



POINTER

RSAF Through 50 Years
of Nation-Building



Editorial Board

Advisor

RADM Giam Hock Koon

Chairman

COL Ng Wai Kit

Deputy Chairman

COL Irvin Lim

Members

COL (NS) Tan Swee Bock

COL Benedict Ang Kheng Leong

COL Lim Siong Tiong

ME7 Shue Pei Soon

LTC Huang Miaw Yi

ME6 Colin Teo

MAJ Charles Phua Chao Rong

MS Deanne Tan Ling Hui

MR Kuldip Singh

MR Daryl Lee Chin Siong

CWO Tang Peck Oon

MR Eddie Lim

Editorial Team

Editor

MS Helen Cheng

Assistant Editor


MR Bille Tan

Research Specialists

CPL Ong Marc-us

CPL Tan Wallace

LCP Kayson Wang

 The opinions and views expressed in this journal do not necessarily reflect the official views of the Ministry of Defence. The Editorial Board reserves the right to edit and publish selected articles according to its editorial requirements. Copyright© 2015 by the Government of the Republic of Singapore. All rights reserved. The articles in this journal are not to be reproduced in part or in whole without the consent of the Ministry of Defence.

Contents

Editorial	iii
 Balancing Our Strategic Resources and 3rd Generation RSAF Mission Imperatives	 1
<i>SLTC Christopher Chew, SLTC Vincent Yap, MAJ Alex Chew and MAJ Lee Hsiang Wei</i>	
 The Expanded Role of Air Power in the Defence and Security of Singapore	 12
<i>LTC Tan Jinq Yeu, MAJ Teo Wei Keong and MAJ Leong Tyng Wey</i>	
 Contributions of Women in the RSAF	 23
<i>LTC Kenneth Chiong, LTC Ng Yu Jing, Eugene, CPT Ye Rouyin and CPT Yam Gui Hao, Gabriel</i>	
 Organisational Culture and the RSAF	 37
<i>MAJ Nicholas Chng, MAJ Alex Chan and ME4 Chia Bing Qiang</i>	
 Civil Military Relations in Aviation	 47
<i>LTC Chen Boon Chong, LTC Brandon Sim, MAJ Sebastian Chai and CPT Ren Jinfeng</i>	
 About the Authors	 61

EDITORIAL

We are pleased to kick off our Pointer Supplement for 2015 with an Air Force-themed issue. This supplement which is scheduled to be published in July 2015 coincides with Singapore's 50th birthday since independence. It is fitting therefore that the theme is 'RSAF through 50 Years of Nation-Building'. Under this theme, the articles presented explore how the RSAF has contributed to the nation-building efforts. Retrospectively, the articles will also examine how the RSAF has evolved over the past 50 years as the world changes and Singapore progresses.

The first article entitled "Balancing Our Strategic Resources and 3rd Generation RSAF Mission Imperatives," is by SLTC Christopher Chew, SLTC Vincent Yap, MAJ Alex Chew and MAJ Lee Hsiang Wei. The article discusses how the RSAF has built itself up since its early beginnings in 1968. Through the acquisition of assets to deal with internal and external threats in the 1970s to strengthening component competencies in the 1980s and 1990s and then focusing on the development of network-centric capabilities in the 3rd Generation Air Force—all these have led to a competent and established Air Force. However, the authors highlight that we cannot rest on our laurels and have to continuously develop ourselves. Moreover, this requirement would need to be balanced with Singapore's limited resources—budget, manpower and geographical space, i.e. land use and airspace. Therefore, as part of our planning policy and discipline, the authors stress that we need to take into careful consideration the available supply of resources, balanced with other national requirements, engage in long term planning and conversation, leverage on technology, innovation, as well as the ingenuity and capability of our people to ensure that not only will we overcome our challenges, but we will turn them into opportunities to better ourselves.

The second article, 'The Expanded Role of Air Power in the Defence and Security of Singapore' by LTC Tan Jinq Yeu, MAJ Teo Wei Keong and MAJ Leong Tyng Wey, examines the expanded role of air power as a result of changes in the global security landscape and technology advancements, and highlights their implications on the RSAF and Singapore. The article aims to show that while the roles of air power have expanded progressively and benefited Singapore over the years, Singapore's strategic vulnerability and the uncertain regional security environment mean that the *raison d'être* of the RSAF remains primarily to defend our nation's sovereignty. This is something we need to keep in sharp focus to avoid over-extending our limited resources for Operations Other Than War missions. The authors emphasise that in order to secure the interests of a small country like Singapore in peace and war, the RSAF's order of battle should be structured for flexibility to meet peacetime demands, yet not compromise our abilities to secure a swift and decisive victory when called upon.

‘Contributions of Women in the RSAF’ is the third article in this Air Force Supplement and is written by LTC Kenneth Chiong, LTC Ng Yu Jing, Eugene, CPT Ye Rouyin and CPT Yam Gui Hao, Gabriel. The article provides insights on the contributions women have made through military service in the RSAF. In this article, the writers interviewed eight of the RSAF’s servicewomen and highlighted their contributions to the RSAF. The article takes a critical look at the challenges they have had to overcome and seeks to dispel any misconceptions that society may have of women in military service. The article also describes how many of our women have managed to build successful families despite the high work tempo in the RSAF. Through these stories, the authors hope to increase awareness of how women have contributed to the RSAF and inspire more women to favourably consider a career in the RSAF.

The fourth article, ‘Organisational Culture and the RSAF’ by MAJ Nicholas Chng, MAJ Alex Chan and ME4 Chia Bing Qiang contend that a strong organisational culture is pivotal to the sustained success of any organisation. The authors state that one of the reasons why the RSAF has been so successful in its growth and development is due to its strong organisational culture. Drawing upon evidence from RSAF’s history, the authors present a case for how the RSAF’s culture has been instrumental to its success. Looking ahead, the authors also suggest how the RSAF can evolve its culture to ensure its continued success in the future.

The final article in this supplement is entitled ‘Civil Military Relations in Aviation.’ Written by LTC Chen Boon Chong, LTC Brandon Sim, MAJ Sebastian Chai and CPT Ren Jinfeng, the article provides an insight on the transformation of both civil and military aviation in Singapore. The authors argue that the RSAF and the civil aviation industries have played crucial roles in Singapore’s growth as a nation, through building a harmonious and symbiotic relationship over the past few decades. However, they caution that many serious challenges still lie ahead for Singapore; for example, the declining pool of manpower, which will affect all industries in Singapore. Furthermore, the sustained growth of civil aviation and the planned expansion of both Changi International Airport and Changi Air Base (East), as well as the proliferation of Unmanned Aerial Vehicles will require continued judicious management of our limited airspace. The authors conclude that for Singapore to maintain its position as a leading premier civil aviation hub and a ‘First Class Air Force’, both civil and military aviation sectors must work in synergy to develop innovative ways to overcome these challenges and limitations.

The POINTER Editorial Team

BALANCING OUR STRATEGIC RESOURCES AND 3RD GENERATION RSAF MISSION IMPERATIVES

By SLTC Christopher Chew, SLTC Vincent Yap, MAJ Alex Chew & MAJ Lee Hsiang Wei

In the face of a struggling European economy, the British announced on 18th July 1967, its plans to reduce its military commitment to the Far East Command and to pull its troops out of Singapore by the mid-1970s. This event, as well as the Japanese occupation of Singapore during World War II, reminds us of the importance of a strong defence force. This defence force needs to be made up of people with a genuine and imputable interest for its success—our very own citizens. Despite being a third-world nation with an extremely fragile local economy, our political leadership has placed an emphasis on building up a strong defence force in the 1960s. As a result, a sizable portion of our limited resources was dedicated to this cause.

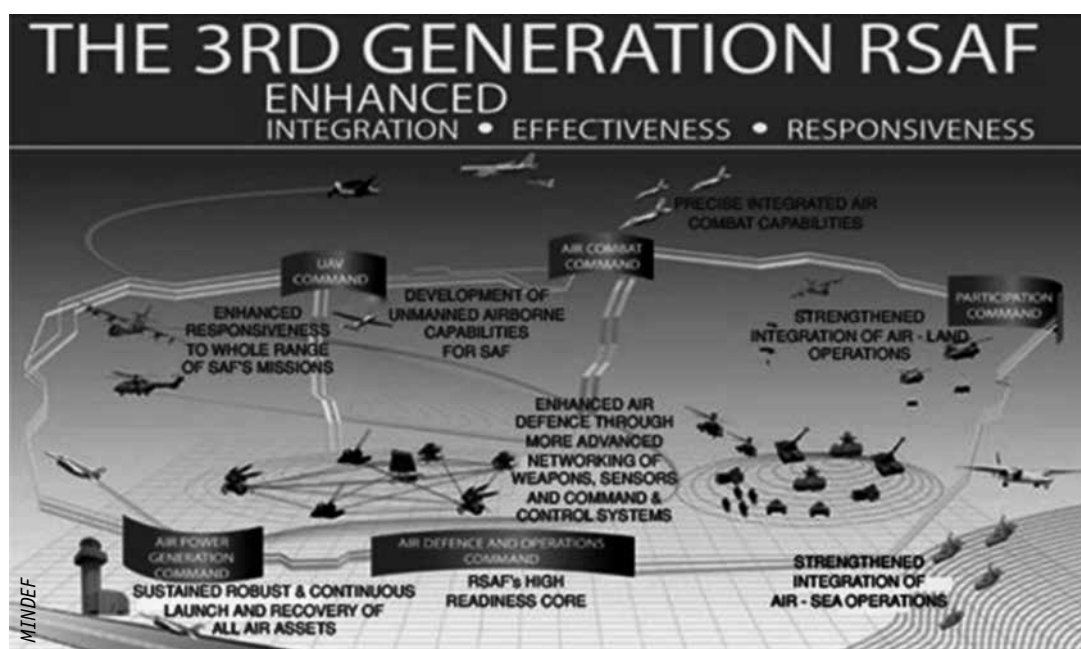


Figure 1: The Evolution of the RSAF.

The SAF was set up in 1965 with the clear mission *to enhance Singapore's peace and security through deterrence and diplomacy, and should this fail, to secure a swift and decisive victory over the aggressor*. Being a critical component of our national security, the RSAF fulfils this mission by being a credible and respected Air Force, one that is always ready for operations 24 hours a day, 365 days a year. It was clear that with only two Cessnas

borrowed from the Singapore Flying Club, the immediate priority in our formative years was to build up the capability to have some form of basic air defence. The RSAF achieved this through the acquisition of assets to deal with internal and external threats. Having those foundations, we started to focus more on higher-valued assets to strengthen our component competencies as an Air Force during the 80s and 90s. The needs and priorities of the RSAF continue to evolve as we mature, and today, we focus on enablers that allow all the individual components to fight as a collective unit, through the development of network-centric capabilities in our 3rd Generation Air Force.



Figure 2: Republic of Singapore Air Force C-130 Transport Aircraft, that was deployed to assist in the search-and-locate operation for the missing MH370, returned to Paya Lebar Air Base at the end of the search.¹

As we enjoy the peace dividend from the past 50 years of independence, it is important that we remember that the need for a strong RSAF, and the larger SAF, has not changed. We only need to look at the turmoil in Ukraine and the insurgency by the Islamic State in Iraq and the Syria (ISIS) in 2014 to be reminded of this strategic reality. In addition, the RSAF's value in peace has also expanded over the years to include Peace Support and Humanitarian Aid and Disaster Relief (HADR) missions. Examples of the RSAF proving its value in peace include the RSAF deploying four UH-1H helicopters in support of the United Nations Mission of Support in East Timor (UNMISET) in 2003, as well as deploying eight CH-47 Chinook and four Super Puma helicopters, six C-130 transport aircraft, and two Fokker F-50 utility aircraft for Operation Flying Eagle in response to the Asian Tsunami in 2004. More recently, it was announced that the RSAF would be contributing to the global

fight against ISIS in the Middle East by committing liaison and planning officers, a KC-135R air-to-air refuelling aircraft, as well as an imagery analysis team.

In order to maintain our readiness and capability to perform our tasks when called upon, the RSAF will need to be resourced properly. However, the RSAF is cognisant that being a small nation, our limited strategic resources in terms of budget, manpower and geographical space, needs to be balanced at the national level, between defence, as well as economic and increasing social demands.

GOOD STEWARDS OF OUR NATIONAL RESOURCES

As a responsible steward of our national resources, the RSAF practises long-term planning to take stock of its current capabilities, identify any gaps in the future operating landscape and the resources that are needed to meet those needs. In addition, to facilitate the optimisation of resources at the SAF-level, the RSAF conducts its long-term planning together with the Army, Navy as well as Joint Staff.



Figure 3: Long-Term Planning Strategy.

RSAF, through MINDEF, works with other Ministries and Statutory Boards to ensure steady and prudent investments in defence, balanced against our national needs in the economic, social and foreign affairs realms. As a nation, given the stable and peaceful

environment we enjoy, we are very fortunate to be able to plan for the long-term. With this strategy, the RSAF is able to fulfil its mission by developing for the future and remaining relevant in our operational capabilities and roles.

We do not need to look very far back to witness how this strategy has proved effective. The RSAF was able to proceed with our plans to modernise our fighting platforms as part of the RSAF's 3rd Generation transformation despite the economic downturn in the region in 2008. This allows us, as a nation, to not only 'make hay when the sun shines,' but to a certain extent, 'make our own sun to make the hay.' We shall now look closer at the three key resources that the RSAF needs—budget, manpower, as well as training areas.

BUDGET

In terms of budget, our national approach is to constantly set aside up to 6% of our GDP on defence and this steady defence spending allows the SAF to prevent a 'feast or famine' phenomena, allowing us to plan ahead and avoid hasty acquisition of sub-optimal and yet expensive solutions to security issues when the economy is doing well and conversely, having to compromise security capabilities in the medium term because of an economic downturn.

While there is strong support for continued investments in defence and acknowledgement that Singapore's defence spending might be high but necessary, there have been increased scrutiny on the defence budget, with some questioning if more can be allocated to fulfill social needs. The wisdom of history however, teaches us that peace is very fragile.

Kuwait is a good example of this wisdom. Despite being a close ally in a war barely two years prior, having a strong bilateral relationship and providing strong financial assistance to its neighbour, Kuwait was invaded by Iraq in 1990. Even when we look at our own short history, we are once again reminded, through the Indonesian ship-naming of *Usman Harun* episode and of *Konfrontasi*, which was conducted by Indonesia in protest to the formation of Malaysia in 1963. This resulted in civilian deaths and damage to property in Singapore, with 29 bombs going off. Recently, the naming of the Indonesian frigate after the two Marines involved in the bombing of MacDonald House reminded us that warm bilateral relationships can turn sour without any warning.

Additionally, there are other groups that, while convinced of the need for an Armed Force, are not quite convinced of the need for the continued emphasis on defence expenditure, noting that the RSAF has already established itself as a formidable Air Force. At this point, it is useful for us to remember this saying, "if you remain stationary in a world that is constantly moving, you are in reality retreating." A survey by the Stockholm International Peace Research Institute (SIPRI) on military expenditure in Asia and Oceania shows that it had more than doubled, from US\$247B to US\$407B, in the last 10 years.² Closer to home, the defence expenditure of Malaysia, Indonesia, Philippines and

Thailand grew between 50% to over 300%, as the table on the next page shows, and it is likely that the rate of defence spending will continue as the economy of these countries are forecasted to grow between 5% to 6% according to the report by the Deloitte’s Global Defence Outlook for 2014.³

	Defence Expenditure (in 2011 US\$ Billion)		Percentage Increase
	2000	2013	
Australia	17,994	23,963	33%
Indonesia	1,925	8,356	334%
Malaysia	2,442	4,809	97%
Philippines	2,086	3,208	54%
Thailand	3,180	5,622	77%

One of the reasons for the escalating defence expenditure is the increase in the cost of military equipment over the years. A case in point is combat aircraft. The F-16 cost US\$14.6M in the 1990s, while the current estimated price of the F-35 is US\$153M. Even if inflation is factored in, the cost of the F-35 exceeds the F-16 by more than three fold.

However, to ensure prudence in our defence expenditure, the RSAF does not only depend on the acquisition of new equipment for our technological refresh. Instead, we look objectively at our operational requirements based on our projected threats and



Figure 5: Multi-Role Transport Tank as an Example of Platforms with Multiple Capabilities.

requirements and thereafter across the entire solution spectrum, from maintaining and upgrading the current equipment, to acquiring new hardware, before deciding on our course of action.

This mechanism looks at the comparable life-cycle cost of the solution, taking into consideration factors such as the escalatory cost of maintenance and manpower cost, projection of potential technological development at the global-level, as well as the trajectory of our R&D advancement in a realistic timeline. These factors are rationalised at both the intra and inter-Services level, to ensure that resources are duly optimised, while allowing for the growth of our local industries.

By rationalising at the Joint-level, there is potential to reap multiple benefits from the same platform and we have had many examples of this strategy. One good example is the C-130 aircraft that is able to conduct search and locate missions as part of our national Flight Information Region (FIR) responsibility, Air-to-Air Refuelling (AAR) to allow our fighter aircrafts to travel further without landing for fuel and provide aerial resupply for our Army troops. Looking into the future, likewise, our new acquisition, the Multi-Role Transport Tanker (MRTT), will be able to provide multiple capabilities such as long range transport capability as well as AAR capability to support the RSAF and our sister Services, as well as enhancing our response to HADR situations with the ability to carry more load, with a shorter response time and over a longer range.

MANPOWER

Even as the RSAF places emphasis on technological advancement, manpower, made up of full-time Regulars, NSmen and NSFs, continues to be our key capital. Just like in the case of budget, the RSAF is cognisant that it has to share this critical resource with the other areas of national development. This supply, however, has been reducing over the years, with the number of resident live births in Singapore dropping from 40,100 in 1980, to 35,129 in 2010, coupled with the ratio of the Singapore population being male, between the ages of 15 to 44 dropping more than 10%, from 55.3% to 44.1% from 1980 to 2013.⁴

On a positive note, there has been a change in the academic demographics of the Singapore population, with the percentage of our population being tertiary-educated increasing from 2.7% in 1980, to 25.7% in 2012.⁵ We see great opportunity in this and have been leveraging on this strength to develop our capability, by bringing in sophisticated technology that can be operated by highly educated and trained personnel, developing concepts to better utilise them as a network, pushing new boundaries of technical capability and automating mundane tasks, to allow our people to do higher-valued work. One such platform that the RSAF has inducted recently is the Surface-to-Air PYthon and DERby (SPYDER) Ground-Based Air Defence System, which replaces the legacy Rapier.



