pointer

Values-based Leadership in the SAF
by MG Neo Kian Hong

Learning Army Thinking Soldier
by BG Goh Kee Nguan,
MAJ Bryan Tan and MAJ Damian Lim

Networking for Integrated Ground Operations
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Editorial Board

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EDITORIAL

The contemporary operating environment is getting increasingly challenging for armed forces around the world. In the arena of land warfare, the Army has to be operationally ready for a full spectrum of operations and at the same time, deal with the complexities associated with the urban terrain and asymmetric threats. As such, the 3rd Generation Army will need to manage all these complexities and fight as an integrated force leveraging on cross-Service capabilities.

It is in this context that we are delighted to introduce the inaugural Army-sponsored issue of *POINTER.* In this issue, we feature six articles on the issues and challenges of the varied aspects of ground operations in the new paradigm. In the spirit of Organisational Learning, the articles were all written by young Army officers, under the leadership and guidance of senior Army commanders.

We are honoured to publish the article, *"Values-based Leadership in the SAF"* by the Chief of Army, MG Neo Kian Hong. In the article, MG Neo shares his thoughts on the importance of values in leadership, and articulated that organisations are heavily influenced by their leaders and leaders by their values. He then highlighted the idea of moral quotient in leadership and proposed some simple ideas to ensure values in practice. MG Neo summarised the application of this values-based leadership into the acronym REAL. R – Reflect and seek counsel; E – Educate and develop shared perspective based on values; A – Action and L – Learning.

The second article *"Learning Army Thinking Soldier"* provides the preamble to all the other articles by explaining the need for a learning army and thinking soldiers, and goes on to describe in detail what it means. It then outlines the Army's journey in developing the learning army with thinking soldiers, highlighting the key initiatives, the Army Learning System, as well as the training philosophies and principles.

The next article *"Networking for Integrated Ground Operations"* outlines the value proposition of technology in achieving networked operations. Through the use of simple examples, the article highlighted the benefits of Blue Force Tracking, advantage of having shared understanding and how technology can revolutionise information sharing, enable power to the edge and enhance asset tracking. It then goes on to describe the challenges to implementing the networks and closes by acknowledging that although technology is a key enabler in modern warfare, eventually we still have to develop our soldiers to be able to fight as a system.

Looking ahead, more advanced, lethal and powerful equipments, platforms and weapon systems are constantly being developed. The article *"Emerging Capabilities – A Precision Weapon of Mass Destruction"* outlines the emerging technologies in biotechnology, nano-sensors and unmanned systems. It goes on to postulate that these emerging technology could re-invent biological warfare to be more precise than precision warfare and more devastating than asymmetric warfare. It continues to argue the validity of ethical concerns if the application of biological warfare could be refined through technologies to be accurate and precise.

In recent years, the discussion of military operations in urban terrain has come to terms with its inevitability. *"The Citizen-Soldier and the City Fight: Threat Entrepreneurship on the Urban Battlefield"* emphasises the need for thinking soldiers, especially in an urban setting. The article describes the latent affinity between the city dweller and the city fight and explains why our soldiers cannot be expected to perform like fish in water on an urban battlefield. It then postulates that the heterogeneity inherent in citizen-soldiers is the key to the development of adaptive solutions during the urban fight and represents a latent reserve of threat entrepreneurship. The article further suggests to tap this reserve by allowing soldiers to feel the effects of their performance in field through effects-based training where men and commanders are provided with selective pressure rather than selected answers.

In the new operating environment, our military commanders are expected to make sense of increasingly uncertain, complex, and ambiguous situations. Even with advanced technology and networking equipment, it is ultimately the human mind which needs to make sense of the situation and to make the decision. *"Making Sense of Sense-making"* examines the role and purposes of sense-making in the next generation of warfare and to study its practicability and application at the individual soldier, tactical and operational levels, with the hypothesis that sense-making quality can be quantitatively assessed.

In this issue, we have published articles offering some perspectives on the different challenges in ground operations. With the future battlefield likely to be increasingly complex, there will be more challenges and we look forward to receiving more viewpoint comments and feedback from readers.

