

Expanding the Discourse of C4ISR

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Abstract:

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

Keywords: Airpower; C4ISR; RSAF

INTRODUCTION

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

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

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



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

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

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

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

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

C4ISR IN SAF DISCOURSE

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

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

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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

it passively awaiting for information to generate the required shooter.

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

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

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

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

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

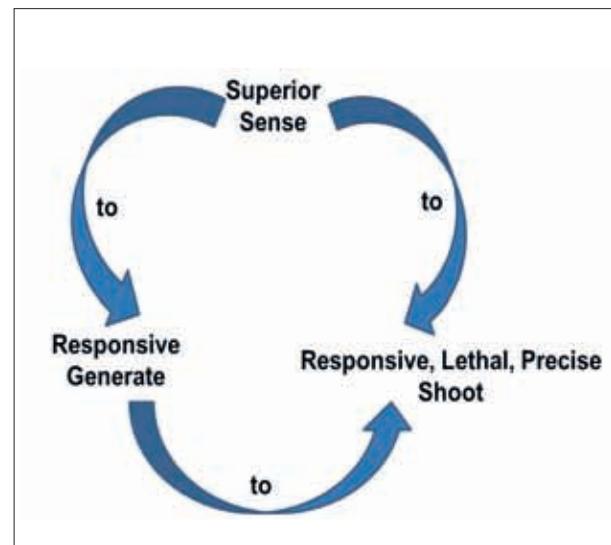


Figure 1: RSAF OODA Loop

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

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

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

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

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

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

CONCLUSION

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

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

ENDNOTES

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