Figure 6: Manpower Savings through Employment of Technology.

Another trend in the population is the increase in the life expectancy, from 67.8 in 1970, to 84.5 in 2012, with the median age increasing from 24 to 37 in the same timeline.⁶ In this, we see another opportunity to retain knowledge and expertise through the introduction of the Military Domain Expert Scheme in 2010. This allows personnel from selected vocations that require deep expertise and wide experience a longer period of ‘gestation time’ to contribute to the organisation at their peak for a longer period of time.

Other than the traditional manpower of full time Regulars, as well as NSmen and NSF, the RSAF has, over the years, explored alternative sources of manpower to meet our operational and training requirements. One such example is the outsourcing of non-core work, such as maintenance of buildings and even selected core tasks to our trusted industrial partners in Singapore Technologies to meet our defence needs. Not only do we reap efficiency through their economies of scales to decrease the national overheads, but we also gain innovation through discussion and sharing of technological and industrial best practices.

As alluded to earlier, technology has been harnessed by the RSAF to reap better efficiency and free our manpower for higher-valued work. A good example of innovation and leverage on technology is the RSAF’s Enterprise System, implemented in April 2007 to manage our logistics requirements. This system permits the accurate tracking of the items in our inventory and flags out when an item requires replenishment, thereby

cutting down on manpower hours. In addition, it enhances safety through the timely notification of components parts that are coming close to their shelf life or require maintenance overhaul, thereby preventing non-serviceable parts from being installed in the operational platforms.

Another initiative taken by the RSAF to optimise our human resource is restructuring, both at the macro-level, as well as the micro-level. In 2006, the RSAF initiated an Air Force-wide restructuring exercise, to enhance integration across the entire RSAF, allow for a flatter and more dynamic Command and Control structure and permitted seamless transition in peace-to-war continuum, i.e. allowing us to 'train as we fight'.

In addition to improving operational capability, the restructuring allowed the consolidation of operators and equipment of similar tasks, thereby permitting better consolidation of training, operational and logistic requirements across the entire RSAF, better doctrinal development and emphasis, with lower overheads. Moreover, intrinsic in the structure is the scalable and modular capability of units that allow our Commanders to flexibly configure our forces according to specific mission demands, thereby permitting increased sustainability of our manpower by activating only components that are absolutely required for the particular operations. Also, because the organisational structure already mirrors that which would be used in operations, less resources are required for component level training, but instead, more emphasis can be placed on higher-valued system-level training and development.

LAND USE AND AIRSPACE

The RSAF requires land to house our operational infrastructure, to accommodate our troops and equipment and for training. However, with a limited land stock and, just like budget and manpower, the land portfolio would need to be carefully balanced with the other national requirements. Currently, while the RSAF utilises a small portion of our national land stock, it is in constant communication with the Urban Redevelopment Authority (URA), to ensure that it is optimised at a national level, without compromising our requirements.

One major decision made recently with regard to the rebalancing of land use is the planned relocation of Paya Lebar Air Base. In terms of economic and domestic impact, an extensive amount of land (more than 500 ha) can be redeveloped for housing, offices and social purposes. In addition, the height restriction for the surrounding areas (because of the approach paths of the aircraft into Paya Lebar Air Base) would be lifted, removing the height restriction for the buildings in the surrounding areas, giving tremendous potential for multi-purpose high-rise buildings in land-scarce Singapore.

However, as the guardian of our sky, and to ensure that our ability to defend Singapore is not compromised when we relocate Paya Lebar Air Base, plans are to be made for the expansion of both Changi Air Base and Tengah Air Base. The RSAF also looks upon this as an opportunity for innovation and creative planning. We will utilise technology to

increase the efficiency of our launch and recovery operations and enhance the protection capabilities and redundancy of our airbases. By leveraging on these growth areas, in addition to ensuring that there will be no degradation in our operational capabilities, the RSAF will be able to do our bit to support national development and at the same time, emerge stronger.

Moving ahead, at a strategic level, the RSAF, together with members of the local defence ecosystem and inter-ministerial agencies, are looking at alternate spaces such as exploring underground or even unconventional spaces, such as above roads and reservoirs, for administrative and operational uses. This is not new as selected functions are already utilising underground caverns, including the Mandai Ammunition Storage Facilities. Nevertheless, there is potential for more to be done.

However, land is only part of our training requirements, as our pilots need airspace to hone their skills and fine-tune tactics and concepts of operations. Given Singapore's small size, the RSAF also has to contend with limited airspace over our island that our pilots can train in. Therefore, other than our local training airspace, the RSAF leverage on our partner nations to conduct both long-term and periodic detachments in their lands. Examples of permanent detachments include operational training detachments such as Peace Carvin II, Peace Carvin V, Peace Prairie and Peace Vanguard in the United States (US), housing the F-16s, F-15s, CH-47s and AH-64s respectively, as well as the flying training detachments, such as the Air Grading Centre, 130 Squadron in Australia and 150 Squadron in France for air grading, basic and advanced fighter pilot training, respectively. Additionally, we conduct periodic detachments to countries like Australia, New Zealand and Thailand. More importantly, we conduct unilateral large scale, cross-Service exercises, such as *Exercise Wallaby* and *Exercise Forging Sabre* and participate in both bilateral and multilateral exercises such as *Exercise Cope Tiger*, *Exercise Kiwi Flag*, *Exercise Red Flag* and *Exercise Indopura*, to exercise our concept of operations, enhance cross-Service integration with our Army and Navy counterparts and increase our interoperability with our partner nations.

However, this availability to overseas training areas cannot be taken for granted and is subjected to several factors such as geopolitical sensitivities, domestic pressures and global politics. Notwithstanding, the RSAF will continue to explore new areas and innovate ways to meet our training requirements.

Another strategy the RSAF employs to mitigate the lack of training airspace is to utilise simulators to create virtual space to meet our training requirements. Simulators are an important component of RSAF training, as not only does it overcome the lack of physical airspace, it allows cost-effective training of RSAF personnel in realistic scenarios that are difficult or dangerous to replicate in the real world.

Over the years, our simulators have evolved from skill-training simulators, such as basic procedural trainers that allow aircrew to perform simple checklist training, to more realistic simulators that allow skills development. Today, the RSAF uses task-level simulators that allow a number of simulators to be networked, permitting realistic training either with the accurate presentation of threats or large force employment exercises and at the highest level, campaign-level simulators that allow personnel in the Command Post to orchestrate operations at the Air Force level. Moving forward, the capability of mixed live and simulated assets can be fused in the same picture to create a more realistic scenario for training for higher-level exercises, such as at the Command Post-Level. Moreover, there is potential for simulators to be networked with that of other Services, to develop and exercise a networked 3rd Generation SAF.



Figure 7: A trainee pilot undergoing flight training during a 'sortie' on the flight simulator. The simulator's ability to generate complex operational scenarios enhances the pilot trainees' situational awareness and skills in aerial tactics.

CONCLUSION

The RSAF is a competent and established Air Force, but we cannot rest on our laurels and have to continuously develop ourselves. However, this requirement would need to be balanced with Singapore's limited resources. Therefore, as part of our planning policy and discipline, we need to take into careful consideration the available supply, balanced with other national requirements, engage in long term planning and conversation, leverage on technology, innovation as well as the ingenuity and capability of our people to ensure that not only will we overcome our challenges, but we will turn them into opportunities to better ourselves.

ENDNOTES

1. http://www.mindef.gov.sg/imindef/resourcelibrary/cyberpioneer/topics/articles/news/2014/mar/11mar14_news2.html#.VTBsAtK4Xy4
2. *"Military Expenditure"* Sipri.org. December 31, 2013. <http://www.sipri.org/research/armaments/milex>
3. *"Global Defence Outlook 2014,"* <http://www2.deloitte.com/content/dam/Deloitte/global/Documents/Public-Sector/gx-ps-global-defense-outlook-2014.pdf>
4. *"A Sustainable Population for a Dynamic Singapore"* Population.sg. January 1, 2013. <http://population.sg/whitepaper/downloads/population-white-paper.pdf>.
5. Ibid.
6. Ibid.

THE EXPANDED ROLE OF AIR POWER IN THE DEFENCE AND SECURITY OF SINGAPORE

By LTC Tan Jinq Yeu, MAJ Teo Wei Keong & MAJ Leong Tyng Wey

INTRODUCTION

Since the end of the Cold War, changes in the global security landscape have reduced the probability of large-scale inter-state conflicts. While border and territorial disputes continue to be potential flash points for conflicts around the world, non-conventional security threats such as transnational terrorism, natural disasters and global pandemics have added complexities and posed new challenges for military forces. Air power, a traditionally offensive military instrument, is increasingly employed for Operations Other Than War (OOTW) such as humanitarian assistance, counter-terrorism and peace keeping operations. Concomitantly, the Revolution in Military Affairs (RMA) has significantly increased the cost of modern warplanes and influenced the evolution of air power roles. In order to meet the increasing peacetime operational demands, some air forces such as the United States Air Force (USAF) had even deferred its fleet modernisation and its conventional fighter force over the last decade in order to acquire more unmanned drones for operations in Iraq and Afghanistan.¹

Since the Republic of Singapore Air Force (RSAF)'s first United Nations (UN) Peace Support Operation (PSO) mission to Cambodia in 1993, Singapore has leveraged on air power to advance its international standing and contributes to international efforts in humanitarian assistance, peace-keeping and counter-piracy. At the same time, the success of these OOTW missions and the continued romanticism of air power have also greatly enhanced the value proposition of the RSAF to Singapore in peace.

This essay examines the expanded role of air power as a result of changes in the global security landscape and technology advancements, and highlights the implications to the RSAF and Singapore. It will show that while the roles of air power have expanded progressively and benefited Singapore over the years, Singapore's strategic vulnerability and the uncertain regional security environment meant that the *raison d'être* of the RSAF should still be to defend our nation's sovereignty rather than to over-extend our limited resources for OOTW. As an effective instrument to secure the interests of a small country like Singapore in peace and war, the RSAF's order of battle should therefore be structured for flexibility in peacetime demands without compromising our abilities to secure a swift and decisive victory when called upon.

THE EXPANDING ROLES OF AIR POWER

The oldest independent air force in the world, the Royal Air Force (RAF), defines air power as “the ability to project power from the air and space to influence the behaviour of people or the course of events.”² Major General William ‘Billy’ Mitchell, father of the USAF, referred to it simply as “the ability to do something in the air.”³ It is from the immutable properties of air that we derive air power’s fundamental characteristics of speed, range and height. With its ability to bypass the enemy’s surface forces and overcome terrain that would impede surface force movement, air power offers military commanders the flexibility and responsiveness to concentrate mass and firepower and strike the enemy’s identified Centres of Gravity (CoGs) simultaneously.⁴ When implemented as capabilities, it encompasses all aviation uses in the pursuit of a nation’s security interests and can be broadly classified into the roles of Control of the Air, Force Projection, ISR (Intelligence, Surveillance, and Reconnaissance) and Attack.⁵ As a military instrument, air power can be applied both in offensive and non-offensive manners.

The peak of modern offensive air power was arguably during the height of the Cold War when astronomical numbers of strategic bombers, fighters, nuclear ballistic missiles and long range cruise missiles were held by then superpowers, the US and the Soviet Union (USSR). Since the USSR’s breakup in 1991, the US as the sole superpower and its allied NATO air forces have participated only in a few conventional air campaigns in the Middle East (Iraq 1991, 2003) and Kosovo (1999). Conversely, global air forces have been involved in far more non-conventional conflicts (Somalia 1993, Haiti 1994, Bosnia 1995, East Timor 2001, Libya 2011, Mali 2012) and disaster relief operations (2004 Asian Tsunami, 2008 Cyclone Nargis, 2009 Padang Earthquake, 2010 Pakistan Floods, 2011 East Japan Earthquake,⁶ 2014 Typhoon Haiyan) in the same timeframe. In 2001, the 9/11 suicide attacks by Al-Qaeda also sparked off a long global war on terrorism in Afghanistan and Pakistan, culminating in the killing of terrorist leader Osama Bin Laden. However, due to air power’s inability to capture or hold ground, it played a more supplementary role in many of these operations in the forms of force projection, reconnaissance and limited air strikes. Although air power seems to be playing a bigger role in the 2014 US-led effort against the Islamic State of Iraq and Syria (ISIS), it was chosen as the preferred military option mainly due to the political decision to limit boots on the ground rather than its effectiveness in containing an insurgency.

As a result of prolonged peace, some smaller air forces have restructured to address more pressing peacetime requirements while deferring their offensive capability purchases. For example, in 2001 the New Zealand Ministry of Defence removed the Royal New Zealand Air Force’s (RNZAF) air combat capability by cancelling the purchase of 28 Block-15 F-16 Fighting Falcon fighters and disbanding its Skyhawk and Aermacchi fighter squadrons.⁷ Today, the RNZAF operates only helicopters, transport and maritime patrol aircraft. In Western Europe, Belgium has also pulled out of the US Joint Strike Fighter (JSF) programme and assigned its 72 ageing F-16s to NATO’s collective defence and peace keeping framework since 2000.⁸ Similarly in Switzerland, a lack of general air threats

meant that Swiss fighter replacement programmes were repeatedly delayed, pilots put onto reserve lists and airbases closed at night as their air force's budget was trimmed for other more pressing needs.⁹

The RMA in the 1990s, Global War on Terrorism and the rising costs of modern fighters have also significantly reduced the number of fighter aircraft that the shrinking defence budgets of many Western nations can afford while shifting the acquisition trend to aerial ISR assets such as Unmanned Aerial Vehicles (UAV). This was evident when the US cut its order of F-22 fighters from an initial 750 to a final procurement of only 187 in 2005, while increasing its total number of UAVs to 30% of the air force's order of battle.¹⁰ Due to the high cost of the F-22 and their low numbers, the US also did not field the high-tech stealth fighter during the conflicts in Iraq, Afghanistan or even the relatively low risk 'no-fly' zone enforcement in Libya (2011).¹¹ Conversely, US Reaper combat drones have carried out numerous counter-terrorism missions in Pakistan and Yemen, while the Global Hawk UAVs have been extensively used for ISR in humanitarian missions such as the 2007 fires in California, the 2010 Haiti earthquake and the 2011 Fukushima reactor leaks. In the ongoing Operation Inherent Resolve against ISIS, UAVs have also proven to be so invaluable in providing real-time tactical surveillance in the targeted operations against terrorists, that the US has sought additional buys in her 2015 budget.¹²

CONTRIBUTIONS OF THE RSAF TO SINGAPORE

Since its inauguration on 1st September, 1968 as the Singapore Air Defence Command (SADC) with a humble fleet of eight Cessna 172s, air power development in Singapore has been driven largely by defence demands. Fresh from the memories of overwhelming



Our UAVs and their operators, under the ambit of Operation Blue Ridge, contributed to the international community's reconstruction efforts to restore stability in Afghanistan.

Japanese air attacks in World War II, Singapore's pioneer leaders recognised that only a strong and capable air force could establish deterrence and safeguard her sovereignty given her small size and lack of depth. As the SADC evolved into the Republic of Singapore Air Force (RSAF), the RSAF built up her basic air defence in the 1970s, established a credible air superiority capability in the 1980s and focused on improving the professionalism of her people in the 1990s.¹³ Since then, the RSAF has made significant progress and has transformed from a 1st to 3rd generation air force within a short span of 50 years.

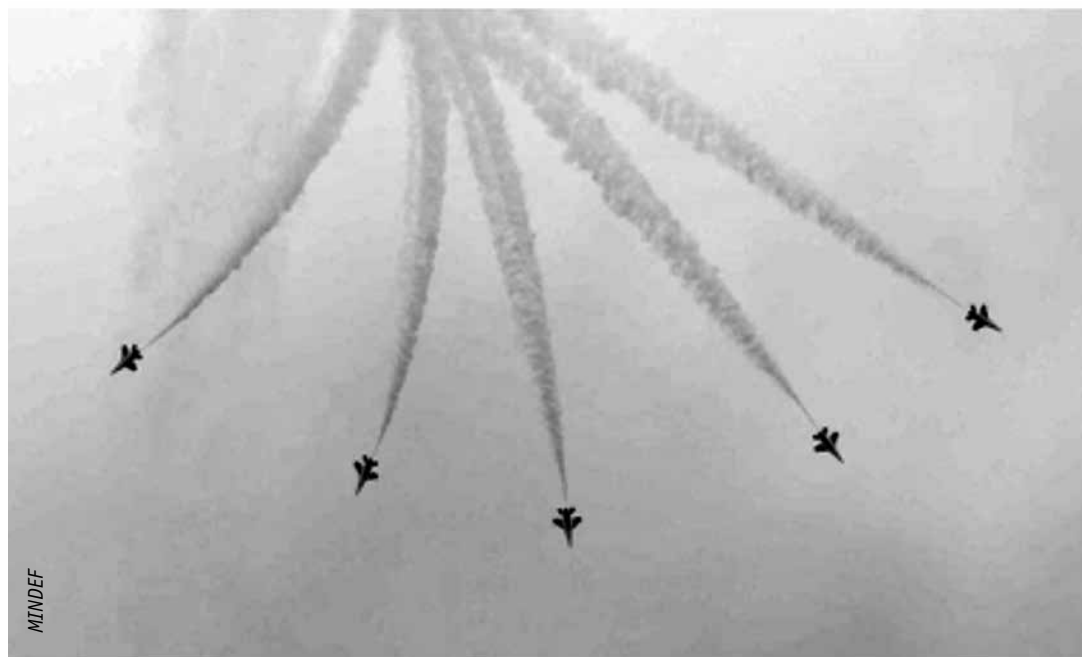
Although the RSAF's mission of defending the skies and safe guarding the sovereignty of Singapore has remained unchanged since its inception, changes in the global security landscape and advancement in technologies have allowed it to take on OOTW, which helps upkeep RSAF's operational readiness and gives it operational experience.