In addition, this issue of the Personality Profile section concludes our four-part series on prominent commanders of Southeast Asian countries. In this last profile, we look at the life and career of Filipino hero, Ramon Magsaysay (1907-1957).

We hope you will enjoy this issue. Happy Reading!

Editor, *POINTER*

Values-based Leadership in the SAF

by MG Neo Kian Hong

Introduction

Leadership is key for military success. In the Army's transformation into the 3rd Generation fighting force, uncertainty and flux are being generated as the Army realigns its organisational and force structures, and revolutionises the way it thinks, trains and fights. New technologies and capabilities are being developed at a much faster pace than before, and more new strategies and initiatives are being undertaken to ensure that the Army remains relevant and ready for a spectrum of operations from peace to war. Strong leadership is therefore required to organise and hold the transformation effort together as well as to unite the Army in working towards common goals and desired outcomes.

Leadership is a very wide topic and there are many perspectives. There is, however, an important aspect of leadership that I would like to highlight, and that is Values. **An organisation is heavily influenced by its leaders, and leaders by their values. The success and continuity of an organisation depends on it.** Values are the anchors for leaders to make decisions in an increasingly complex and unpredictable environment. In situations where the boundaries between right and wrong are unclear, values keep our actions aligned and true to our people, ourselves and the Army.

In this essay, I will first explain why values are important for modern organisations. I will then highlight the

idea of the Moral Quotient in leadership and propose some simple ideas to ensure that values are put into practice.

The Importance of Values for Modern Organisations

Last year, our Prime Minister articulated the competitive edge that Singapore has as a nation. They are trust, knowledge, connectivity and life. Trust ensures that our nation and people are valued by global companies, and is particularly important as Singapore strives to be a global financial hub. Knowledge is vital to Singapore's growth, and Singapore has been investing in its "polis" and networking with key centres of excellence in research and development (R&D) to build a knowledge economy. Natural connectivity is an advantage that Singapore has, as it is well-situated in the global grid to facilitate the movement of people, goods, money and knowledge. Lastly, the excellent quality of life that Singapore provides will create a positive and appealing environment to root our own talent and attract new ones to sustain its growth. Amongst these factors, trust is key in pushing Singapore above the rest.

After the Severe Acute Respiratory Syndrome (SARS) crisis in 2003, I was invited by the Australian Defence Force to share Singapore's experience in dealing with the crisis. About 150 civil servants from various governmental departments attended the session. After my briefing, an Australian civil servant from the Prime Minister's Office commented that it was remarkable how our diverse society, when faced with adversity, could work together with their leaders to overcome the problem. He added that such a feat would have been almost impossible in any other country. From this observation, we should realise that what Singapore accomplished in the SARS crisis was only possible because of the high degree of trust that exists amongst the people as well as between the people and their leaders.

Almost 20 years ago, when I was a young staff officer in Joint, I was invited to the Istana for a ceremony to recognise our servicemen who had served in an overseas mission. I noted that the reception was extremely frugal and plain. While we were not a rich country, I thought that we could surely afford something nicer. Curious, I asked a long-serving staff in the Istana about my observation and he told me that it was deliberate. He said that many developing countries needed some form of aid from the more developed countries, but it irritated the developed countries when they visited the poorer countries only to find the leaders in the country spending money on themselves and not on their people. The lack of values in leadership was obvious. In Singapore, our people trust our leaders to be good stewards and it is therefore important not to betray this trust by doing the right things for our people.

We are doing well at the national and Singapore Armed Forces (SAF) level. The SAF is recognised not only as a well-trained and well-equipped force but also as a trusted and professional force. This image has been reinforced by our contributions to international and humanitarian missions, such as Operation Flying Eagle. We are

trusted by our friends to deliver on our words. What we cannot do, we do not promise. However, being successful so far does not mean that we will remain successful. We must not take what we have achieved for granted. We know the importance of trust and values in our organisation and nation, and we must ensure that every generation continues to develop enduring values. We are reminded of the consequences when values erode through examples such as the Enron collapse, the NKF scandal, and the food and toy quality control problems in China.

Through our contributions to international and humanitarian missions, the SAF is recognised not only as a well-trained and well-equipped force, but also as a trusted and professional force.

