author and chemical engineer.

It is our attitude at the beginning of a difficult task which, more than anything else, will affect its successful outcome.

– William James (1842-1910), philosopher, psychologist, physician.

Try not to become a man of success. Rather, become a man of value.

– Albert Einstein (1879-1955), physicist, Nobel Prize Winner in Physics.

Success is not the key to happiness. Happiness is the key to success.

If you love what you are doing, you will be successful.

– Albert Schweitzer (1875-1965), theologian, organist, philosopher, physician and medical missionary.

Time is the most precious element of human existence.

The successful person knows how to put energy into time and how to draw success from time.

– Denis Waitley (b. 1933), motivational speaker, author, writer, consultant.

Every successful individual knows that his or her achievement depends on a community of persons working together.

– Paul Ryan (b. 1970), American politician.

Whatever the mind of a man can conceive and believe, it can achieve.

– Napoleon Hill (1833-1970), American author.

Leadership is an opportunity to serve. It is not a trumpet call to self-importance.

– J. Donald Walters (1926-2013), author, composer, lecturer.

Leadership to me means duty, honor, country. It means character, and it means listening from time to time.

– George W. Bush (b. 1946), 43rd President of the United States.

I'm more focused and have a greater sense of challenge, because I constantly feel the weight of time.

– Sylvester Stallone (b. 1946), American actor, screenwriter and film director.

The ear of the leader must ring with the voices of the people.

– Woodrow Wilson (1856-1924), 28th President of the United States.

If your actions create a legacy that inspires others to dream more, learn more, do more and become more, then, you are an excellent leader.

– Dolly Parton (b. 1946), American singer-songwriter, multi-instrumentalist, actress, author and philanthropist.

He who cannot be a good follower cannot be a good leader.

– Aristotle (384BC-322BC), Greek philosopher.

Whatever you want to do, if you want to be great at it, you have to love it and be able to make sacrifices for it.

– Maya Angelou (b. 1928), American author and poet.

It's not about you. It's about them.

– Clint Eastwood (b. 1930), American actor, film director, producer and composer.

Successful leaders see the opportunities in every difficulty rather than the difficulty in every opportunity.

– Reed Markham (b. 1930), American author.

Anyone can steer the ship, but it takes a leader to chart the course.

– John C. Maxwell (b. 1930), American author, speaker, pastor.

Leadership is lifting a person's vision to higher sights, the raising of a person's performance to a higher standard, the building of a personality beyond its normal limitations.

– Peter F. Drucker (1909-2005), American management consultant, educator and author.

There are no secrets to success. It is the result of preparation, hard work, and learning from failure.

– Colin Luther Powell (b. 1937), American statesman and retired four-star general of the United States Army.

Live for something rather than die for nothing.

– George Patton (1885-1945), General of the United States Army.

Instructions for Authors

AIMS & SCOPE

POINTER is the official journal of the Singapore Armed Forces. It is a non-profit, quarterly publication that is circulated to MINDEF/SAF officers and various foreign military and defence institutions. *POINTER* aims to engage, educate and promote professional reading among SAF officers, and encourage them to think about, debate and discuss professional military issues.

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For example:

Tim Huxley, *Defending the Lion City: The Armed Forces of Singapore* (St Leonard, Australia: Allen & Unwin, 2000), 4.

Huxley, *Defending the Lion City*, 4.

Ibid., 4.

Edward Timperlake, William C. Triplett and William II Triplet, *Red Dragon Rising: Communist China's Military Threat to America* (Columbia: Regnery Publishing, 1999), 34.

Articles in Periodicals

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Chan Kim Yin and Psalm Lew, "The Challenge of Systematic Leadership Development in the SAF," *POINTER* 30, no. 4 (2005): 39-50.

Chan and Lew, "The Challenge of Systematic Leadership Development in the SAF," 39-50.

Ibid., 39-50.

Mark J. Valencia, "Regional Maritime Regime Building: Prospects in Northeast and Southeast Asia," *Ocean Development and International Law* 31 (2000): 241.

Articles in Books or Compiled Works

Michael I. Handel, "Introduction," in *Clausewitz and Modern Strategy*, ed. Michael I. Handel, (London: Frank Cass, 1986), 3.

H. Rothfels, "Clausewitz," in *Makers of Modern Strategy: Military thought from Machiavelli to Hitler*, eds. Edward Mead Earle and Brian Roy, (Princeton: Princeton University Press, 1971), 102.

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David Boey, "Old Soldiers Still Have Something to Teach," *The Straits Times*, 28 September 2004, 12.

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International Committee of the Red Cross, "Direct participation in hostilities," 31 December 2005, <http://www.icrc.org/Web/eng/siteeng0.nsf/html/participation-hostilities-ihl-311205>.

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