In 1993, the RSAF embarked on its first United Nations (UN) mission by sending four Super Puma helicopters and 65 personnel to Cambodia to assist the UN Transitional Authority in Cambodia (UNTAC) during the electoral process.¹⁴ Since then, the RSAF has expanded her international peace-keeping efforts to include sending UH-1H helicopters to Timor-Leste (Operations Blue Heron), KC-135 tanker aircraft to the Persian Gulf (Operations Blue Orchid) and Searcher UAVs to Afghanistan (Operations Blue Ridge). In addition, the RSAF had provided humanitarian assistance and conducted disaster relief operations to Indonesia and Thailand during the 2004 Boxing Day Tsunami (Operations Flying Eagle), New Zealand after the 2011 Christchurch Earthquake, the Philippines after Super Typhoon Haiyan in 2013, assisted in search and locate efforts of AirAsia flight QZ8501 in December 2014, deployed CH-47s to help combat forest fires in Chiang Mai in March 2015 and also participated in many multi-lateral counter-piracy missions (Operations Blue Sapphire)



An RSAF Super Puma taking off from the deck of Landing Ship Tank *RSS Endurance* while in the Gulf of Aden as part of multinational anti-piracy efforts there.

in the Gulf of Aden since 2009.¹⁵ These efforts have earned Singapore goodwill from neighbouring countries, enhanced our standing as a responsible member of the UN and international community and protected our strategic interests as a small maritime nation.



The RSAF's Black Knights continue to be a crowd favourite at the Singapore Airshow and various other aerial display events.

Another significant, albeit less tangible contribution of the RSAF, is her efforts towards the nation-building of Singapore. As the representation of air power in Singapore, RSAF aircraft have captivated Singaporeans with the National Flag fly-pass and aerobatic displays at National Day Parades for decades. As shown by the consistent large turnouts at the Singapore Airshows and the popularity of the RSAF's Black Knights aerobatic team, Singapore's air power has been an enduring source of national pride and continues to generate strong appeal among Singaporeans.¹⁶ An explanation for this appeal may be attributed to the romanticism of air power which has existed since the early days of aviation. Former British Prime Minister Harold Macmillan once remarked that "we thought of air warfare in 1938 rather as people think of nuclear warfare today,"¹⁷ while Sir Winston Churchill had opined that "air power may either end war or end civilisation."¹⁸ As a conscript nation that depended on National Service to protect the homeland, this romanticism of air power played a key role in nation-building as it translated to widespread support for the RSAF and enabled institutional trust to be established between Singaporeans and the Singapore Armed Forces (SAF).

In view of the expanded peacetime roles of air power and their significance to Singapore, should the RSAF invest more in its OOTW capabilities to further strengthen its value in peace, or should she continue to build a strong conventional force with her limited resources to achieve deterrence and victory in war? As with most air forces, the impetus for the RSAF

to invest in OOTW capabilities is undeniable and inevitable. However, it is also paramount that the RSAF's force structure remains sufficiently flexible to meet additional peacetime demands without compromising her war-fighting capabilities due to uncertainties in the regional security environment and Singapore's inherent strategic vulnerability.

UNCERTAIN SECURITY ENVIRONMENT AND STRATEGIC VULNERABILITY

While there has been relative peace in Southeast Asia since the end of World War II (WWII), there are significant geo-political undercurrents that can quickly alter the security environment. Unlike the resolute peace in Western Europe, the fragile peace in the Asia-Pacific belies a much more unstable situation.

In the last decade or so, Asian nations have been spending increasingly on their militaries and this has resulted in concerns over a possible arms race in the Asia Pacific region.¹⁹ For example, South Korea continues to commit billions to its fighter acquisition programme,²⁰ while Japan has recently committed to the F-35 Joint Strike Fighter (JSF) as its next generation fighter,²¹ as they grapple with increased tensions in the region. Closer to home, ASEAN nations such as Indonesia and Malaysia are embarking on the KF-X fighter development project and the Multi-Role Combat Aircraft programme respectively to boost their defence capabilities.²² While some of these air power acquisitions can be rationalised as developing nations modernising their defence due to their growing economies, this modernisation can easily turn into an arms race should relationships deteriorate.

Regionally, the rapid economic development and increase in energy demands from emerging states have also created potentially destabilising flashpoints from resource and territorial disputes with their smaller neighbours. For example, competing claims in the South China Sea has already strained relationships with regional countries such as Vietnam, the Philippines, Japan and to a lesser extent, Taiwan. Countries such as the Philippines and Australia have recently announced their decisions to acquire the FA-50 and the F-35 JSF fighter aircraft respectively, to strengthen their air forces in a bid to counter any aggressive expansion into the South China Sea and the Indian Ocean.²³ Non-claimant states to the South China Sea islands, such as Indonesia, are also bolstering its defence in the Natuna Islands with warships and Apache gunship helicopters in order to protect its Exclusive Economic Zone (EEZ).²⁴

By virtue of her geographical location and small physical size, Singapore will always be inherently vulnerable as a nation due to her dependence on international trade and lack of natural resources. As seen through the *KRI Usman Harun* naming incident in Indonesia, Singaporeans are also reminded that even good bilateral relationships can face challenges.²⁵

WAY FORWARD FOR THE RSAF

With increased peace time demands, the key to continued success for the RSAF from peace to war is in finding the right mix and balance of air power capabilities without over-committing resources. In order for the RSAF to continue supporting future peace time operations, one possible approach is to adopt a portfolio approach to acquisition and establish a wide range of capabilities that the RSAF can potentially offer to international efforts in times of need. While this approach ensures that the RSAF would be capable for a wide array of peacetime operations, the cost of up-keeping these additional assets cannot be underestimated and their actual utility may be limited if not called to action. A more focused approach would be in the judicious acquisition of 'dual-use' platforms such as multi-role transport aircraft, helicopters and UAVs that are essential in war and can also provide much needed transportation and surveillance functions in a civil disaster relief operation. This acquisition approach will ensure that the RSAF's force structure remains focused on national defence, but have sufficient capacity in certain key areas during peace time to respond to contingencies. Ultimately, this approach will provide better prudence for the RSAF in managing resources, while providing national policy makers with military options to advance Singapore's national interests.

CONCLUSION

The changes in the security environment after the Cold War and the RMA have helped shaped new trajectories in air power and for global air forces towards OOTW and non-conventional military operations. In Singapore, air power has played a significant role in the development of the nation and the SAF through the evolution of the RSAF. As the RSAF embraces her expanded roles in peacetime and strives to contribute to Singapore's national interests, the strategic constraints faced by Singapore are unlikely to change amid an increasing volatile security situation in the Asia-Pacific region with the rise of new hegemonic states. With air power continuing to play a critical role in the defence and security of Singapore, the RSAF will need to calibrate her efforts when participating in international missions and balance her force structure and defence acquisitions to address both conventional and unconventional threats throughout the operational continuum.

BIBLIOGRAPHY

- Eaglen, M. "Air Force Cuts Mean Service Is 'Slowly Going Out of Business' 8 August , 2012. <http://breakingdefense.com/2012/08/air-force-is-slowly-going-out-of-business-service-stands-on/>
- Gertler, J. Air Force F-22 Fighter Program. CRS Report for Congress. Congressional Research Service, 11 July 2013. www.crs.gov.
- "Global Hawk Served New Role in Japan Aftermath, Air Force Times, [Airforcetimes.com](http://airforcetimes.com)", 14 August 2011.
- <http://www.airforcetimes.com/article/20110814/NEWS/108140323/Global-Hawk-served-new-role-Japan-aftermath>.
- Jones, J.R. William "Billy" Mitchell's Air Power. University Press of the Pacific, 2004. <http://books.google.com.sg/books?id=UZpugRwqQuAC>.
- Lee J., and Park J.M., "South Korea Dumps Boeing Fighter Jet Tender, Lockheed Soars Back.", Reuters," 24 September 2013. <http://www.reuters.com/article/2013/09/24/us-korea-fighter-idUSBRE98N00R20130924>.
- Kammel, B. and Foerster J.H.. "Invading Switzerland? Try Before 8 or After 5 - Bloomberg," 17 February 2014. <http://www.bloomberg.com/news/2014-02-17/invading-switzerland-try-before-8-or-after-5.html>.
- Kapoor K. and Thatcher J.. "Indonesia Military Worries over Asia Arms Race, Territorial Tensions, Reuters," 3 April 2014. <http://www.reuters.com/article/2014/04/03/us-indonesia-military-idUSBREA320GD20140403>.
- Leong, J. "RSAF to Celebrate 45th Anniversary with Public at Singapore Airshow" – Channel NewsAsia, 8 February 2014. <http://www.channelnewsasia.com/news/singapore/rsaf-to-celebrate-45th/987598.html>.
- Martin, L. "Global: Participation: Japan". F-35 Lightning II, 19 December 2011. <https://www.f35.com/global/participation/japan>.
- Ministry of Defence, Singapore. "Republic of Singapore Air Force - History," 24 April 2010. http://www.mindef.gov.sg/imindef/mindef_websites/atozlistings/air_force/about/History.html.
- Ministry of Defence, United Kingdom. British Air And Space Power Doctrine. 4th Edition., 2009. <http://www.airpowerstudies.co.uk/ap3000.htm>.
- Moss, T. "Asia's Next Fighter Project", The Diplomat 14 July 2011. <http://thediplomat.com/2011/07/asias-next-fighter-project/>.
- Mueller, P. Air Power. RAND, 2010. http://www.rc.prgs.edu/content/dam/rand/pubs/reprints/2010/RAND_RP1412.pdf.
- NZ Government. "Air Combat Review Description [Ministry of Defence NZ]" February 2001. <http://www.defence.govt.nz/reports-publications/air-combat/desc-options.html>.
- Pittaway, N. "Malaysia Looks To Refresh Fighter Force", Defense News Defensenews.com, 10 April 2013. <http://www.defensenews.com/article/20130410/DEFREG03/304100013/Malaysia-Looks-Refresh-Fighter-Force>.
- Rahman, R. "Indonesia to Deploy Four Apache Helicopters on Natuna Islands, Begins Pilot Training", IHS Jane's 360, 27 March 2014. <http://www.janes.com/article/36124/indonesia-to-deploy-four-apache-helicopters-on-natuna-islands-begins-pilot-training>.

Richard, T. "Belgian Government Restructures Armed Forces" and "Restarts Its African Policy", World Socialist Web Site, 9 June 2000. <https://www.wsws.org/en/articles/2000/06/belg-j09.html>.

Royal Air Force. "RAF - Role of Air Power," June 2010. <http://www.raf.mod.uk/role/airpower.cfm>.

TAKAHASHI, KAORI, and MINORU SATAKE. "Australia, Philippines Scrambling to Boost Air Forces." *Nikkei Asian Review*, 25 April 2014. <http://asia.nikkei.com/Politics-Economy/International-Relations/Australia-Philippines-scrambling-to-boost-air-forces>.

"The Era of Robotic Warfare Has Arrived – 30% of All US Military Aircraft Are Drones", Singularity Hub, Accessed 17 April 2014. <http://singularityhub.com/2012/02/09/the-era-of-robotic-warfare-has-arrived-30-of-all-us-military-aircraft-are-drones/>.

The Straits Times. "Why KRI Usman Harun Is Not Welcome," 20 February 2014. <http://www.stasiareport.com/the-big-story/asia-report/editorials/story/why-kri-usman-harun-not-welcome-20140220>.

Thompson, M. "The Strange Case of the (Nearby) But Missing F-22s Over Libya", 17 April 2011. <http://nation.time.com/2011/04/17/the-strange-case-of-the-nearby-but-missing-f-22s-over-libya/>.

Clausewitz, C., Michael Howard, and P. Paret. *On War*. Princeton Paperbacks. Princeton University Press, 1989. <http://books.google.com.sg/books?id=DRoLONmsrlwC>.

ENDNOTES

1. Eaglen M. "Air Force Cuts Mean Service Is 'Slowly Going Out of Business'", *Breaking Defense - Defense Industry News, Analysis and Commentary*, 8 August 2012, <http://breakingdefense.com/2012/08/air-force-is-slowly-going-out-of-business-service-stands-on/>.
2. Royal Air Force, "RAF - Role of Air Power", June 2010, <http://www.raf.mod.uk/role/airpower.cfm>
3. Jones, William "Billy" Mitchell's Air Power (University Press of the Pacific, 2004), <http://books.google.com.sg/books?id=UZpugRwqQuAC>.
4. C. Von C., Michael H. and Paret P., *On War*, Princeton: Princeton University Press, 1989, 488–489, <http://books.google.com.sg/books?id=DRoLONmsrlwC>.
5. Mueller P., *Air Power* (RAND, 2010), 1, http://www.rc.prgs.edu/content/dam/rand/pubs/reprints/2010/RAND_RP1412.pdf; United Kingdom Ministry of Defence, *British Air And Space Power Doctrine*, 4th Edition, 2009, 37, <http://www.airpowerstudies.co.uk/ap3000.htm>
6. Operation Tomodachi. Beside repatriating citizens by airlift, the USAF also contributed to Search and Rescue operations with HH-60 Pave Hawk helicopters and reconnaissance with U-2 spy planes and Global Hawk UAVs.
7. NZ Government, "Air Combat Review Description [Ministry of Defence NZ]", February 2001, <http://www.defence.govt.nz/reports-publications/air-combat/desc-options.html>.
8. Richard T., "Belgian Government Restructures Armed Forces and 'Restarts Its African Policy' - World Socialist Web Site", 9 June 2000, <https://www.wsws.org/en/articles/2000/06/belg-j09.html>.
9. Kammel B. and Foerster J.H., "Invading Switzerland? Try Before 8 or After 5" *Bloomberg*, 17 February 2014, <http://www.bloomberg.com/news/2014-02-17/invading-switzerland-try-before-8-or-after-5.html>.
10. Gertler J., *Air Force F-22 Fighter Program*, CRS Report for Congress, Congressional Research Service, 11 July 2013, 11, www.crs.gov; "The Era of Robotic Warfare Has Arrived – 30% of All US Military Aircraft Are Drones" *Singularity Hub*, accessed 17 April 2014, <http://singularityhub.com/2012/02/09/the-era-of-robotic-warfare-has-arrived-30-of-all-us-military-aircraft-are-drones/>.
11. Thompson M., "The Strange Case of the (Nearby) But Missing F-22s Over Libya.", 17 April 2011, <http://nation.time.com/2011/04/17/the-strange-case-of-the-nearby-but-missing-f-22s-over-libya/>.
12. "Global Hawk Served New Role in Japan Aftermath", *Air Force Times*, [Airforcetimes.com](http://www.airforcetimes.com), 14 August 2011, <http://www.airforcetimes.com/article/20110814/NEWS/108140323/Global-Hawk-served-new-role-Japan-aftermath>. Parson, Dan. "US Seeks to Purchase Small UAS for Battle against Islamic State - 11/11/2014", *Flight Global*, 11 November 2014. <http://www.flightglobal.com/news/articles/us-seeks-to-purchase-small-uas-for-battle-against-islamic-405920/>.
13. Singapore Ministry of Defence, "Republic of Singapore Air Force - History", 24 April 2010, http://www.mindef.gov.sg/imindef/mindef_websites/atozlistings/air_force/about/History.html.
14. The tasks included ferrying elections officials and ballot boxes to polling sites and counting centres, providing transport for medical casualties and conducting aerial policing.

15. MINDEF, "MINDEF - Key Topics", Overseas Operations", 13 January 2014, http://www.mindef.gov.sg/imindef/key_topics/overseas_operations.html.
16. Leong J., "RSAF to Celebrate 45th Anniversary with Public at Singapore Airshow" Channel NewsAsia, 8 February 2014, <http://www.channelnewsasia.com/news/singapore/rsaf-to-celebrate-45th/987598.html>.
17. Royal Historical Society, Transactions of the Royal Historical Society: Volume 11, 6th Edition, (UK: Cambridge University Press, 2003), 234.
18. Carlo Kopp, "Quotations and Reflections." <http://www.ausairpower.net/Quotes.html>.
19. Kapoor K. and Thatcher J., "Indonesia Military Worries over Asia Arms Race, Territorial Tensions", Reuters, 3 April 2014, <http://www.reuters.com/article/2014/04/03/us-indonesia-military-idUSBREA320GD20140403>.
20. Lee J. and Park J.M., "South Korea Dumps Boeing Fighter Jet Tender, Lockheed Soars Back", Reuters, 24 September 2013, <http://www.reuters.com/article/2013/09/24/us-korea-fighter-idUSBRE98N00R20130924>.
21. Lockheed M., "Global: Participation: Japan", F-35 Lightning II", 19 December 2011, <https://www.f35.com/global/participation/japan>.
22. Pittaway N., "Malaysia Looks To Refresh Fighter Force", Defense News Defensenews.com, 10 April 2013, <http://www.defensenews.com/article/20130410/DEFREG03/304100013/Malaysia-Looks-Refresh-Fighter-Force>.
23. Takahashi K. and Satake M., "Australia, Philippines Scrambling to Boost Air Forces", Nikkei Asian Review, 25 April 2014, <http://asia.nikkei.com/Politics-Economy/International-Relations/Australia-Philippines-scrambling-to-boost-air-forces>.
24. Rahman R., "Indonesia to Deploy Four Apache Helicopters on Natuna Islands, Begins Pilot Training", IHS Jane's 360, 27 March 2014, <http://www.janes.com/article/36124/indonesia-to-deploy-four-apache-helicopters-on-natuna-islands-begins-pilot-training>.
25. The Straits Times, "Why KRI Usman Harun Is Not Welcome", 20 February 2014, <http://www.stasiareport.com/the-big-story/asia-report/editorials/story/why-kri-usman-harun-not-welcome-20140220>.

CONTRIBUTIONS OF WOMEN IN THE RSAF

By LTC Kenneth Chiong, LTC Ng Yu Jing, Eugene,
CPT Ye Rouyin & CPT Yam Gui Hao, Gabriel

PROLOGUE

Over the last 50 years, Singaporean women have played a pivotal role in nation building and in Singapore's success. One such contribution is through military service in the Republic of Singapore Air Force (RSAF). Although women constitute a small percentage of the RSAF's population, their contributions over the years have been significant. As we celebrate the 50th anniversary of Singapore's independence, it is apt that we look back at these contributions by showcasing the success stories of women in the RSAF. In this article, the team interviewed eight of the RSAF's servicewomen and highlighted their contributions to the RSAF. The article will tell of the challenges they have had to overcome and that they had to dispel misconceptions that society may have of a woman in military service. It will also tell of how many of them have built successful families despite the high work tempo in the RSAF. Through these stories, we hope to increase awareness of how women have contributed to the RSAF and inspire more women to consider a career in the RSAF positively.