The New Q

Singapore has developed very quickly in the past four decades. Our companies and the SAF have advanced in tandem with the economy. In the past, it was good enough to be just good doers who possessed high IQ (Intellectual Quotient). Then EQ (Emotional Quotient) came into play, and was seen as crucial when we had to socialise to do business. So we developed that. But now that our nation and organisation have reached an even higher level, what is next? If you look at strong organisations and successful countries today, you will notice that people are key. These people need to be inspired by things other than money – things such as good leadership and strong values. There is a moral element to it and some say therefore, that the next Q is **MQ (Moral Quotient)**. People are glad to be associated with great organisations because these organisations have leaders that possess the necessary MQ to inspire them through shared values and ideals.

Values determine who we are and what we do as leaders. To have strong leadership, it is necessary to think about how we can nurture and apply our values. For ease of memory, I would like to use the acronym **REAL**.

Reflect and Seek Counsel

It is important to take time to reflect on our values. We must be clear on what our values are. They are our operating and guiding principles. We may notice in certain occasions that taking some positions and selecting an option may come to us more readily than to others. That is probably because we already possess certain convictions and beliefs. However, our beliefs in areas that we think we are clear about may also be tested in certain situations. For example, some feel that it is acceptable not to be too precise in marking our parking coupons. Others think that it is alright to take papers meant for the office back

home for personal use. A few may even think that since they have no problems in achieving the Individual Physical Proficiency Test (IPPT) gold standard, there is no need for them to complete all five stations on the actual test date and simply declare that "everything is in order". These occurrences are rare but it serves to remind us that small lapses may lead to greater lapses over time due to poor personal and collective moral standards.

Besides reflecting on our own, **we must seek counsel from our peers and superiors** as well, to hear about their experiences and learn about how they handled various issues and challenges. A few years ago, when I was in the General Staff, I was approached by a Commanding Officer who was in a dilemma. His unit had been working very hard over the past year and was on the verge of being declared the best combat unit. All of us know how difficult it is to motivate and rally a unit, and this positive recognition would be extremely important for them. However, a week before the announcement, his logistics officer informed him that there were some problems in the accounting of stores and if this logistics lapse was factored in, it would cause the unit to be relegated to the second last position. All he had needed to do was to wait for one more week. It was a tricky situation. However, I said to him that since he had called me, it meant that he already knew the right answer and that he just wanted someone to share his disappointment with. Therefore, I simply told him to go ahead and do the right thing. His unit came in second last that year. **Even with counsel, we must know that the responsibility still lies with us**. As leaders, we are often faced with similar situations that require difficult decisions, and every one of these decisions we make helps to strengthen our convictions and beliefs. They also serve to educate us in taking on and making more difficult decisions later in life. The judgements that we make define who we are, and will inevitably influence and shape the behaviours of those we lead.

Educate and Develop Shared Perspectives Based on Values

As leaders, we have the responsibility **to educate and develop shared perspectives based on our values**. Shared values build trust and understanding within the organisation. An organisation with a good shared values system will engender a positive working environment where people are able to perform and do the right things.

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In today's operating environment, change is constant and transformation is necessary. The inability to do so will lead to stagnation and eventual failure. **To change organisations, the mind must first be changed**. When we first started our transformation journey, we faced many difficult challenges, as there was a lot of resistance to change. The Army then had already been successful on many accounts, and some thought that all the Army needed to do was simply to continue doing things the way it was done before. As the old axiom goes, *why fix it when it is not broken*. However, this is not how the Army works. Instead of resting on our laurels, we started to envision what future challenges would be like and took on the proactive approach to change and adapt ahead of the curve. We change before change is forced upon us. To shift mindsets and build shared perspectives, the Learning Organisation (LO) initiative was introduced to improve the quality of conversation within the Army. Significant progress has since been made. The LO movement was soon introduced SAF-wide and today, we are moving aggressively to becoming an integrated SAF. The mental model has shifted and the question today is not how to protect our legacy but how to create a new future to achieve a more potent and effective 3rd Generation SAF, which operates as *ONE*.

We have to learn to apply our values and leadership in new operating environments. In the past, while different security agencies do coordinate their efforts, it was not exactly integrated. However, after 9/11, under the leadership of various governmental agencies, we have established a robust integrated network amongst the various government agencies to provide a holistic operational approach to secure Singapore. In our peace support operations in Timor Leste in 2004, we learned to conduct humanitarian operations to provide assistance to the people there. Our actions were motivated by our values to help others whenever we could. When we were asked to assist our Indonesian friends in Aceh after the Asian Tsunami, we ensured that the assistance rendered was professional and sincere. Our efforts were much appreciated because they were genuine and were not done to stage a "Kodak" moment. Thus even in uncertain situations, we must remain grounded by the right values to make decisions with the right motivations in order to portray a professional image and receive continual support from the people.

Even in uncertain situations, we must remain grounded by the right values to make decisions with the right motivations in order to portray a professional image and receive continual support from the people.

In today's operating environment where the three block war[1] is commonplace, our perspectives to situations may vary depending on

which part of the three block war we are in. In a complex operating environment, there is a need to continually develop new perspectives to take in each of the ever-changing scenarios. Leaders must continually reframe their perspectives to ensure their relevance, and it must be done based on sound values and the right motivations.

Action and Learning

We should not talk about values as theory. We must be prepared to act on our beliefs and make hard but principled decisions.

During the SARS crisis, it was decided that we should adopt a very open attitude in providing information to the public and the international community. Such an approach was unusual in consequence management operations. Surely it would constrain and hinder our work in combating SARS. Nevertheless, we went ahead with this approach. WHO experts were embedded in the executive group and they had all the information we had. The media was briefed everyday, and they were given all available information so that they could help present these information in a way that the public could understand. As it turned out, this approach proved to be effective and, more importantly, enabled us to gain trust from all quarters to get the job done better. We noticed that several other countries had trouble in dealing with the crisis because they had not been as open as we were.

Last year in May, after an incident where a few soldiers were killed, we were asked to consider terminating the overseas exercise. On one hand, we had

to consider whether the troops were in a condition to continue and if the leaders could carry the ground. On the other, we understood the principle of resilience. In operations and in difficult times, we must be prepared to maintain our aim. With counsel from the psychologists and various commanders, we directed for the exercise to proceed after a few days. Meanwhile, we mobilised all our available resources to provide help and assistance to our injured personnel. We had a difficult few days, but we understood that the men from the unit subsequently agreed that it was a right decision after all.

Source: Army News

We should not talk about values as theory. We must be prepared to act on our beliefs and make hard but principled decisions.

As professional military personnel, we must be prepared to stand by our recommendations and tell the truth. Sometimes, we may be pressured to say something to facilitate a decision. We must be prepared to deal with such dilemmas. In the movie *A Few Good Men*, soldiers felt obliged to keep a secret on some unjust act in order to protect the honour of the unit. In the first place, we should be careful not to have a misguided sense of values. For example, just because our subordinates work very hard for the unit, it does

not mean that we do not mete out the appropriate punishment when they make mistakes. Some leaders may get confused and choose the value "care for soldiers" in such situations to protect the erroneous soldier. That should not be the case. One of the lessons learnt from the last Lebanon war was that the Israeli Defence Forces (IDF) had neglected training their reserves due to budgetary issues. As a result, the IDF suffered serious repercussions due to the poor combat readiness of its reserve forces. With limited resource availability, decision-making boils down to finding the right balance, and informed and balanced decisions can only be made when all available information are accessible and factually presented.

In operations, we often spend time looking at how we can do things better but often neglect discussing the principles behind our actions and decisions.[2] After decisions and actions are executed, there should be learning sessions to share the rationale behind each action and decision, and to determine whether the premise on which the actions taken or decisions made is correct. Correct things done for the wrong reasons are not desirable as well.

To ensure that we can have a values-based leadership, we should reflect on our daily decisions and seek counsel to test ourselves. We should also educate our people and have platforms to clarify and develop common perspectives based on our shared values. Finally, we must act on our convictions and learn through our decisions and their outcomes.

Conclusion

When we look around, we see some countries struggling and some organisations crumbling. More often than not, we find these countries and organisations suffering from either poor leadership that is lacking in values or insufficient critical mass of people with the right values. Even in the US, we see voters hungering for a moral leader that they can trust, such as John McCain, the Republican presidential candidate, who has become a strong contender because he is perceived as not only as an experienced senator but also as an upright and moral leader as well. His values are reflected by his words: "A democratic government operates best in the disinfecting light of the public eye. Ethics and transparency…are the obligations…and the duties of honourable public service."