OUR EARLY DAYS (1968-1970s)

After World War II (WWII) and up till the early years of our independence, Singapore had depended completely on Britain's Royal Air Force for its air defence.¹ With the impending withdrawal of British troops from Singapore, the Singapore Air Defence Command (SADC) was formed in 1968 with the immediate and urgent task of setting up the Flying Training School to train pilots. The first batch of six pilot trainees returned from the United Kingdom in 1970, ready to operate the newly acquired Hawker Hunter fighter aircraft.² In the same year, a pioneer batch of technicians was sent to Royal Air Force (RAF) Cranwell to begin technical training on the Aérospatial Alouette III helicopter. By September 1971, Britain's former air bases in Tengah, Seletar, Sembawang and Changi were handed over to the SADC as well as its air defence radar station and Bloodhound II surface-to-air missiles.³ The SADC was subsequently renamed the Republic of Singapore Air Force (RSAF) on 1st April, 1975.

During this period, internationally, the service of women in the military, particularly in combat roles, was controversial. However, women were already actively playing a role in the SADC and even in the days of the Royal Air Force (RAF) in Singapore.



1973 saw the first batch of women recruited into the then-SADC. MAJ (RET) Vasanti D/O Sivaguru Ayadurai was one of the twenty women who were recruited as Air Traffic Control Assistants. Six years later, the RSAF also opened up the first recruitment of female officers as Air Traffic Controllers. MAJ (RET) Vasanti quickly took up this opportunity. Together with her course mates, MAJ (RET) Vasanti pioneered the way for women to pursue lifelong careers in the RSAF. She recounted that as the only female officer in Tengah Air Base, she had to take care of the other servicewomen, which included overseeing their physical training. The women were treated no differently from the men. In turn, these women did not expect any privileges and through their exemplary conduct, earned the men's respect. "The Air Force gave me many opportunities to realise my potential," said MAJ (RET) Vasanti, "What I am today is because of what I have been through in the Air Force."

"In those days, only the best Air Traffic Controllers were posted to Tengah Air Base, which was a base for fighter aircraft," recalled MAJ (RET) Vasanti. "After graduating from the course, I felt that I had to prove myself worthy of being in Tengah," said MAJ (RET) Vasanti. With this determination, she quickly attained her Air Traffic Control qualifications to control live aircraft solo. "Every day, you will face new situations. Every day without fail (in the 1970s), there would be a challenging incident to overcome. You have to be competent and possess vast knowledge beyond your job scope, which you may need to apply when the incident calls for it." The challenges fuelled her passion and strengthened her resolve to contribute to the RSAF.

EXPANDING OUR CAPABILITIES — THE 2nd GENERATION RSAF (1980s-1990s)

The 1980s saw a spike in the recruitment numbers of females in the RSAF. Internationally, it was also in 1980 that the first female cadets graduated from the 200-year-old United States Military Academy at West Point.⁴ The Singapore Armed Forces (SAF) recruited its first female combatants in 1986, allowing them to serve as artillery gunners, pilots and intelligence analysts.

This period saw the RSAF expanding its capabilities to provide a stronger deterrence against potential aggressors and to overcome Singapore's lack of strategic depth. These reasons necessitated the rapid expansion of the fighter aircraft fleet, beginning with the acquisition of the A-4 Skyhawks from the United States (US) Navy in 1971.⁵ The RSAF would eventually go on to procure more advanced platforms such as the F-5 supersonic fighters, AS-332 Super Puma helicopters, C-130 transport aircraft, the RBS 70, Rapier and I-Hawk ground-based air defence systems.⁶ In tandem with these new systems, the RSAF revamped and improved the management of our most important asset—our people.



Air Operations and Systems Expert – ME3 Teo Poh Lin

It was during this period that ME3 Teo Poh Lin joined the RSAF in 1988 after completing her GCE 'O' Levels. "I joined the RSAF when I was only 21 and it has been more than 25 years since," said ME3 Teo. "Back then, it was my mother's idea that I joined the RSAF. The 1988 film 'Airforce' featuring local artiste Li Nanxing influenced me too," quipped ME3 Teo. Her decision sparked interest from her friends. Common questions included "Is it tough?", "Do you need to be very

fit?", and "Is it a male-dominated environment?" There were indeed some transitional challenges, in her own words, "from school girl to soldier". The regimentation and training were tough at the beginning, but she quickly got used to life as a soldier. As a young Air Operations and Systems Expert (then called Air Operations and Communications Assistant), ME3 Teo put in her best in everything she undertook, clinching the RSAF Best Serviceman of the Year award in the Service category in 1994.

Pilot(Helicopter) – LTC Christine Sim

The 2nd Generation RSAF also saw the recruitment of Singapore's first female Helicopter Pilot. LTC Christine Sim, an AS-332M Super Puma Helicopter Pilot, joined the RSAF in 1991, after going through the Singapore Youth Flying Club (SYFC) in Junior College. That sparked her interest in becoming a Pilot with the RSAF. Asked whether her family supported her decision, LTC Sim admitted that she only informed her parents after she had made the decision to join the RSAF. Her parents' primary concern was her safety, but she convinced them that the RSAF has a strong safety culture and her job would not put her in dangerous situations. Looking back, she has no regrets about her decision. "It was an interesting, but not an easy job—one that is meaningful and not desk-bound," said LTC Sim.



Air Warfare Officer (C3) – BG Gan Siow Huang

The RSAF continued to open up more opportunities for females to pursue their career as well as academic aspirations. In 1993, a pioneer group of females was awarded the SAF Merit Scholarship for Women (SMS(W)). The SMS(W) groomed aspiring young women to take on senior command and leadership positions in the SAF. BG Gan Siow Huang was one of the first recipients of the scholarship. During her school days, BG Gan actively participated in the Girl Guides, Brownies and canoeing club. “I have always liked the



idea of being in a uniformed group, having a strong identity and serving the greater good.” said BG Gan. Intrigued by the mystique surrounding the high-tech equipment, fast-paced machines and the image of professionalism, agility and toughness, she felt that “joining the RSAF was a natural decision.”

Air Defence Systems Specialist – 1WO Yuen Pui Leng

Recruited to operate the 2nd Generation RSAF’s suite of air defence capabilities, 1WO Yuen Pui Leng joined the RSAF in 1995 as an Air Defence Systems Specialist (ADSS). Currently a Warrant Officer-In-Charge (WOIC) in 163

Squadron, she operates the I-HAWK Ground-Based Air Defence system.

Asked what the most memorable moment of her career was, 1WO Yuen replied, “I was given the privilege to represent the RSAF as the first female ADSS to attend the Royal New Zealand Air Force Warrant Officer course in 2010. Initially, I was anxious but, I also realised the trust that the RSAF had in me. I was determined to do my best and make the RSAF proud. It was a truly memorable five weeks spent at Base Woodbourne, Blenheim with many good experiences and interactions with foreign forces.”

As a WOIC in 163 Squadron, 1WO Yuen is frequently called upon to lead her team to accomplish the Squadron’s mission. “Today, I am thankful to work in an environment that carries no chauvinistic sentiments.” 1WO Yuen frequently takes the time to mentor and nurture her people to enable them to realise their full potential within the RSAF. For her efforts in developing and engaging her people, she was awarded the Squadron CARDINAL Individual Award in 2012.⁷

THE 3rd GENERATION RSAF (2000-PRESENT)

During the mid-2000s, the RSAF embarked on its 3rd Generation transformation to meet the needs of a more demanding and complex operating environment. The



transformation aimed to develop the RSAF into a highly integrated force, capable of conducting a full spectrum of operations in both peace and war.⁸ It consisted of three key components—inducting new and advanced systems and technologies, re-organisation of base-centric organisational structures into operational commands and a stronger emphasis on people development.⁹

Pilot(Fighter) – MAJ Khoo Teh Lynn

It was around this period that the RSAF recruited its first female Fighter Pilot, MAJ Khoo Teh Lynn. MAJ Khoo joined the RSAF in 2000 at the age of 19 and had a strong desire to become a fighter pilot. She had previously obtained her Private Pilot Licence (PPL) from the SYFC over her two years in junior college. Her passion for flying was evident as she recounted her experience at SYFC: “The environment was conducive for nurturing and learning. The students worked closely together and spurred one another on to get our PPL. We eventually formed close bonds with one another as we fostered the love for flying.”

MAJ Khoo’s decision to join the RSAF as a pilot was met with some scepticism from her male friends and classmates. Her subsequent journey as the RSAF’s first female fighter pilot was also not without its challenges. However, MAJ Khoo’s tenacity and independent nature helped her persevere and stand up against the odds. “The joy of flying had led me to decide that I wanted to join the RSAF as a fighter pilot. I had made up my mind. No one could convince me otherwise that it was not worth fighting for.” Both her parents were supportive and encouraged her to pursue her dream.

One of the most memorable points in her career was during the Basic Wings Course (BWC) in Perth, Australia. MAJ Khoo smiled as she recounted her journey to attaining her basic wings. “The course was tough and the learning curve steep. However, my basic wings course was memorable because of the course mates that I had. We were a close-knit bunch of aspiring pilots who weathered the tough times and emerged as ‘winged’ RSAF pilots. The friendships born then would last us through our careers and I still keep in contact with many of them, even though a few have since left the RSAF.”

After achieving her wings, MAJ Khoo was posted to 143 Squadron, which operates the F-16C/Ds. She had participated in several overseas exercises such as Exercise Pitch Black, Exercise Wallaby and Exercise Cope Tiger. “Exercise Pitch Black 2006 was my first overseas

deployment and involvement in a Large Force Employment (LFE) exercise. In this exercise, I was given the opportunity to operate with aircrew from other nations and practise the tactics that I had honed in my training. The exercise was invigorating and I felt a real sense of achievement after we successfully concluded it."

Air Force Engineer – ME5 Ang Lay Fang



Beyond its fighting edge, the success of the RSAF could only be guaranteed with a strong team of engineers and technicians. The 3rd Generation RSAF strengthened its Air Engineering capabilities and continued to entrench its safety culture and belief that zero accident is an achievable goal.

It was in 2002 that ME5 Ang Lay Fang graduated with a Bachelor of Engineering in Mechanical Engineering. Then 23 years old, she joined the RSAF because it was a job related to what she had studied in university and at the same time, provided dynamism. Said ME5 Ang, "At that time, it was not about defending the country. Pragmatically, I chose the job because it was not a desk-bound one and it involved more interaction with people." Although she was not the 'active, sporty type', the support from her family eased her transition into military life. "My dad used to send me to and from Basic Military Training. There was a lot of support from my family."

ME5 Ang's first job in the RSAF was as an Officer-in-charge in the Non-Destructive Inspection Section of Air Logistics Squadron, Sembawang Air Base. Her university studies were relevant to her line of work, and she was able to quickly apply her knowledge in areas such as mechanical stress, deformation of solids and types of failures to her new job. Asked how she would describe her work in non-destructive inspection to a member of the public, ME5 Ang said, "It is a bit like forensics. We conduct thorough checks on our aircraft to ensure they do not have any problems before allowing them to fly. And we do so without 'destroying' the aircraft in the process. That's why it's called non-destructive inspection."

ME5 Ang spent about two years on her first job before being posted to HQ RSAF as a Staff Officer in Rotary Wing Section, Structures Branch in the Air Engineering and Logistics Department. There, she undertook several underslung projects for the CH-47 Chinook helicopter. One of these involved designing a water bucket that could be fitted onto the Chinook helicopter, so that it could carry out fire-fighting roles in forest fires. "To transform a military helicopter into a civil disaster relief platform required some out-of-the-box thinking," said ME5 Ang. These operational demands that required creative and innovative solutions also attracted ME2 Joanne Tan to the RSAF as an Air Force Engineer (Maintenance).

Air Force Engineer (Maintenance) – ME2 Joanne Tan

ME2 Joanne Tan joined the RSAF in 2002 at the age of 21 after completing an electrical engineering diploma. Her decision to join the RSAF was motivated by the prospects of career stability and opportunities to travel overseas. Since then, she has been exposed to three different aircraft platforms; the A-4 Skyhawk, the F-16 Fighting Falcon, and the Heron-1 Unmanned Aerial Vehicle (UAV). In 2014, she was the first female Dedicated Crew Chief (DCC) to be deployed to Australia to take part in Exercise Pitch Black. When asked about her overseas deployment, ME2 Tan explained that “the opportunity to participate in Exercise Pitch Black validated my skills as a DCC. It is a good feeling to operate together as a team and produce successful results.”



Leading up to Singapore Airshow 2014, ME2 Tan was also chosen to be the first female DCC for the RSAF Black Knights team. Her background in electrical engineering had put her in good stead to excel in her new role as a DCC for the Black Knights Team. As she recounted her training, ME2 Tan attributed her success to the dedication of the trainers and the team spirit of the flight line crew. In her own words, “the learning curve was steep and almost daunting, but my trainers and fellow flight line crew were both supportive and encouraging. We always worked as a team and through our multiple practice sessions, we gradually learned to operate more efficiently and effectively together.” The dynamics of a flight line crew were similar to a F1 pit stop crew. Everyone was required to work together efficiently and with great precision to successfully produce a serviceable machine. The success of the Black Knights team at the Singapore Airshow 2014 was in no small part due to the passion and dedication of the maintenance team who worked tirelessly to deliver serviceable aircraft and ensured that the show went on smoothly. She said, “After my training, I felt confident in my abilities and my team to support the Black Knights for their aerial display. No one wanted to let the team down and we were proud to always deliver serviceable aircraft so that the show can go on.”

ME2 Tan was also nominated to be an RSAF Ambassador during the 2014 Singapore Airshow. She smiled as she recounted the conversations she had with members of the public and their questions. “I really felt proud to be a part of the RSAF. It was a great opportunity for the public to learn about my vocation and most people were surprised when I told them what I did to prepare the F-16 for flight. I felt an immense sense of achievement every time the Black Knights team delivered a good show and thrilled the spectators.”

ME2 Tan also recounted her time in UAV Command as one of the high points in her career. “There was one individual who especially inspired me—Air Engineering and Logistics Squadron Command Chief ME3 Tay Kheng Chuan. He found the time to mentor me in my daily tasks and constantly challenged me to rise to the next level. It was with his guidance that I accepted the opportunity to contribute to National Day Parade (NDP) 2013 as a trainer for the Girl’s Brigade contingent. Over the many months of training, I purposefully led my girls through each training session and sought to forge a close bond with them. When they delivered a flawless performance at NDP 2013, I was overjoyed to be part of their success. To value add to the next generation is in itself an inspiration.”

FULL-SPECTRUM AIR FORCE

LTC Sim’s experience in the Gulf of Aden

Today, the 3rd Generation RSAF operates a suite of highly sophisticated aircraft and weapons systems and is able to undertake a full spectrum of operations from warfighting to peace support and disaster relief operations.¹⁰ Speaking of humanitarian assistance and disaster relief operations, one servicewoman with no lack of such experiences is LTC Sim. As a Search and Rescue pilot operating the Super Puma helicopter, she has flown numerous life-saving missions to rescue people suffering from gunshot wounds to heatstroke. Her most vivid memory was during the 2004 Boxing Day Tsunami, when she was deployed as a Super Puma helicopter pilot on board the Republic of Singapore Navy’s (RSN) Landing Ship Tank.¹¹ “Everyone went in not knowing what to expect and it was an eye-opener seeing how a full-scale operation could be executed within 24 hours of the disaster,” said LTC Sim. “This opportunity to provide humanitarian assistance reinforced the reasons why I joined the RSAF.”

Besides life-saving missions, LTC Sim also played an active role in counter-piracy missions for the SAF. She was deployed twice, in 2009 and again in 2012, to the Gulf of Aden for counter piracy operations.¹² “This operation is a good example of the close integration among the SAF’s air, land, and sea assets,” says LTC Sim. “We had to work together to patrol the sea for pirates and respond to distress calls from merchant ships that were under attack.”

ME5 Ang’s experience during the AH-64D Emergency Landing

Although the 3rd Generation RSAF now boasts a safety record as good as that of other advanced air forces in the world, our people stand ready to respond to the occasional incident when called upon. One notable incident occurred in 2010 when ME5 Ang returned to Sembawang Air Base after a three-year stint in HQ RSAF. This time, she was appointed as Officer Commanding of the Maintenance Operations Flight in Sembawang Air Base. In her new role, she was responsible for two helicopter types, the CH-47 Chinook and the AH-64D Apache. Leveraging on her previous background in structures and design modifications on the Chinook, ME5 Ang quickly adapted to the new AH-64D Apache platform. Said ME5 Ang, “As the Officer Commanding, I need to ensure the safety and serviceability of the aircraft.”

The notable event during her appointment occurred on 30th September 2010, when an AH-64D Apache helicopter conducted an emergency landing on an open field between Woodlands Avenue 12 and Woodlands Drive 64 at about 3:30pm.¹³ ME5 Ang led a team of Air Force Engineers and was the first to arrive on-site to recover the aircraft. Within four and a half hours from the time of the incident, the field was cleared and the aircraft was back in Sembawang Air Base. The incident taught ME5 Ang the importance of teamwork and being ready, given the dynamic nature of Air Force operations. She started sharing with younger servicemen the meaning of being on duty in the Air Force—one must always be ready to act steadfastly and professionally, working as a team to achieve mission success, when called upon in critical situations.

SPREADING OUR WINGS (OPPORTUNITIES OVERSEAS)

ME5 Ang's experiences as the Senior Maintenance Officer in Peace Vanguard Detachment

Because of Singapore's limited airspace, the RSAF has to spread its wings for flying training with its counterparts overseas. Our people get to interact and learn from their counterparts, immersing and enriching themselves in diverse cultures around the world. This not only strengthens the bonds of understanding and cooperation, but also allows us to benefit from the other Air Forces' long histories and experiences.¹⁴

ME5 Ang was posted to the United States (US) from 28th December 2011 to 22nd January 2014, serving as Senior Maintenance Officer in the RSAF's Peace Vanguard Detachment. Leading a team of 80 personnel to support the detachment in all engineering and maintenance issues, ME5 Ang recalled the challenges of being stationed overseas. During Exercise Forging Sabre in December 2013, there was a fleet hold called on the AH-64D Apache because of an incident concerning the blade attachment pin in Singapore. There was a need to conduct radiography inspection on the entire Apache fleet in the US to ensure the other aircraft were not affected, but there were no specialised equipment in the detachment for this particular inspection. The crew had to remove the blades from all the Apache helicopters and send them to a commercial company. In addition, ME5 Ang had to personally convince the contractor of the urgency of the issue and had them complete the inspections within one day. Through the efforts of ME5 Ang and her team, the Apache helicopters were serviceable and flying in the major exercise the very next day.