Singapore's success is built on meritocracy, harmony and trust within the society. Strong values and moral fibre are vital in sustaining the nation's success. The SAF, particularly the Army, provides and nurtures the moral fibre of the nation, and is responsible for imbuing the same set of values into the generations of Singaporean males that pass through the organisation. Therefore as leaders, we must possess MQ to continually ensure that shared values exist in the SAF so as to maintain our professional standards, and engender common understanding and expectations between us and our people.

Finally, I would like to end with a story told by Warren Buffet when he visited the Massachusetts Institute of

Technology (MIT) in 1998. Warren Buffet was tasked by the President of the United States, to select a CEO for a financial firm which was on the verge of collapse. The firm was worth about US$150 billion. Warren Buffet had twelve candidates to choose from. He was tasked on Thursday and was told to reveal the name by the following Monday. By Saturday, Warren Buffet was still unable to decide on the CEO because of the high calibre of candidates. He then decided to use three criteria to facilitate the selection process – Intellect, Drive and Character. When he used the first two criteria, he was unable to eliminate anyone as they all possessed the necessary intellect and drive to qualify as a candidate in the first place. But when he used character as the criterion, he selected his CEO. The moral of the story is that while skills, competencies and intellect can be developed, it is character and values that ultimately differentiate the great leaders from the rest.

Endnotes

1 The Three Block War was used by General Charles C. Krulak to describe how small unit leaders must be agile enough to meet the challenges of conducting humanitarian assistance, peacekeeping and traditional warfighting, often in the same area of operations and at the same time. General Charles C. Krulak, "The Strategic Corporal: Leadership in the Three Block War" *Marines Magazine*, Jan 1999.

2 When we communicate commander's intent, we usually explain the intention of the operations, and rarely the values and principles behind the operations.

MG Neo Kian Hong assumed his current appointment as Chief of Army on 20 Mar 07. A Guards Officer by training, he has held amongst others, the appointments of Chief of Staff (Joint Staff), Director of Joint Operations and Planning Directorate, Commander TRADOC and Commander 9th Singapore Division. MG Neo is a SAF Overseas Scholar and SAF Postgraduate Scholar. He holds a Bachelor of Engineering (Second Class Upper Honours) in Electrical and Electronics Engineering from King's College London, U.K., as well as a Master of Science in Management of Technology from the Massachusetts Institute of Technology, USA. MG Neo has also attended the Singapore Command and Staff Course in 1993 and he was the top student of his class. For his significant contributions to Singapore and the SAF, MG Neo was awarded the Public Administration Medal (Gold)(Military) in 2007.

Learning Army Thinking Soldier

by BG Goh Kee Nguan,
MAJ Bryan Tan and MAJ Damian Lim

Army . Culture . Experience
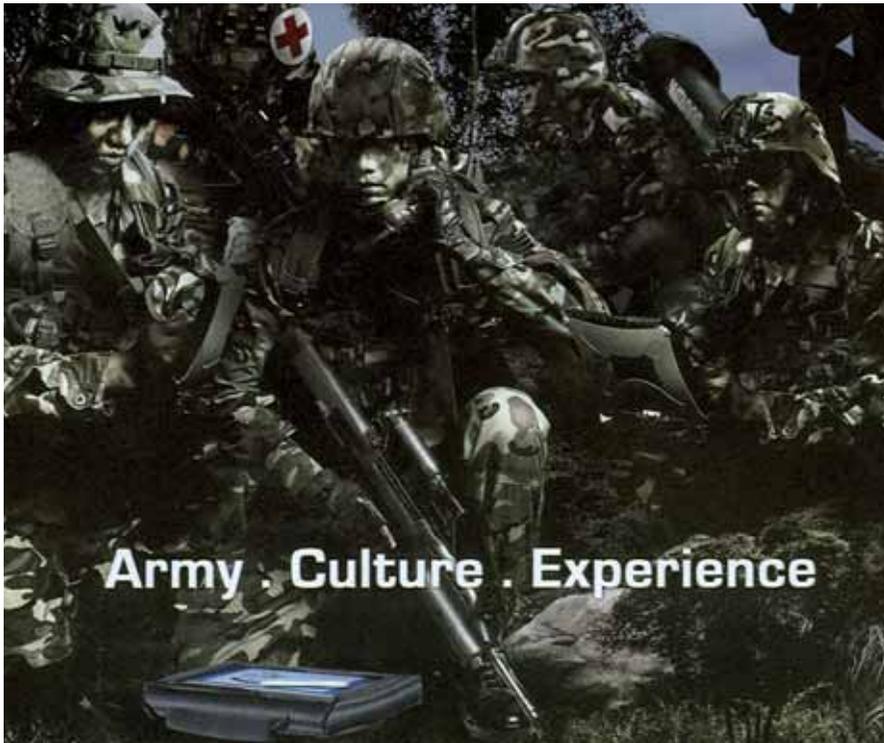
"In SAF units, every man is a thinking soldier, able to fully exploit the technologies and fighting capabilities in his section, platoon or company. Every person understands the intent of his commander, and is trained to act independently and exercise initiative to turn the tide of battle, and contribute to the success of the mission."