PEOPLE DEVELOPMENT

The RSAF firmly believes in upgrading its people and helping them realise their aspirations. ME3 Teo, for example, was awarded the SAF Diploma Studies Award in 1995 and obtained a Diploma in Business Studies in Ngee Ann Polytechnic. She was also subsequently awarded the Continuous Learning Academic Study Scheme in 2009 to do a part-time degree in Singapore Institute of Management (SIM) University. Similarly, MAJ Khoo was awarded an overseas scholarship in 2007 and obtained a Bachelor of Arts (History and International Relations) from the University of Southern California. "I thank the RSAF for providing

me the opportunity to further my studies abroad. Completing my Bachelor of Arts in Southern California allowed me to broaden my horizons and enhance my life experiences. I kept abreast with the RSAF by frequently visiting my friends at Peace Carvin II and V (detachments that the RSAF operates in the United States)."

Another good example is BG Gan Siow Huang, the first female Brigadier General in the RSAF. Throughout her career, she was provided with many opportunities, such as drafting policies, commanding 203 Squadron and the Air Surveillance and Control Group. Asked what the highlight of her career was, BG Gan said, "Certainly, my experience as Commanding Officer of 203 Squadron (a military Air Traffic Control Squadron). It was an inspiring experience seeing my personnel so committed to their jobs. There were ups and downs, but everyone got together to make things work and emerge stronger. Those were very uplifting moments for me." As part of the RSAF's efforts in people development, BG Gan was awarded the SAF Postgraduate Award (General Development) in 2009 and completed her Master of Business Administration in Massachusetts Institute of Technology, US, in 2010.

Lifelong Training, Lifelong Career

As the RSAF continues to transform, so does its people and vocations. ME3 Teo is no stranger to the RSAF's transformation. The vocation she joined in 1988 has since undergone three transformations, from Air Operations and Communications Assistant (AOCA), to Air Operations Specialist (AOS), to Air Operations and Systems Specialist (AOSS) and finally to Air Operations and Systems Expert (AOSX). Each transformation was a clarion call by the organisation to the vocation to upgrade itself to manage the new capabilities of the RSAF. The latest iteration, in particular, is to develop deep expertise to harness the full potential of the RSAF's third-generation network capabilities, such as its integrated, multi-layered air defence system.

ME3 Teo was also appointed Squadron Command Chief on 26th July, 2010. As a Command Chief, she is responsible for the regimentation and discipline of the squadron, as well as the engagement of the servicemen under her. It is by no means an easy task, having to balance the carrot and the stick. "The people found me too blunt initially," admitted ME3 Teo who is a straightforward lady who does not mince her words. But she learnt to adapt to her job, and to the younger generation of servicemen. "A bit of sensitivity to the needs of the people goes a long way," says ME3 Teo. "The mission must be achieved, but increasingly the journey is also equally important." The role of a Command Chief has expanded significantly. "The Air Force expects its Command Chief to inspire, communicate and motivate; and not just focus on discipline and regimentation." says ME3 Teo. "It is also about how to align everyone to the organisation's goal. At the end of the day, I derive a huge sense of achievement when I see the servicemen I have groomed win awards. Even if they don't come in first, there is still a sense of achievement." The nature of a military job requires us to uphold the highest standard of discipline in ourselves as well as of our people. "The public expects high standards from our soldiers," shares ME3 Teo. "And, it is

always a challenge to teach new batches of soldiers and help them internalise all the good values that the RSAF seeks to inculcate in our airmen during all phases of training.”

Even as the RSAF trains and develops new people, it also strives to take care of its pioneers. In 2004, when MAJ (RET) Vasanti was reaching her retirement age, she wanted to continue to serve the RSAF, in teaching future generations of RSAF airmen. With her experience, MAJ (RET) Vasanti could still impart much wisdom to new batches of Air Traffic Controllers. She was offered the Defence Executive Officer (DXO) scheme to continue serving in the Air Force Training Command as an Air Traffic Control instructor. She has not looked back since and has served more than 10 years as a DXO instructor. “True enough, over the years, I still have the passion.” said MAJ (RET) Vasanti.

DISPELLING THE MISCONCEPTIONS OF MILITARY LIFE

On Safety

Many of our interviewees highlighted that the primary concern of their families and friends when hearing about their decisions to join the RSAF was about their safety. Over time, they have managed to convince their families and friends that the RSAF’s strong emphasis on safety and its deeply entrenched safety culture ensures that the job does not put one at unnecessary risk. As one of the core values in the RSAF, safety is vital to mission success. The Air Force is also relentless in working towards a zero accident record. The 3rd Generation RSAF today boasts a strong safety track record that matches, if not exceeds, that of other advanced Air Forces in the world.

On Male-Dominance

As a military organisation, the RSAF remains largely constituted of males. One of our interviewees, 1WO Yuen admitted, “The physical aspect of the job can be a challenge for aspiring young women. I worked hard to prove myself to my male counterparts and to earn their respect.” 1WO Yuen has attained a gold Individual Physical Proficiency Test standard every year since she joined the RSAF. ME3 Teo added, “The RSAF is gender-neutral and meritocratic. Hard work and good performance are key to achieving your dreams.”

Being the first female fighter pilot, MAJ Khoo has in many ways pioneered the way for other aspiring female aircrew in the RSAF. However, her journey was not without its challenges. “As the first female fighter pilot in the RSAF, I had to compete in a highly competitive and male-dominated environment. It was not uncommon for it to be competitive in a Fighter Squadron. But more importantly, as I honed my skills and earned respect among my peers, the camaraderie built was strong and prevalent. Overseas training opportunities such as Tucson or Peace Carvin II were coveted, I did not get the opportunity during my time and I am heartened to see other young female aircrew now training overseas.”



On Whether there is a Glass Ceiling for Women

BG Gan, who was promoted to the rank of Brigadier General in 2015 and became the first female BG in the RSAF, said, “The Air Force demands high professional standards and it takes time to train and develop its people to their full potential. There is no fast lane (for females), neither is it any slower for us.” But the Air Force needs greater mass and talent and the number of females will grow over time.

MAINTAIN GOOD WORK-LIFE HARMONY

These career women also fulfil their roles as wives and mothers at the home-front.

Contrary to popular belief, the roles of women in the military need not conflict with their commitment to their families.¹⁵ Having a successful career in the RSAF does not preclude women from being a successful wife and mother.

On balancing her career and family roles, BG Gan, a mother of three, said, “It is a personal choice that one makes and has to accept the outcomes of. I was able to make arrangements at work and had the understanding and support from both my peers and subordinates.” She added that one must first be able to perform her duties well at work and pull one’s weight in order to gain the understanding and support from peers and subordinates. It was important to manage expectations of herself, both at work and at home. Most importantly, the mission gets done not by a single person but as a team.



The RSAF’s first female fighter pilot, MAJ Khoo is married to an ex-RSAF serviceman and has one son. “Having a spouse who intimately understands my hectic work schedule and the operational demands of my job is important. But like any relationship, mutual trust and understanding must be the bedrock of a strong family unit. I thank my husband for being my pillar of support and strength.” When asked about being a mother and work commitments in the RSAF, MAJ Khoo had this to say, “Right now I am overjoyed with my newborn son and having a baby certainly changes my priorities. I am very thankful for the support provided by my Department Heads to facilitate flexible work arrangements during my maternity period. However, I also look forward to returning to work and to be flying again soon.”

RSAF'S AMBITION TO RECRUIT MORE WOMEN

The RSAF looks forward to increasing its population of women to provide diversity and further strengthen its capabilities. "For a start, it (the SAF) wants at least 500 more women by 2018. When that happens, one in 10 career soldiers will be a woman. Beyond that, the military hopes to double its current female population to at least 3,000," said BG Gan, who was then-Head of Joint Manpower Department.¹⁶ The move to recruit more women in the military has been dubbed as 'timely', given Singapore's declining birth rates and ageing population.¹⁷ This recruitment is also likely to extend to the Volunteer Corps, as mentioned by Defence Minister Dr Ng Eng Hen.¹⁸ The RSAF has begun to make progress towards this potential initiative. In 2013, the Air Force inducted our first female volunteer, SSG Amanda Giam, under the Volunteer Service Scheme for Ex-Regulars or NSmen who wish to continue serving after their contract or NS cycle. This marked another milestone in our history.¹⁹

Internationally, the perception of women in the military has evolved. Women in the upper echelons of the military have dispelled the misconceptions of glass ceilings and unequal opportunities for servicewomen. Admiral Michelle Howard, for instance, is the first female in the US Navy to attain the rank of Admiral.²⁰ The RSAF, like many Western militaries, has female incumbents in senior leadership positions. Nevertheless, as BG Gan said, "We are not about to put a woman in a job or promote her for the sake of doing so or to make a statement. It is about who is the best person for the job."

ADVICE FOR ASPIRING SERVICEWOMEN

Finally, we decided to ask our interviewees what advice they have to give to younger generations who are considering joining the RSAF. Said ME5 Ang, "This job is about making a difference to the RSAF, the SAF, and ultimately, to Singapore. The RSAF trains our people well, and imbues in them a sense of pride, passion and professionalism. But it is ultimately up to each and every individual to reaffirm their sense of purpose and to know why they are in the profession for." ME3 Teo added, "The RSAF is a fast-paced organisation and is constantly transforming. You have to embrace the changes and learn new skills to make yourself deployable. Hard work is necessary to achieve your biggest dreams. And, find a mentor early. It really helps. And, when the time comes, give back by being a mentor to someone else."

CONCLUSION

The RSAF has come a long way since its genesis in 1968 and is now a 3rd Generation Air Force capable of a full spectrum of operations, integrated tightly with the Army and Navy, and stands ready to deter aggressors and secure a swift and decisive victory. All these would not have been possible without the sheer determination and hard work of all its people—men and women alike. This article hopes to dispel some of the common misconceptions of life in the military and showcase the contributions of many of the successful women in the RSAF over the years.

ENDNOTES

1. "All out by 1971," *The Straits Times*, p. p1, 17 Jan 1968.
2. "Rising To The Challenge: Building Up An Air Force," *JMD*, vol. 2, no. 9, Sep, 1998.
3. J. Corfield, *Historical Dictionary of Singapore*, Scarecrow Press, 2010.
4. "The First Women Graduates of West Point Say With Pride: It Was Tough But We Survived," *People Magazine*, vol. 13, no. 16, 1980.
5. "A4 Skyhawk Association," [Online]. Available: a4skyhawk.org/2e/singapore/singapore-150.htm.
6. "1968 - Building Up Of An Airforce," *Military History*, vol. 2, no. 9, 2008.
7. Project CARDINAL refers to the RSAF's efforts to develop its people to their full potential. Its three key thrusts of Developing Professionals (DP), Realising Your Potential (RYP) and Engaging the Heart (ETH) intend to imbue the competencies, commitment and core values required to achieve success in the RSAF's missions.
8. "The Transformation of the RSAF: The Organisational Dimension," *RSIS Commentaries*, no. 6/2007, 2007.
9. "The RSAF - Becoming a Full Spectrum, Integrated and Ready Air Force," *POINTER*, vol. 35, no. 1, 2009.
10. "RSAF in Operations Other Than War - The Challenges," *POINTER*, vol. 33, no. 1.
11. Dr. N. E. Hen, Interviewee, *Opening Ceremony Speech of 5th APSEC*. 31 Jan 2010.
12. "Singapore to send third team to Gulf of Aden," *The Straits Times*, 13 Dec 2012.
13. "Apache copter forced to land in HDB field," *Asia One*, 1 Oct 2010.
14. "Overseas Detachment," www.mindef.gov.sg/rsaf/careers/about-the-rsaf/overseas-detachment.html.
15. "Wartime Soldier, Conflicted Mom," *The New York Times*, 26 Sep 2009.
16. "SAF aims to recruit at least 500 more women by 2018," *The Straits Times*, 21 Jul 2013.
17. Ibid.
18. "SAF's timely decision to recruit more women," *The Straits Times*, 29 Jul 2013.
19. "MINDEF - The RSAF's First Female Volunteer," 2 Aug 2013. www.mindef.gov.sg/mindef_websites/atozlistings/air_force/news_events/news/2013/01Aug13.html.
20. "Navy Names First 4-Star Female Admiral," *TIME Magazine*, vol. Dec, 2013.

ORGANISATIONAL CULTURE AND THE RSAF

By MAJ Nicholas Chng, MAJ Alex Chan & ME4 Chia Bing Qiang

INTRODUCTION

The RSAF has come a long way in its development in the past decades. Growing from a small fleet of aircraft, it now utilises some of the most advanced aircraft in the world and a comprehensive, layered and networked air defence system with state-of-the-art technology. While it started out operating only 2 borrowed Cessna aircraft, the RSAF is arguably one of the most potent air forces in the region today.

There are many reasons why the RSAF has been so successful in its build up and one of the reasons identified is the RSAF's strong organisational culture. This essay will argue that a strong organisational culture is pivotal to the sustained success of any organisation and drawing upon evidence from the RSAF's history, we present a case for how the RSAF's culture has been instrumental to its success. Finally, looking ahead, the essay suggests how the RSAF can evolve its culture to ensure its continued success in the future.

THE IMPORTANCE OF CULTURE TO AN ORGANISATION'S SUCCESS

Our culture is the ballast that will determine the performance for future generations of airmen as they face the unknown challenges of the future.

- LG Ng Chee Meng, then-Chief of Air Force¹

Culture is defined as systems of shared norms, values, and practices² capable of evolving over time,³ and linked to social and professional circles.⁴ Mahatma Gandhi once famously said, "A nation's culture lies in the hearts and minds of its people."⁵ Similarly, the culture of an organisation resides in its people. Without people, there can be no culture.

At its essence, the culture of an organisation "is defined as a complex set of values, beliefs, assumptions...that define the way in which a firm conducts its business."⁶ Or, as what Chief of Defence Force, then-Chief of Air Force, LG Ng Chee Meng described, "Culture, in the simplest sense, is about how we do things around here."⁷

The father of organisational culture, Edgar H. Schein, argues that "culture matters because it is a powerful, latent and often unconscious set of forces that determine both our individual and collective behaviour, ways of perceiving, thought patterns and values."⁸ At the individual level, culture influences how each of us goes about our daily work. Aggregate that, you can see how culture would determine how an organisation would respond to a crisis and how it would organise itself to resolve the challenges

it faces.⁹ Schein puts it succinctly as he states that, “Organisational culture...matters because cultural elements determine strategy, goals and modes of operating. The values and thought patterns of leaders and senior managers are partially determined by their own cultural backgrounds and their shared experiences.”¹⁰

However, a strong organisational culture in itself does not guarantee sustained success. Indeed, the very culture that made some organisations great in a remarkably short period of time can become dysfunctional as the operational context evolves. Failure of the culture to adapt can become the root of the organisation’s decline. Hence, if our culture is to be ‘the ballast’, we must understand the role that our culture plays in organisational life and how, moving forward, the RSAF should evolve its culture to ensure that the RSAF would be well placed to maintain its edge over potential adversaries.

CULTURE AS A CORNERSTONE OF RSAF’S SUCCESSES

Culture of High Standards and Professionalism

From its inception, the RSAF has been responsible for the air defence of Singapore. This demands that it be ready to conduct operations at a moment’s notice. Our radar stations constantly monitor the skies while fighter pilots and Ground Based Air Defence (GBAD) crews are poised to respond to any potential threats. One of the major difficulties faced in developing the Singapore Air Force during its inception was the deep specialisation of skills required by each vocation. Each position in the Air Force required personnel who had undergone extensive training to accomplish their assigned roles. The first batch of pilot trainees completed their Basic Military Training in August 1968, but the pilots were only awarded their pilot wings after another year of intense training with the Royal Air Force (RAF) in October 1969.

The long lead time required to recruit and train air force personnel posed significant challenges given the short timeframe that Singapore had to create a credible air defence system. However, the deep-seated expertise obtained during these periods of training imbued a strong sense of professionalism amongst the airmen. In addition, RSAF personnel have trained with the very best in their field from its inception. For example, the first batch of air traffic controllers was trained by the RAF, which allowed them to benchmark their competence against a well-established Air Force. The high level of professionalism instilled at the RSAF’s infancy has carried on through the decades to current times.

Today, we continue to train with some of the best Air Forces around the world. We conduct professional exchanges and benchmark our standards against theirs. The strong culture of professionalism and high standards are what drive the servicemen and women of RSAF to excel in its operations. Each operational service person in the RSAF is respected as a professional who has passed a rigorous selection and training process and who is more than able to hold his or her own against another service person from any other Air Force around the world. A testament to the professionalism of our personnel is the successful operations that they have conducted, year after year.



First operational deployment to help our neighbours - Kuantan flood relief.

The RSAF demonstrated our professionalism from the early years. On 6th January 1971, five Alouette IIIs from 120 Squadron were dispatched to participate in the Kuantan Flood Relief Operations after the Malaysian Government made a request for assistance.¹¹ The RSAF helicopter crews flew search and rescue operations in aid of Malaysian civilians and they rescued three people from raging waters on the morning of 13th January 1971.

Again, on 29th January 1983, the RSAF was activated to save lives, when the mast of a drill ship damaged the cable car lines between the Singapore mainland and Sentosa.¹² This was one of the first rescue missions conducted within Singaporean territory and 120 Squadron successfully rescued 13 passengers from their stranded cable car cabins.

More recently, on 22nd January 2008, the RSAF intercepted an unauthorised aircraft that was heading into Singapore's Airspace.¹³ This was but an example of a continuous string of operations that the RSAF has undertaken since its earliest days. In 2014 alone, the RSAF was deployed in the search for Malaysian Airlines' MH370 and AirAsia's QZ8501 and to provide clean drinking water to flood-stricken areas in Kelantan.

The successes in these operations would not have been possible without the culture of high standards and professionalism that the RSAF has built up. Furthermore, the growing complexity of our systems and operations would mean that the expertise required of each individual will only increase. Consequently, each airman must trust and rely on one another to conduct operations.

Air operations require our airmen to co-operate and collaborate with their counterparts from other vocations, even at the most tactical level. For example, our Pilots depend on the Air Force Engineers to prepare and keep their planes ready. Similarly, the Pilots and the Ground Based Air Defence crew need to work together seamlessly to provide a robust air defence shield to safeguard Singapore's airspace. This is where culture plays a crucial role, as it can serve as an alternate and oftentimes more effective form of communication: where the excellence that needs to be achieved in each task remains unsaid as each professional understands that the entire system depends on his/her sense of responsibility and competency. This, in essence, is the impetus behind 'Forging Our Tribe'. The emphasis on *strengthening team competencies* and *strengthening sense of purpose, identity and belonging* go hand in hand, in building a tribe of high performing RSAF servicemen and women strongly bonded through a shared purpose and culture. The desired end-state is one where every airman and woman strives to be the best in his/her respective vocation, understands what his fellow airmen from the other vocations are doing towards a shared purpose and in so doing, ensures that the RSAF maintains its operational edge.

Culture of Safety

Preparing for and conducting air operations has always been an inherently risky task. Mistakes can rapidly become fatal and one can never afford to be complacent on the job. Though there has always been an understanding of this fact amongst our airmen, a period known as the 'A4/Skyhawk Crisis', with its unprecedented loss of life and machines, drove home the danger involved in aviation to the young RSAF.

Till this day, the RSAF places a strong emphasis on educating airmen about the inherent dangers of air operations. One of the RSAF's slogans is "Mission Success, Safety Always," and this priority is reflected in the safe conduct of operations 24 hours a day, 7 days a week, all over the globe. Safety is one of the core values of the RSAF and an open reporting system, through which safety lessons pertaining to both air and ground operations are shared, is in place. Furthermore, there are also other channels through which any service person, regardless of seniority or vocation, can voice their concerns on operational safety. Indeed, the RSAF's safety system has piqued the interest of other organisations, such as the Singapore Police Force, SMRT and the RAF, which have sought to learn from our practices.¹⁴ Reflecting this, many of our retired officers are highly sought after and have been recruited to manage safety policies of other organisations.

However, a true safety culture goes beyond the safety policies, practices and even organisations that have been put in place. These are manifestations of a set of beliefs and values. The development of a strong safety culture, one where safety is seen as integral to everything we do, has been pivotal to the RSAF's strong safety record. Consequently, this creates a sustainable operational edge for the RSAF through the preservation of materiel, while also signalling our professional standards and capabilities.

The safety culture that the RSAF has today was passed down from one generation of airmen to the next and strengthened with the principles learnt from each mishap or near-miss. We must be proud of our strong safety culture and, more importantly, be mindful that our safety culture was built up over decades, through the conscious efforts of the RSAF leadership and servicemen. We must never forget the lessons learnt along the way.

A CULTURE FOR OUR FUTURE

Culture of Innovation

As the RSAF celebrates its 47th anniversary, it has entered a new era where the environment is changing rapidly. The evolving internal and external environments would mean that the RSAF can ill afford to maintain the status quo. The pace of change is only likely to hasten. A culture that embraces change and advancement is a prerequisite for a nimble and adaptive RSAF that is capable of securing mission success amidst a highly uncertain environment.

Innovation is a key driver for growth and advancement and the RSAF has demonstrated its ability to bring together disparate ideas to form innovative solutions to meet our own unique needs and challenges. Air Power Generation Command¹⁵ and Project CAYLEY¹⁶ are just two of the many examples demonstrating our ability to think-out-of-the-box and



From Republic of Singapore Air Force, One TA-4SU leading Two A-4SU Super Skyhawks taxi on the flight line at Korat AB, Thailand, during Exercise Cope Tiger '02. Cope Tiger is an annual, multinational exercise in the Asia-Pacific region which promotes closer relations and enables air force units in the region to sharpen air combat skills and practice interoperability with US Forces.



As part of Project CAYLEY's effort in deepening engineering expertise, 9 AELG was stood up on 22nd May 2014. The new Group will better allow the RSAF to better meet the escalating demands brought about by an increasingly networked 3rd Generation Air Defence Infrastructure.

break free from traditional mindsets and modus operandi. Such innovation speaks well of the organisation, but it is perhaps time to look into ways to allow this innovative culture to permeate the entire organisation.

Being a military organisation, the RSAF demands a high level of standard from its airmen. This often means a strict compliance and adherence to rules, orders, procedures and policies. With a comprehensive and entrenched set of rules, Standard Operating Procedures in place, it can be daunting to ask questions about the system and if there are other ways of doing old things. There have been examples of ground-up innovation, thus the question is whether such a culture can be more widespread and prevalent.

The focus of this section will be on the tangible steps that can be taken by the RSAF leadership to further encourage innovation.

1. Removing Disincentives. The first and most obvious step is to remove any disincentives that discourage our airmen from voicing their opinions and suggestions. Superiors at all levels should learn how to suspend judgment and be receptive to new ideas. They should be convinced that there exists hidden opportunities and values in all ideas and refrain from putting them down in haste. An emphasis should be placed on eliminating the negative reactions and aversion to new ideas that seem to challenge the status quo.

2. Supporting Innovation. This is the stage where the RSAF can put in place a reward structure to incentivise our airmen to generate ideas aimed at improving work processes. In terms of formal structures, the RSAF has done well with the PRIDE movement, USMS, and UWMS initiatives. One thing that prevents more of these efforts from achieving greater success is the lack of highly skilled facilitators to assist in refining and bringing to life some of the very good ideas that were conceived. Almost all great innovations have their roots in concepts that were initially coarse and unpromising. Only through a series of refinements and iterations can these ideas be developed into innovations that benefit the organisation. The organisation thus has to be prepared to set aside resources to make this process of fine-tuning possible.

Apart from establishing formal structures, much can also be done informally. Our airmen look up to and take reference from their superiors when prioritising their responsibilities. Commanders should therefore make deliberate efforts in encouraging innovation and reward good ideas in their professional capacities. Public commendation of a good initiative, for instance, can be a simple but effective way of demonstrating the organisation's emphasis on innovation.

3. Creating a Conducive Environment. In the book, *Where Good Ideas Come From*, Steven Johnson put forth his case of how collaboration is the key to generating good ideas.¹⁶ Hence, to build an innovative organisation, spaces that foster collaborations have to be built. To this end, the RSAF can take reference from the efforts undertaken by Google, one of the most innovative companies of recent times. The RSAF can take small steps by designing discussion-friendly spaces in selected pockets of the organisation. These specially designed spaces can then be extended to other parts of the organisation if they prove to be effective.

Contrary to popular belief, great ideas rarely come as epiphanies.¹⁸ Instead, they are born when one notices the connection between two seemingly disparate ideas—or between many different ideas—and this can only be achieved if one is either consciously or subconsciously looking out for it. The quote “chance favours the prepared mind” by Louis Pasteur illustrates this concept concisely.¹⁹ Hence, we must make innovation part of our identity. Just like safety, it would take time to cultivate this aspect of the RSAF culture and, similarly, it needs to start with Commanders understanding the strategic significance of innovation and making it part of their command responsibility to promote innovation at every level.

Culture of People-Centricity

The RSAF today boasts of advanced technology, exceptional safety records, robust work protocols and processes and rigorously thought-out Concepts of Operations. However, we are only as potent and as effective a fighting force as the quality of the people we have. The RSAF today is a well-regarded Air Force, but we can only continue to be one if we

continue to have capable people in the organisation. Today's best practices might, in a blink of an eye, become obsolete tomorrow. It is the people, with their ability to conceive new ideas, who would be the drivers of change and who will ensure that the organisation continues to enjoy sustained success.

Looking ahead, the RSAF will continue to face challenges in the areas of recruitment and retention of committed and talented individuals. Singapore's declining birth-rate, coupled with an ever-increasing competition for the limited pool of labour, will place significant constraints on the quantity and quality of personnel that we can attract. To prepare ourselves for the future, the RSAF needs to take incremental steps to progressively reduce its manpower requirement without losing its competitive edge against our potential adversaries.

Apart from streamlining work processes to enhance efficiency and acquiring more advanced weapon systems that require less manpower to operate, we have to pay more attention to our people, with the aim of building a workforce that is "competent, committed and imbued with the SAF Core Values."²⁰ Indeed, that is the impetus behind Project CARDINAL, which encompasses the different elements of Developing Professionals, Realising Your Potential and Engaging the Heart. The RSAF understands that in order for us to fully optimise the technology and concepts that we have, we need a rigorous and holistic way of developing our people.

In the words of Chief of Defence Force, then-Chief of Air Force, LG Ng Chee Meng, "Forging a people-centric culture is perhaps the most challenging part of our transformation journey... Imagine an organisation with consistent high standards, deep pride, and a strong sense of purpose and values. Imagine an environment that is fun and where our people feel happy coming to work each day...where each generation takes it upon itself to groom the next. That would be the sort of Air Force that we would have no hesitation in encouraging our children to join."²¹ The RSAF needs a culture of people-centricity if it is to continue to be successful in the future. However, as the essay has expounded upon, culture is not created overnight. A culture of people-centricity can only evolve when the organisation recognises its imperative. Project CARDINAL is a clear step towards that goal. Though the reception to this movement has been generally positive, it is still early days yet and only the continued emphasis by the RSAF Leadership and Commanders will ensure that the RSAF will be successful in building the "Air Force that we would have no hesitation in encouraging our children to join."

CONCLUSION

In this essay, we have shown that a strong organisational culture is pivotal to the sustained success of any organisation. We have also discussed the origins of the RSAF's culture of high standards, professionalism and safety and have examined how they have been instrumental to our success. Finally, we have contemplated how the RSAF could evolve its organisational culture to ensure that it remains successful in the future.

We hope that the essay has provided readers with ideas and insights on how to enhance the cultures of their respective organisations. This is our Air Force—let us work together to make it a better place.

In the years ahead, as you go about your daily duties in defending our nation's skies, I trust that you will continue to draw strength and inspiration from the men and women in our Air Force Tribe, both past and present, to bring our Air Force to greater heights.²¹

- MG Hoo Cher Mou, Chief of Air Force

ENDNOTES

1. LG Ng Chee Meng, "Our Culture: The Cornerstone of Our Enduring Success", in The RSAF Journey – Voices from the Past, Present and Future, (POINTER Supplementary Issue, 2013).
2. Schein, Edgar H., "Organizational Culture and Leadership", (San Francisco, CA: Jossey-Bass, 1985): 429.
3. Hatch, Mary J., "The Dynamics of Organizational Culture", *Academy of Management Review* (Vol. 18, No. 4, 1993): 657 – 693.
4. Sackmann, Sonja; Phillips, Margaret E.; Kleinberg, Jill; & Boyacigiller, Nakiye, "Single and Multiple Cultures in International Cross-Cultural Research: Overview", in *Culture Complexity in Organizations*, S. Sackmann (ed.), (Thousand Oaks, CA: Sage): 14-48.
5. Mahatma Gandhi, "Mahatma Gandhi's Quote", 2015, http://www.brainyquote.com/quotes/authors/m/mahatma_gandhi_2.html.
6. Jay B. Barney, "Organizational Culture: Can it be a Source of Sustained Competitive Advantage?", *The Academy of Management Review* (Vol. 11, No. 3, 1986): 657.
7. LG Ng Chee Meng, "Our Culture: The Cornerstone of Our Enduring Success", in The RSAF Journey – Voices from the Past, Present and Future, (POINTER Supplementary Issue, 2013).
8. Edgar H. Schein, "Corporate Culture Survival Guide", (San Francisco: Jossey-Bass, 2009).
9. Trice, H., & Beyer, J. M., "The Culture of Work Organization", (New Jersey: Prentice Hall, 1993).
10. Edgar H. Schein, "Corporate Culture Survival Guide", (San Francisco: Jossey-Bass, 2009).
11. "20 years of helicopter operations: 1969-1989", (Singapore: RSAF Sembawang Airbase, 1989).
12. Tay Lay Yuen, "Cable Car Tragedy in Sentosa" in Singapore Infopedia, http://eresources.nlb.gov.sg/infopedia/articles/SIP_761_2004-12-31.html.
13. MINDEF statement on civilian aircraft intercepted by the RSAF, MINDEF, 23 January 2008, http://www.mindef.gov.sg/imindef/news_and_events/nr/2008/jan/23jan08_nr.html.
14. LG Ng Chee Meng, "Our Culture: The Cornerstone of Our Enduring Success", in The RSAF Journey – Voices from the Past, Present and Future, (POINTER Supplementary Issue, 2013).
15. Air Power Generation Command is one of a kind. The RSAF is the only Air Force that has a Command that focuses on generating Air Power for operations. This innovative organisational structure is conceived to meet the RSAF's unique operating environment whereby our air bases

are situated very close to our borders because of our small land area. The other Air Forces in the world have the luxury of space to site their air bases far away from territorial borders, thus lessening the threat of the air bases coming under fire during hostilities.

16. In anticipation of the continued tightening of technical manpower supply, and the increased demands arising from the induction of new capabilities in the areas of Air Intelligence, Surveillance and Reconnaissance (AISR), Electronic Warfare (EW), and Air Power Generation (APG), Project CAYLEY was initiated to transform the Air Engineering & Logistics Organisation (AELO), in an effort to rebalance its engineering resources within existing manpower constraints. For instance, maintenance crews were integrated across 1st and 2nd lines to increase workforce flexibility.
17. Steven Johnson, *Where Good Ideas Come From: The Natural History of Innovation*, (New York: Riverhead Books, 2010).
18. Scott Berkum, *The Myths of Innovation*, (Canada: O'Reilly Media, 2010).
19. Bill Welter and Jean Egmon, *"The Prepared Mind of a Leader: Eight Skills Leaders Use to Innovate, Make Decisions, and Solve Problems"*, (New York: Jossey-Bass, 2005).
20. LG Ng Chee Meng, "Our Culture: The Cornerstone of Our Enduring Success", in *The RSAF Journey – Voices from the Past, Present and Future*, (POINTER Supplementary Issue, 2013)
21. Ibid.
22. Speech Delivered by Chief of Air Force, MG Hoo Cher Mour, during the 46th Anniversary Celebrations held on 1st Sep 2014.

CIVIL MILITARY RELATIONS IN AVIATION

By LTC Chen Boon Chong, LTC Brandon Sim, MAJ Sebastian Chai & CPT Ren Jinfeng

INTRODUCTION

Singapore has made significant progress in both civil and military aviation. Today, aviation in Singapore is in a position of strength. On the military aviation front, the RSAF has undergone formidable transformation over the past few decades, to become one of the most advanced and respected air forces in the region. On the civil aviation front, Singapore is now a thriving aviation hub—home to the world’s seventh busiest airport and burgeoning aerospace engineering industry. Civil aviation is now integral to Singapore’s economy, contributing more than 3% to our GDP.¹ The global air connectivity has also enhanced Singapore’s position as a global city, tourism hub and international business centre. The successes in both the military and civil aviation have not been an easy feat; they have been built upon decades of hard work and ingenuity of our aviation pioneers, that have allowed a strong, synergistic civil-military relation to thrive in the Singapore aviation.

SINGAPORE AVIATION - POWERING TO SUCCESS

Over the past four decades, the world witnessed the birth and transformative growth of Singapore aviation—a feat that is no less miraculous than the Singapore Story itself. Indeed, the growth of aviation has always been an integral part of Singapore’s growth as a nation, with the RSAF securing the sky over Singapore, while the civil aviation connects Singapore with the rest of the world and powers Singapore’s growth.

The RSAF: Transformation into 3rd Generation Air Force

The RSAF started with a humble beginning as Singapore Air Defence Command (SADC) in 1968, inheriting British legacy air defence systems and infrastructure. The SADC subsequently expanded its basic air defence capabilities rapidly, seeding the formation of the RSAF in 1975. In the 1970s and 1980s, the RSAF expanded its fleet significantly to attain air superiority capabilities. In the late 1980s and 1990s, the RSAF embarked on its efforts to build a first-class organisation, focusing on enhancing the quality and professionalism of its people. At the same time, the RSAF continued to build a robust safety system and culture, to enhance mission success.

Since the early 2000s, the RSAF has successfully transformed into a 3rd Generation Air Force that is integrated and ready to deal with a full spectrum of operations. It stands ready to defend Singapore and its skies, 24/7 and all year round. It has operationalised a suite of sophisticated and advanced platforms, including the F15SG fighter aircraft, G550 Airborne Early Warning aircraft, AH-64 Apache helicopters and the Heron 1 Unmanned

Aerial Vehicles (UAVs). Indeed, the RSAF has one of the ‘best trained, led and equipped’ air forces in the region.²

Singapore Civil Aviation - Building World-Class Aviation Hub

Similarly, the civil aviation in Singapore has witnessed a miraculous, rapid build-up from scratch to become a civil aviation hub in the region today. It had a much earlier beginning than military aviation. 1911 witnessed the birth of civil aviation in Singapore, when a British demonstration flight took place at the Singapore Race Course. In 1930, Seletar Airport was opened to commercial flights. Local air service, known as Weane’s Air Service (WAS), started operating a twin-engine biplane with an eight-passenger capacity to link Singapore to towns in the Malay Peninsula.³

However, it was not until a few decades later that Singapore began to witness significant growth in civil aviation traffic. As the commercial flight industry grew exponentially over the years, Kallang Airport and Paya Lebar Airport were built, in 1937 and in 1951, respectively, to accommodate the growing air traffic. After the separation from Malaysia Federation, Singapore built its own flag carrier, the Singapore Airlines (SIA), which aimed to become an international carrier. In subsequent years, the SIA aggressively built up its carrier capacity and became the first country in South East Asia to operate the Jumbo Jet. By 1975, annual passenger movements grew to 4 million. The existing Paya Lebar Airport was expanded, while the decision to build a new airport known as Changi Airport, was made. Today, SIA has flourished and continues to chart new grounds in innovation and service excellence. Changi Airport has become a world-class airport, known for its operational efficiency, service excellence and enhanced infrastructure, that supports 70 million passengers and 3 million tonnes of cargos annually.⁴

At the same time, the aviation industry had grown in vibrancy and diversity—able to house more than 100 international aviation Maintenance, Repair and Overhaul (MRO) companies, including SIA Engineering Company and ST Aerospace, two of the world’s largest MRO companies. Being one of the leading aviation hubs in the region today, Singapore captures a quarter of the Asian MRO market, providing comprehensive nose-to-tail engineering and maintenance services.⁵ Today, Singapore is further seeing a rapid growth in the aerospace industry, particularly with the setting up of the Seletar Aerospace Park.⁶ The Seletar Aerospace Park, a military airbase in the past, now houses more than 30 aerospace companies, such as ST Aerospace, Jet Aviation and Fokker Services Asia. This leading-edge aerospace facility is designed to meet the region’s burgeoning aerospace demands. Aircraft manufacturers have projected that a third of the worldwide aircraft delivery will go to the Asia Pacific region over the next two decades.