Thinking Soldiers – "... a valuable hedge against the strategic uncertainties of the future."

— Prime Minister Lee Hsien Loong, in a speech to mark the 40th Year of National Service on 27 Sep 07

The 3rd Generation Singapore Armed Forces (SAF) is a calibrated and flexible force that is able to conduct operations ranging from peace to war. As part of an integrated SAF, the 3rd Generation Army will be a full spectrum force that is leaner, better networked, more agile and lethal.[1] The *raison d'être* of the Army is to raise, train and sustain an operationally ready and capable land force, which when called upon, will be able to successfully conduct operations in a swift and decisive manner.

The 3rd Generation Army will have to operate in a more complex environment where soldiers are faced with both

conventional war and Operations-Other-Than-War (OOTW) challenges where the onus will lie with teams and individuals to be technically and professionally competent. The true test of the quality of the competencies that we have built is when we exercise them in an operational setting. In this setting, victory goes to the one that can better manage operational complexities by harnessing its collective capacity as a system to learn, adapt and continuously innovate, so as to act swiftly and more decisively than the adversary.

Clearly, there exists a value proposition in a Learning Army with Thinking Soldiers to enable our organisation to learn, re-learn, and adapt to new situations and operational needs. In March 2005, a definitive paper for the Army titled 'Training Transformation' articulated the "Learning Army Thinking Soldier" initiative as an Army in which leaders are able to learn collaboratively and quickly, make sense of complexities and decisions in an expeditious manner, while soldiers are able to better appreciate the intent of higher command and execute their own initiatives for action on the ground.

Is There a Need for a Thinking Soldier?

A smart, well-trained thinking soldier is many times more effective than one who just follows orders. In the summer of 2006, despite superior equipment and fire-power, the Israeli Defence Forces (IDF) battled in vain for 34 days to dislodge the Hezbollah from Southern Lebanon, due in part to insufficient training.[2] The Hezbollah was able to hold back a better equipped and technologically superior IDF. The Second Lebanon War became a stark wake-up call that an army with superior equipment may not necessarily have an advantage over its adversary. Ground troops are still required for a positive outcome in the battlefield. People have replaced technology as the force multiplier for the SAF, with the notion of the strategic corporal[3] behind the machine, being of utmost importance to the positive outcome of any operation. Success or defeat in future battlefields will be determined by abilities possessed by individual soldiers on the ground in exercising exceptional degree of maturity, discipline and independent judgement. The "Thinking Soldier" will be equipped with cognitive tools to independently adapt to complex situations and make timely and right decisions in order to overcome local challenges whilst under extreme duress. Guiding this decision-making process would be their understanding of the higher intent and their ability to continuously appreciate that intent through interaction with superiors. Therefore the need arises to train our soldiers and commanders to 'feel' the battlefield tempo, discern patterns among chaos, make decisions with incomplete information, and take calculated risks. Only then will the Army be able to deal effectively with the dynamic complex operational environment.

Success or defeat in future battlefields will be determined by abilities possessed by individual soldiers on the ground in exercising exceptional degree of maturity, discipline and independent judgement.

Is There a Need for a Learning Army?

A Learning Army provides the competitive edge in ensuring that we can understand emerging situations and manage complexity better and faster. Additionally, the Learning Army supports the development of Thinking Soldiers by laying the foundation for the Army to build upon its underlying knowledge base, whilst embracing a culture of innovation and learning; and creating an environment for shared awareness. It requires the leadership to be well-networked to harness collective knowledge and wisdom, and to be mentally agile to adapt to and better manage emerging complex situations in a swifter manner.[4] With new perspectives and insights, we can better frame the challenges ahead, share perspectives, and provide direction for the whole organisation. It is therefore crucial that every member of the Army share such a common purpose.

Two Becomes One – Learning Army Thinking Soldier

Understanding the relationship between Learning and Thinking is imperative for an appreciation of the notion "Learning Army Thinking Soldier". In a philosophical sense, Learning Army Thinking Soldier is a social construct that possesses shared awareness and mental function, i.e. capacity to learn and think. Learning can be defined as the modification of behaviour and understanding through events and experiential activities. In 1956, Benjamin Bloom developed what is known as the domains of learning.[5] His research described the major areas of learning and thinking, and classified them into three domains of learning, namely, Cognitive (thinking), Affective (feeling), and Psychomotor (doing).

Developing our people in the Psychomotor Domain has traditionally been the Army's forte. Soldiers in operational battalions require 2 years of training prior to achieving operational readiness status. In recent years, the Army introduced initiatives to enhance the Army Culture and Experience to garner greater commitment to defence, in a bid to develop the Affective

Domain of our people. However, a gap exists in the development of the Cognitive Domain, which would form the concluding piece of the puzzle in the Army's transformation into a Full Potential Force; one that can execute tasks across a spectrum of operations.

Learning Army Thinking Soldier represents a capability for the Army as a complex adaptive system[6] to make sense of its surroundings, adapt to survive or gain an advantage over, change for the better, and learn from the experience. It represents the superior cognitive edge over our adversaries. This is largely a cognitive process that involves the entire organisation working as a collective organism, or individuals working independently. This superior cognitive edge enhances the Orient and Decide[7] segments of the OODA[8] loop. Orientation puts things in perspective to facilitate decision-making and actions. Specifically, it helps to convert information into knowledge. And knowledge, not information, is the real predictor of making good decisions.

Understanding the Thinking Soldier

In certain quarters of the Army, there is fear and apprehension that a time will come when soldiers will start to question authority on the battlefield. The 18th and 19th century views were that an educated, **thinking soldier** was a danger to military discipline.[9] The line infantry or soldiers then were made up of the working class, and in many cases, peasants and criminals, while the officers were of noble descent. In a poem[10], a communist told a general that a soldier can fly and can kill, but has one defect – the soldier can think. To the communist, the thinking soldier is a danger and a threat. These fears were unfounded because the underlying idea of the thinking soldier is one who understands the intent and works towards achieving the goal. Perhaps, the pertinent question to be asked is, "why". The 'why' is important because it is the enhancer of the 'how'. Questioning scaffolds the knowledge and encourages thinking. It may seem inconceivable for the older generation of soldiers to ask 'why' but it will be common and a welcome relief when problems become more complicated and the solutions may not be so clear. Furthermore the social context of the Singapore Soldier originates from a common immigrant root further bound together through a 40-year-old institution of National Service. There is no nobility and neither is there a communist ideology that separates the ruling from the working class. Our Minister Mentor, Mr Lee Kuan Yew, in his memoirs[11] said, "We inherited the island without the hinterland, a heart without a body," with only our citizens as the fledgling nation's most valuable assets, they would become our citizen soldiers tasked with protecting a young nation. The potential of thinking citizens cannot be understated when Mr Goh Keng Swee wrote in a paper to the Defence Council in the early years of Singapore's existence, "The war-making potential of a small, vigorous, well-educated and highly motivated population should never be underestimated". As a nation that holds dear the concept of its citizens as the most valuable asset it possesses, it is obvious that the thinking citizen must also become a thinking soldier.