Recent years have also witnessed the diversification of local aerospace industry from MRO to aerospace design and manufacturing. Increasingly, leading companies have started to set up their engine manufacturing facilities in Singapore, leveraging on Singapore’s strength in precision engineering and electronics. For instance, Rolls Royce launched

their Seletar Campus in 2012, which is not only a facility for engine assembly and Research and Development (R&D), but also a manufacturing facility for their titanium engine fan blade. Similarly, Pratt & Whitney stood up their first turbo hybrid fan blade and turbine disk manufacturing arm outside of their US headquarters in Seletar.

The transformational journey to success of both the military and civil aviation was no less than a feat, considering the limited resources available in Singapore. To fully appreciate the extent of the enormous tasks and challenges involved, one has to understand the typical constraints in modern day military-civil aviation relationships.

EXAMINING CIVIL-MILITARY RELATIONS IN AVIATION

Military and civil aviation, whilst operating in the same Air Traffic Management (ATM) environment, are fundamentally different from one another—both in their nature and functions. While military aviation is essential for national security and defence and is therefore a legitimate and indispensable activity, civil air transport is not only necessary for global interaction between nations but it also makes a significant contribution to the global economy.⁷

The global airline industry consists of over 2,000 airlines operating more than 23,000 aircraft, providing service to over 3,700 airports. The growth of world air travel has averaged approximately 5% per year over the past 30 years and is expected to continue at this pace for the foreseeable future.⁸ Similarly, military aviation has also continued to grow not only through the sheer increase in the overall number and types of aircraft, but also evolved in its responsibilities to incorporate Humanitarian Aid and Disaster Relief (HADR) as well as a multitude of non-conventional missions under the ambit of Operations Other Than War (OOTW).

The continued development of both users of this common resource called Airspace has invariably led to changes in the relationship between military aviators and civil aviation authorities. In the past, civil-military relations revolved mostly around the military operating within its vast and exclusive training airspace and commercial air traffic being vectored around by a joint team of civilian and military controllers who take orders from their respective bosses. Most Air Forces were also independent entities and self-sufficient in almost all of their daily operations including logistical and engineering support. In recent years, economic and demographic evolution has brought about growth in leisure air travel, increase in professional mobility as well as explosion in the air freight sector. The symbiotic relationship is coming under strain whereby competition for resources has taken priority in the push for economic progression. This tension is particularly pronounced for a small country like Singapore. These key resources include airspace, land for airfield infrastructure and skilled manpower.

Civil-Military Airspace Management

Airspace management has come to the forefront of several countries' civil aviation authorities as they try to contain the burgeoning number of commercial traffic and its impact on their bottom line. Countries like China, Jordan, UAE including the European

Union and the US have sought for a relook into the management of the military airspace to allow for greater flexibility in airspace use in order not to stifle the pace of growth of their respective aviation industries. The concept of a European-style centralised air traffic control system has also gradually gained popularity in order to avoid constraining growth in the aviation sector.⁹

Aviation Airfield Infrastructure

The structure of most military air bases allows it to be self-sufficient in its operations and when necessary, provide critical support for the local community in times of emergency and disaster relief. With the pace of commercial aviation growth out-stripping the aviation infrastructure development, military airfields have become increasingly attractive as an economical alternative to the building of more airports which, amongst other issues, might have significant environmental impact on the local population. In Australia for example, in remote localities, the Royal Australian Air Force (RAAF) has traditionally opened its airfields to airlines, charter operators and general aviation. These airfields are a critical part of the transport infrastructure of regional and remote Australia, often providing the only means of reliable year round transport to other centres and cities.¹⁰ The RAAF has and will continue to study the impact on its military operations with regard to their 'joint user airfields' against the backdrop of increased civil air traffic levels and rising costs at commercial airfields. Another country that has embarked on maximising existing aviation infrastructure is Japan. The proposal of civil-military dual usage of Yokota Air Base is an effort to combat capacity constraints, uneven distribution of airports to the eastern part of the Tokyo Metropolitan area, and insufficient measures for various air travel needs.¹¹ In Singapore, we are also working towards the co-usage of Changi Runway 3 for civil and military aviation.¹²

Human Resource and Skilled Labour

Labour forces and skills matter very much to the high-technology and high-skilled business of the aerospace industry. Therefore, it is essential to the competitiveness of the aerospace industry that it can pull from a wide reservoir of skilled and qualified labour supply. In the current context, worries about skill shortages are widespread across the aerospace industries. In some parts of the world, the number of engineering graduates per year is not enough to fill the growing demands of the aerospace industry.¹³ Overlay this situation with military aviation and you can be sure that the push to recruit skilled labour into the civil aviation sector will invariably lead to a manpower retention challenge in the military aviation sector. This challenge is likely to be more acute for countries that face declining birth rates and ageing population.

CIVIL-MILITARY RELATIONS IN SINGAPORE

Singapore, being a small nation-state, invariably faces these key challenges in resource constraints as both its civil and military aviation power to success. Nonetheless, the ingenuity and meticulous long-term planning have allowed a synergistic civil-military relation to thrive in Singapore, creating a unique environment that enables both sectors to share and optimise the limited resources.

Airports and Air Bases

Due to the scarcity of land in Singapore, it has always been a challenge to serve the interests of both the commercial and military aviation sectors. Unlike countries with an abundance of land, and consequently airspace, such as the United States (US) and the United Kingdom (UK) where commercial airports and military air bases are distinctly separated, Singapore does not have the luxury to do so. Resources have to be shared between these two sectors. Since the 1930s, these two sectors have overcome the constraints of resources and developed a synergistic relationship that allows the advancement of both sectors.

In the 1930s, Singapore, then under the British rule, operated from four flying Royal Air Force (RAF) stations, namely, RAF Kallang, RAF Seletar, RAF Sembawang and RAF Tengah. RAF Seletar (also known as Seletar Airport) was Singapore's first international airport. It served as stopovers for the Dutch Airline Koninklijke Luchtvaart Maatschappij (KLM) flight between Amsterdam and Jakarta and the British flagship airline Imperial Airways flight between London and Darwin. The booming commercial aviation industry created the demand for a larger airport. In 1937, the RAF Kallang (also known as Kallang Airport) replaced RAF Seletar as Singapore's international airport for land planes and seaplanes.

During World War II (WWII), all four RAF stations were used by the RAF for military aviation operations. RAF Kallang became the principal fighter airfield and housed the British Brewster Buffalo fighters and Hawker Hurricanes, while RAF Seletar housed the British PBY Catalina seaplanes and Vickers Vildebeest torpedo bombers. Despite efforts to protect Singapore, all four RAF stations ultimately fell into the hands of the Japanese.

During the Japanese Occupation, the Imperial Japanese forces built two unpaved landing strips, which intersected in an approximately North-South and East-West orientation, to support their military aviation operations. After the surrender of the Japanese, the RAF took over the facility, improved it and renamed it as RAF Changi.

After WWII, the commercial aviation industry started to develop exponentially. The increasing number and size of commercial aircraft resulted in the need for longer runways and more advanced aviation support equipment and technologies. RAF Kallang was operating at its maximum potential. In 1955, Paya Lebar Airport was opened and RAF Kallang was closed down.

When the British withdrew their forces in 1971, the RAF stations were handed over to the SADC. Singapore needed to expand its air defence capabilities rapidly. The SADC acquired the Cessna 172G Hawker Hunter, Singapore's first air defence fighter, Aerospatiale Alouette III, BAC Strikemaster and Shorts Skyvan. To increase strategic depth, these flying assets were spread out among the air bases. Paya Lebar Airport, which was originally a pure commercial airport, was converted for military use. In 1981, Singapore's

International Airport moved to Changi Airport and Paya Lebar Airport was renamed as Paya Lebar Air Base (PLAB).

On 29th November, 2004, Changi Air Base (East) was officially opened by then-Minister for Defence, Rear-Admiral (NS) Teo Chee Hean. The opening of Changi Air Base (East) marked a significant milestone in the development of the RSAF. Then-Minister for Defence, Rear-Admiral (NS) Teo Chee Hean, mentioned in his inauguration of Changi Air Base (East) Speech:

*"Changi Air Base (East) enhances the RSAF's operational capability and readiness, for it provides greater operational flexibility and more deployment options for the RSAF's fighter assets Changi Air Base (East) enhances the RSAF's ability to launch and recover its air assets under adverse conditions, as well as to mitigate our airspace constraints."*¹⁴

Then-Minister for Defence, Rear-Admiral (NS) Teo Chee Hean

Meanwhile, from the early days when Changi International Airport first received a commercial plane on 12th May, 1981,¹⁵ it has now grown into a renowned aviation hub with over 6,500 flights weekly, flown by 100 airlines to over 300 cities.¹⁶ This number is likely to keep growing with International Civil Aviation Organisation (ICAO) already forecasting world civil aviation to average growth of around 6% up to 2016.¹⁷ This is a strong testament to the efforts undertaken by both the civil and military authorities in the management of airspace, as operations of both Changi Air Base (East) and Changi International Airport continued unhindered. This provides a strong foundation to manage the future expansion of both Changi Air Base (East)¹⁸ and Changi International Airport,¹⁹ which is likely to translate to greater demands for airspace usage.



Then-Minister for Defence, RADM (NS) Teo Chee Hean viewing the RSAF's F16D Blk 52+ aircraft, operated by the 145 Squadron, housed at Changi Air Base (East).

Airspace

Airspace is the medium in which aviation activities (and non-aviation activities such as fireworks) shares. While intuitively easy to understand in basic concept, airspace is wrought with numerous rules, regulations, regimes and safety considerations which make

it a highly complex subject. It is in this context that we examine the differences between the usage of airspace by civil and military aviation.

In the early years of aviation (before WWI), “people with foresight had realised that the advent of the airplane added a new dimension to transport which could no longer be contained within strictly national confines.”²⁰ Though the two World Wars had demonstrated the deadly use of military aviation, its utilisation also significantly advanced the technical and operational possibilities of air transport in a world which had finally found peace again. Large numbers of people and goods were transported over long distances for the first time and ground facilities were correspondingly developed. The post-war civil aviation problems were studied by the US and the conclusion was that it had to be tackled on an international scale, else it would not be possible to use it as one of the principal elements in the economic development of the world. It was in this context that the ICAO eventually emerged and formalised the aviation rules in the manner of Convention of International Civil Aviation.

The most significant point to note for the civilian way of demarcating airspace is that it is territorial-boundaries-blind. The amount of airspace delegated by ICAO to a State for the purpose of Air Traffic Control (ATC) is not synonymous with boundaries or size of countries. Rather it is a combination of safety, track record, compliance to rules, equipment and infrastructure which determines the allocated area as a Flight Information Region (FIR). A FIR is a designated airspace where Air Traffic Services (ATS) are provided by a designated agency. In summary, a single FIR can straddle between two or more countries territorial airspace, as well as international airspace, while under the purview of a single ATC agency. This is an efficient mean of managing airspace for civilian air traffic to optimise the provision of ATS, as well as to enhance safety and reliability by giving the responsibilities to the best qualified agency.

Airspace is thus broadly classified as Controlled and Uncontrolled Airspace. Within Controlled Airspace, it generally indicates that ATC rules and procedures are applicable to all aircraft contained therein. This is further distilled into multiple types of ATS airspace like Airways (akin to sky highways for aircraft), Terminal Area, Control Zone (CTR), and Aerodrome Traffic Zone (ATZ). Other special uses of airspace also consist of Danger, Restricted and Prohibited airspace which the general aviator has to avoid or keep clear at all times. To further define the obligations and rules that are binding to the users and ATC service providers for the aforementioned airspaces, airspace can also be divided into different classes.

This results in an extremely complex and intimidating web of rules, regulations and imaginary boundaries interlaced on the unseen entity that we call airspace. The purpose is to put some semblance of order and control into an otherwise dynamic and chaotic air traffic environment. Uncontrolled airspace is less regulated and activities within are more associated on a seen-and-be-seen nature. However, the fact that it is classified as Uncontrolled airspace means that airspace is still been carved up in some ways. On top

of which, uncontrolled airspace can encompass territorial airspace, which means that while ATC rules are minimal, state laws are still applicable. Therefore, territorial airspace brings with it a set of rules that is associated with *Sovereignty and Legislations* and what a State can choose to do within this space and what its aircraft have to do out of it. Further segregation of civilian and military airspace is thus seen from the angle of *Control and Non-interference*. To differentiate clearly between civilian and military airspace is to allocate clearly segmented areas, so that both civilian (like recreational flying, cargo, commercial transport) and military activities (like military manoeuvres, air to air firing, parajump activities, sensitive areas) will not interfere with each other. But this does not preclude military aircraft from entering civilian airspace, unless it overlaps with foreign territorial airspace, then special permission is required from the foreign state.

Understanding Military/Security Airspace

The airspace classified for military usage can potentially be dangerous for civil aviation and can have a security-laden nature. Military activities range from live firings (from air-to-air, air-to-ground and surface-to-air) to other activities that are considered dangerous for civil aviation. Fighter jets training which can utilise several thousands of feet of vertical airspace within a short lateral distance is definitely incompatible in operating within the same space associated with a passenger jet that is flying straight and level for passengers comfort and technical requirements. Hence, the need to have exclusive use of military training airspace arises. From the security enforcement point of view, there are also special airspaces that can be designated for the purpose of traditional national security and these airspaces can overlap with civilian airspace. For example, such control of airspace can be through the designation and enforcement of an Air Defence Identification Zone (ADIZ).²¹ The ADIZ necessitates the identification of one's identity and purpose while flying through the designated airspace. While simple in concept, it can be difficult to implement and enforce. Declaring an ADIZ requires the co-operation of all aircraft flying through for it to work, without which, the country needs to have the means to enforce the ADIZ on errant or non-compliant aircraft. Moreover, the legitimacy of the ADIZ will be called into question if it is not confined solely within territorial boundaries or over disputed territories. To declare an ADIZ over another country's territorial airspace can also be interpreted as a hostile act, not to mention the means in which to enforce it using State assets. Even if it is declared over international airspace, its legitimacy can be challenged by an adjacent country who may similarly declare an overlapping ADIZ of their own. The US declared ADIZ and TFR (Temporary Flight Restrictions) over its territory after the 11th September episode for reasons of national security. They amended one of the ADIZ (Washington ADIZ) subsequently to SFRA (Special Flight Rules Area), which still reflected more onerous rules and responsibility on the pilots and the threat of criminal prosecution if breached.²² While this was not met with protest by foreign countries since it was over US Airspace, it did elicit unhappiness and lobbying against it by the general aviation community within the US. Recently in November 2013, China established the East China Sea ADIZ which met with protests and regrets from neighbouring countries.²³

The significance of which was that it covers disputed areas and overlaps with an existing ADIZ declared by Japan.²⁴ The onus is thus on civil aviation to ensure due care when navigating through such airspaces and hope that the situation does not arise when different militaries give conflicting instructions.

For the case of Singapore, given the geographical constraints, efforts must continuously be made by both the civil and military authorities to ensure that both civil aviation and military activities are managed safely and effectively for their respective purposes.

Manpower

Another resource constraint faced by Singapore is human resource. As of June 2013, Singapore's total population was 5.4 million, of which 3.31 million or 61.3% was the citizen population.²⁵ The Total Fertility Rate (TFR) was 1.29, significantly below the 2.1 required for population replacement. With increasing life expectancy and declining fertility rates, the population will continue to age and the citizen old-age support ratio will decrease.²⁶

The SAF is one of the largest organisations in Singapore. It has a strength of 300,000 personnel, made up of Regulars, NSFs and NSmen, of which NSmen form the backbone of Singapore's military defence system. Unlike other organisations, the SAF cannot rely on the foreign worker population to augment its workforce. With a declining population, it will only get increasingly challenging to compete with the other industries for manpower.

Against the backdrop of decreasing manpower pool, the SAF has introduced several innovative measures to ensure that the SAF's mission and operational capabilities are not compromised and at the same time, the civil sectors' manpower requirements are not ignored.

In both the civil and military sectors, pilots are a precious commodity. It takes a significant amount of time and money to train a pilot. To apply to become a pilot, one would have to undergo multiple rigorous medical examinations and aptitude tests.²⁷ After which, the trainee would have to undergo a few years of training before graduating as a pilot. The RSAF, which prides itself as a 'First Class Air Force, World Class People', and Singapore Airlines, which is one of the world's leading airlines, both require top-notch pilots. The RSAF and SIA have an existing arrangement to optimise the scarce national pilot resource. This arrangement allows the RSAF to meet its operational requirements and provide SIA with trained pilot resources through second career opportunities for RSAF at certain stages of their careers. After serving the country for a number of years, military pilots are allowed to cross over to the civil sector through various transition schemes as such the RSAF-SIA Pilot Schemes (Junior and Senior) and RSAF-Silkair Pilot Scheme. These schemes allow pilots to have a meaningful career in the RSAF, whilst ensuring that their transition to a second career in the civil aviation sector is taken care of. On the whole, this arrangement allows both the military and civil sectors' needs to be satisfied.

The success of the RSAF-SIA Pilot Schemes and the RSAF-Silkair Pilot Scheme has translated to the Air Traffic Control community. In Jan 2009, the Civil Aviation Authority of Singapore (CAAS) signed a Memorandum of Understanding (MoU) with the RSAF to formalise a career transition scheme for retiring RSAF Air Traffic Controllers.²⁸ Similar to the above mentioned schemes, this partnership allows the civil sector to tap on the highly experienced pool of military Air Traffic Controllers who are intimately familiar with Singapore's airspace, to augment its own recruitment and training efforts.

More recently, in April 2010, the SAF introduced the Military Domain Expert Scheme (MDES) to complement the existing Officer and Warrant Officer Corps. The purpose of the MDES is to attract, develop and retain talented military personnel with deep specialisation in specific military domains. Instead of the traditional retirement age of 50 for the SAF Officer Corps, Military Experts (MEs) have a full career up to 60 years old. The MDES also facilitates mid-career professionals with the relevant expertise to join the SAF. Coupled with the longer career, the MDES allows military personnel to develop deeper core expertise, harness the potential of highly sophisticated aircraft and weapon systems and meet the rising aspirations of a more educated youth.

FUTURE CHALLENGES

Charting New Paths for Unmanned Aviation

The world is witnessing significant growth in the advancement and commercialisation of unmanned technologies. While the current status remains that UAVs are largely operated by the military and segregated from the civil airspace, increasingly, commercial players are employing UAVs for various purposes. In countries such as the US, UAVs are deployed by the homeland security forces for surveillance operations and border patrols.²⁹ The environmental agencies have also commenced employing UAVs to survey forests and wildlife. Other uses of UAVs include firefighting, disaster relief, and search and rescue.³⁰ With the proliferation of UAVs for civilian uses, there has been increasing calls to integrate the UAVs into the civilian airspace. Significant progress has been made in this respect in countries such as the US, UK and Israel. Already, in the United States, UAVs are allowed to operate in certain civilian airspace, albeit under 'carefully monitored exemptions' to the Federal Aviation Administration (FAA) rules. Routine UAV flights over densely populated areas are still prohibited.³¹ Significantly, the FAA plans to integrate UAVs into the civilian airspace by 2015,³² and has chartered a 'UAS Aviation Rulemaking Committee' in 2011 to develop policy recommendations to integrate routine UAV flights into the national airspace, as well as the Unmanned Aircraft System Integration office in 2012 as a one-stop agency for civil and public use of UAVs in the national airspace.³³

The predominant concern is the safety and reliability of UAVs flying in the civilian airspace, including the inability of the UAVs to perform 'sense-and-avoid' functions of a manned aircraft. Already, such collision warning and avoidance systems for UAVs are emerging in the market, even though there remain challenges in system integration and miniaturisation of these components into smaller UAVs.³⁴ Another ambitious

international project is under way to develop the Mid-Air Collision Avoidance System, in order to facilitate UAV integration into the civilian airspace. This project is fronted by five European countries and a consortium of 13 European companies.³⁵ There are also, however, significant legal challenges in integrating UAVs into the civil airspace, in ways that are consistent with the privacy and civil liberty considerations.³⁶ More significantly, in the context of Singapore, there will be national security implications, including maintaining air domain and air defence awareness in an increasingly congested and complex airspace.³⁷ This is particularly pertinent in today's context whereby the transnational terrorist threats are still real.

Taken together, these challenges imply that the civil aviation agencies and the RSAF will need to work closely together in the near future, to integrate the UAV into the local airspace. These include: (a) reviewing the regulatory policies in order to ensure that the UAVs meet the applicable airworthiness certification and performance baseline, and (b) reviewing existing air traffic control policies and procedures to ensure interoperability between the manned and unmanned aircraft.

CONCLUSION

The RSAF and the civil aviation industries have played a crucial role in Singapore's growth as a nation, through building a harmonious and symbiotic relationship over the past few decades.

However, many challenges lie ahead for Singapore. The declining pool of manpower will affect all industries in Singapore. The sustained growth of civil aviation and the planned expansion of both Changi International Airport and Changi Air Base (East), as well as the proliferation of UAVs will require continued judicious management of airspace. To maintain its position as a leading premier civil aviation hub and a 'First Class Air Force', both civil and military aviation sectors must work in synergy to develop innovative ways to overcome these challenges and limitations.

ENDNOTES

1. SM Goh Chok Tong, "Speech by Senior Minister Goh Chok Tong at the Singapore Aviation Centennial Evening Dinner, 16 March 2011 at Compass Ballroom East, Resorts World Sentosa", 2011, http://www.pmo.gov.sg/content/pmosite/mediacentre/speechesninterviews/seniorminister/2011/March/Speech_by_Senior_Minister_Goh_Chok_Tong_at_the_Singapore_Aviation_Centennial_Evening_Dinner.m.html
2. Greg Waldron, "IN FOCUS: Singapore steps up deterrent capabilities", 2012, <http://www.flightglobal.com/news/articles/in-focus-singapore-steps-up-deterrent-capabilities-367582/>
3. Civil Aviation Authority of Singapore, "Our History," http://www.caas.gov.sg/caas/en/About_CAAS/Our_History/?__locale=en
4. Ibid., "Singapore: Inspired by Our Past, Building for the Future," http://appserver1.caas.gov.sg/ebook/Annual_Report/Publications/Singapore_State_Profile/index.html
5. Economic Development Board, "Aerospace Engineering Singapore," <http://www.Edb.gov.sg/content/edb/en/industries/industries/aerospace-engineering.html>
6. Ibid., "Seletar Aerospace Park," <http://www.edb.gov.sg/content/edb/en/why-singapore/ready-to-invest/setting-up/businesslocation/seletar-aerospace-park.html>
7. Dr Ruwantissa Abeyratne, "Managing Airspace in Civil and Military Aviation." *Journal of Aviation Management* (2010): 11-20. http://www.saa.com.sg/saaWeb2011/export/sites/saa/en/About_Us/downloads/Managing_Airspace_Civil_Military_Aviation.pdf
8. Nick Huang, "Global Airline Industry Overview", *Business Vibes*, 2012, <http://www.businessvibes.com/blog/global-airline-industry-overview>
9. Courtney Trentwith, "Let commercial jets use military airspace to ease Gulf gridlock", 2014, <http://www.arabianbusiness.com/let-commercial-jets-use-military-airspace-ease-gulf-gridlock-iata-545548.html>
10. Air Vice Marshal Robert Treloar & Air Commodore Paul Devine, "Air Force Review into Civil Aviation Access to Air Force Airfields", 2010, [http://www.airforce.gov.au/Interact/Public_Consultation/Air_Force_Review_into_Civil_Aviation_Access_to_Air_Force_Airfields_\(HTML\)/?RAAF-gxrI4JnJH9CIFyMg353Ez3kf0kpP87YR](http://www.airforce.gov.au/Interact/Public_Consultation/Air_Force_Review_into_Civil_Aviation_Access_to_Air_Force_Airfields_(HTML)/?RAAF-gxrI4JnJH9CIFyMg353Ez3kf0kpP87YR)
11. Tokyo Metropolitan Government, "Promoting Civil-Military Dual-Use of Yokota Air Base", 2013, http://www.toshiseibi.metro.tokyo.jp/base_measures/english/13May_English.pdf
12. Ministry of Transport, "Fact Sheet - Terminal 5 Concept Plan Finalised", 2015, <http://www.mot.gov.sg/News-Centre/News/2012/Fact-Sheet-on-Changi-2036-Steering-Committee/>
13. Agence France-Presse, "Boeing and Airbus 'Fight Like Hell' for Aerospace Engineers", *Industry Week*, 2012, <http://www.industryweek.com/recruiting-retention/boeing-and-airbus-fight-hell-aerospace-engineers>
14. RADM(NS) Teo Chee Hean, "RADM (NS) Teo Chee Hean Opens Changi Air Base (East)", 2004, http://www.mindef.gov.sg/imindef/press_room/official_releases/nr/2004/nov/29nov04_nr2.html#.VVHyQ5MwC30
15. Changi Airport, "Milestones", <http://www.changiairport.com/our-business/about-changi-airport/milestones>

16. Ibid., "Facts & Statistics", <http://www.changiairport.com/our-business/about-changi-airport/facts-statistics>
17. International Civil Aviation Organization, "Forecasts of Scheduled Passenger and Freight Traffic", 2013, http://www.icao.int/sustainability/pages/eap_fp_forecastmed.aspx
18. Dr. Ng Eng Hen, "Reply by Minister for Defence Dr Ng Eng Hen to Parliamentary Question on Relocation of Paya Lebar Air Base", 2013, http://www.mindef.gov.sg/imindef/press_room/official_releases/ps/2013/16sep13_ps.html#.VIM90jGUd8E
19. Changi Airport, "Infrastructure Investments at Changi Airport to prepare for future growth", 2013, <http://www.changiairport.com/our-business/media#/pressrelease/view/infrastructure-investments-at-changi-airport-to-prepare-for-future-growth-835383>
20. International Civil Aviation Organisation, "History: The Beginning", http://www.icao.int/cgi/goto_m.pl?icao/en/hist/history01.htm
21. Jasper, S. Securing Freedom in the Global Commons. Stanford University Press, 2010.
22. US Government Printing Office. Department of Transportation. Federal Aviation Authority. Federal Register /Vol. 73, No. 242 /Tuesday, December 16, 2008 /Rules and Regulations. <http://edocket.access.gpo.gov/2008/pdf/E8-29711.pdf>
23. BBC News, "China establishes 'air-defence zone' over East China Sea", 2013, <http://www.bbc.com/news/world-asia-25062525>
24. Chico Harla, "China creates new air defense zone in East China Sea amid dispute with Japan", 2013, http://www.washingtonpost.com/world/china-creates-new-air-defense-zone-in-east-china-sea-amid-dispute-with-japan/2013/11/23/c415f1a8-5416-11e3-9ee6-2580086d8254_story.html
25. Department of Statistics Singapore, "Population in Brief 2013", <http://population.sg/population-in-brief/files/population-in-brief-2013.pdf>

The old-age support ratio is generally computed as the ratio of persons aged 20-64 years to persons aged 65 years and over.
26. SM Goh Chok Tong, "Speech by Senior Minister Goh Chok Tong at the Singapore Aviation Centennial Evening Dinner, 16 March 2011 at Compass Ballroom East, Resorts World Sentosa", 2011, http://www.pmo.gov.sg/content/pmosite/mediacentre/speechesninterviews/seniorminister/2011/March/Speech_by_Senior_Minister_Goh_Chok_Tong_at_the_Singapore_Aviation_Centennial_Evening_Dinner.m.html
27. Federal Aviation Administration, "Medical Standards and Certification", 1996, http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&SID=946fd17306d68d75f266219a2010a1de&tpl=/ecfrbrowse/Title14/14cfr67_main_02.tpl
28. Civil Aviation Authority of Singapore, "Boosting Recruitment, Integrating Fresh Talent", 2008/2009 Annual Report, 2014, http://www.caas.gov.sg/caasWeb2010/opencms/caas/en/Annual_Report_08_09/Excel_Enhance.pdf
29. Marshall, Patrick, "The tech that will make drones safe for civilian skies", 2013, <http://gcn.com/articles/2013/07/12/drone-uav-sense-and-avoid-technologies-civilian-airspace.aspx>
30. Federal Aviation Administration, "Fact Sheet – Unmanned Aircraft Systems (UAS)", 2014, http://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=14153

31. Ibid.

32. Marshall, Patrick, "The tach that will make drones safe for civilian skies", 2013, <http://gcn.com/articles/2013/07/12/drone-uav-sense-and-avoid-technologies-civilian-airspace.aspx>.

33. Federal Aviation Administration, "Fact Sheet – Unmanned Aircraft Systems (UAS), 2014, http://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=14153.

34. Ibid.

35. MIDCAS, "MIDCAS is the European Detect and Avoid Project", 2015, <http://www.midcas.org/>.

36. Federal Aviation Administration, "Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap", 2013, http://www.faa.gov/about/initiatives/uas/media/uas_roadmap_2013.pdf.

37. Integration of Civil Unmanned Aircraft System (UAS) in the National Air Space (NAS) Roadmap, US Department of Transport, Federal Aviation Administration, 2013, p.12.

About the Authors

Balancing Our Strategic Resources and 3rd Generation RSAF Mission Imperatives



SLTC Christopher Chew is an AH-64D Apache pilot and now holds the appointment of Head, Air Force Information Centre. Prior to this, he held the appointments of Commanding Officer (CO) 120 SQN and Senior Force Transformation Officer (FTO)(Air) Joint Plans and Transformation Department (JPTD). He read Aerospace Engineering at the University of Manchester and holds a Masters in Science (Defence Studies) from the University of Madras, India.



SLTC Vincent Yap is currently Commander, Air Warfare Training Institute and Head, Training Development Group in Air Force Training Command. An Air Warfare Officer (AWO) Ground Based Air Defence (GBAD) by vocation, he previously served as CO of 163 SQN and a Branch Head in Air Plans Department (APD) in HQ RSAF. He holds a Bachelor of Science in Mechanical Engineering (First Class Honours) from the University of Glasgow (UK) and a Masters of Science in Instructional Systems from the Florida State University (USA), obtained under the SAF Postgraduate Award.



MAJ Alex Chew is a pilot by training. He is currently a Flight Commander in 122 SQN, and was formerly a FTO in JPTD. MAJ Chew holds a Bachelors of Aerospace Engineering from the University of New South Wales.



MAJ Lee Hsiang Wei is a Helicopter Pilot by vocation and flies the Super Puma. He is currently a Senior Policy Officer in Defence Policy Office. MAJ Lee is a recipient of the SAF Overseas Scholarship in 2004 and graduated from Cornell University with a Masters of Engineering and a Bachelors of Science in Electrical and Computer Engineering. MAJ Lee also won the 2nd prize in the 2011/2012 and 2013/2014 Chief of Defence Force Essay Competitions, respectively.

The Expanded Role of Air Power in the Defence and Security of Singapore



LTC Tan Jinq Yeu is a helicopter pilot and is currently a Directing Staff in the Goh Keng Swee Command and Staff College (GKS CSC). LTC Tan held appointments of Head Operations in Sembawang Airbase and CO of 123 SQN. LTC Tan holds a Bachelor of Science from National University of Singapore (NUS).



MAJ Teo Wei Keong is currently the Senior FTO(UAV) in JPTD. An Air Warfare Officer (AWO), Command, Control and Communications (C3) by training, he was formerly an Officer-in-Command (OC) in 200 SQN and served in the Office of Strategy. A graduate of GKS CSC, he also holds a Bachelors of Engineering (First Class Honors) in Mechanical Engineering from NUS and a Masters of Science in Finance from University College Dublin (UCD), National University of Ireland, Dublin.



MAJ Leong Tyng Wey is a helicopter pilot by vocation, flies the Super Puma and had served his Flight Commander tour in 125 SQN. MAJ Leong holds a Bachelors of Computer and Mathematical Science (Honours) from the University of Western Australia and a Masters of Science (Strategic Studies) from the S. Rajaratnam School of International Studies (RSIS).

Contributions of Women in the RSAF



LTC Kenneth Chiong is an AWO GBAD by vocation, and was previously CO 3 DA Bn. He graduated from the New Zealand Defence Force Command and Staff Course in 2011 and holds a Bachelors of Engineering (First Class Honors) from Queensland University, Australia. He was awarded the SAF Postgraduate Award in 2014 and is currently pursuing a Masters of Science in International Employment Relations and Human Resource Management with the London School of Economics and Political Science (LSE).



LTC Ng Yu Jing, Eugene is an AWO C3. He served as a Branch Head in Air Manpower Department (AMD) and an OC in 203 SQN and is now on the Australia Command and Staff Course (Joint). He holds a Bachelors of Engineering in Aerospace Engineering (First Class Honours) from the University of New South Wales.



CPT Ye Rouyin is currently holding the appointment of Head, Information Management Section in Air Force Information Centre, Air Operations Department (AOD). CPT Ye was a recipient of the SAF Academic Scholarship (Military). She graduated from the University of New South Wales at the Australian Defence Force Academy (ADFA) with a Bachelors of Arts in History and Geography. A distinguished graduate of the Academy, CPT Ye was awarded First Class Honours in Geography and the University Medal in 2011.



CPT Yam Gui Hao, Gabriel is a F-16 pilot in 140 SQN. He was a recipient of the SAF Academic Scholarship (Military) and graduated from the University of New South Wales at the Australian Defence Force Academy (ADFA). He holds a Bachelors of Aeronautical Engineering (First Class Honours).

Organisational Culture of the RSAF



MAJ Nicholas Chng is currently a Branch Head in Joint Operations Department (JOD). An AWO GBAD by training, MAJ Nicholas Chng has served in various command and staff appointments including CO 165 SQN, OC in 3 DA Bn and as a Staff Officer in Joints Operations Department (JOD). MAJ Nicholas Chng graduated from GKS CSC and holds a Bachelors of Arts in Economics from the University of Pennsylvania, USA.



MAJ Alex Chan is a KC-135R pilot and a Staff Officer in the SAF Information Group, JOD. He graduated with a Bachelors of Arts in Economics from the University of Chicago and with a Masters of Science in Economics from LSE.



ME4 Chia Bing Qiang is an Air Force Engineer by vocation. He is currently a Staff Officer in Information System Branch, Joint Communications and Information System Department (JCISD). He graduated with a Masters of Engineering in Aeronautical Engineering from Imperial College London in 2012.

Civil Military Relations in Aviation



LTC Chen Boon Chong is an AWO C3. His current appointment is Head, Air Space Office, AOD. His previous appointments included Senior Project Officer (Airspace), Chief Of Air Force Office and CO 203 SQN. He attended the Malaysia Armed Forces Staff College and graduated from NUS with a Bachelors of Computing.



LTC Brandon Sim is a Branch Head in Air Training Department and a graduate of the Indian Armed Forces Defence Services Staff College. Prior to that, he was CO of 111 SQN.



MAJ Sebastian Chai is a F-16 fighter pilot by vocation and is currently a Staff Officer in Force Development Branch in Air Plans Department. MAJ Chai is a recipient of the SAF Military Scholarship and holds a Masters of Engineering (First Class Honours) in Mechanical Engineering from Imperial College London, UK.



CPT Ren Jinfeng is a UAV Pilot by vocation. He is currently the Staff Assistant to Chief of Air Force. He graduated with a Bachelors of Engineering in Materials Science and Engineering from Imperial College London in 2009 and a Masters of Engineering in Materials Science and Engineering from Massachusetts Institute of Technology in 2010.