The notion of the 'Thinking Soldier' is not new. Its conception can be traced back to the transformation of the line infantry in the 18th century, to the light infantry forces of today. Sir John Moore[12] discarded the existing disciplinary system then, largely maintained through fear and brutality, which in his view also stifled individual initiative, and replaced it with a system based more upon self-discipline, mutual respect and trust. In 1809, Sir John Moore died at the battle of Corunna, but his influence and the concept of the 'Thinking Soldier' have been fundamental to the conduct of Light Infantrymen ever since. The idea of the light infantry was borne out of necessity from the changing battlefield tactics during the North American Wars of the 1750s, where the British line infantry were pitted against Indian and French colonists using superior individual field craft and marksmanship operating in closed terrain.

While the context is different, the notion of the thinking soldier still remains relevant and necessary for every Army. Over the last 40 years, the vision of our Army's Training Community had evolved towards a people-centric approach in training our soldiers. Our 3rd Generation soldiers must be independent and decisive leaders in the field, possessing initiative, good situational awareness, and an indomitable fighting spirit. The Thinking Soldier is expected to analyse information, think creatively and critically, make decisions, solve problems, and generate new ideas. Additionally, the Thinking Soldier must possess the cognitive flexibility[13] to derive a course of action when direct supervision of leadership is not available. For a commander, the preferred soldier is one who clarifies intent, uses his values and judgements to make decisions to meet the overall intent and his actions are within ethical and moral boundaries of modern warfare.

"Every Soldier a Leader, every Leader a Thinker, and every Thinker a Warrior", is a powerful idea and food for thought. It emphasises the value and potential that could be unlocked in each and every soldier. In that respect, every soldier is a leader who must be independent, able to

"Every Soldier a Leader, every Leader a Thinker, and every Thinker a Warrior" emphasises the value that we place on our soldiers and the potential that could be unlocked in each and every one of them.

seize the initiative, and apply their skills decisively. Every leader is a thinker who possesses good situational awareness, who can discern and analyse what they see, and make timely decisions in the midst of complexity and uncertainty. Most importantly, every thinker must be a warrior who takes steps to master the situation, overcome all threats and challenges with an indomitable fighting spirit.[14] Every soldier is now a sensor and processor who is able to operate in an asymmetric battlefield, utilising both kinetic and non-kinetic effects, lethal and non-lethal capabilities to deal with a bewildering array of challenges and threats; that require well-reasoned and independent decisions made under extreme stress. The paradigm of technology being the force multiplier of our SAF has now shifted to a focus on the strategic corporal, who is now more likely to be engaged in a myriad of challenges in the new operating environment. As one commander who has led forces in the Middle East[15] said, "The enemy is constantly changing and so are we". The current nature of the ground war has made it a thinking soldier's war. It is the only effective solution to defeat a constantly changing and thinking enemy.

Unlocking Potential by Engendering Higher Order Thinking Skills is key to developing a thinking soldier. Intelligent people do not necessarily equate to Thinking Soldiers. Having more capable people in our Army today does not necessarily warrant us a stable of thinking soldiers. Thinking may be viewed as intelligence, and as a skill.[16] At birth, intelligence is already mapped or encoded in an individual and remains as potential to be unlocked. It is said that intelligence, or potential, that has been encoded in the DNA blueprint of a person cannot be easily altered. As a skill, thinking can be learned, and it requires sustained practice for it to get better. This skill is essential in unlocking and developing our people's potential (intelligence) in learning, in performance improvement, and in their cultivation of practical intelligence. However, high intelligence does not necessarily make one a good thinker. An often quoted example[17] is that of a highly intelligent person defending a perspective so strongly that he becomes resistant to exploring the plausibility of any other perspectives; and this is commonly known as the 'intelligence trap'. We want intelligent soldiers who are able to think. Thinking requires education, training, and sustained practice; on top of acknowledging the intelligence imbued into the individuals at birth. We need to provide the necessary training infrastructure, curriculum, and resources to develop thinking soldiers who are able to use logical reasoning to derive a course of action and to achieve higher order thinking skills.

Sense-making in today's complex operating environment is a critical ability that our thinking soldiers need to possess. Sense-making is the process of creating understanding in situations of high complexity or uncertainty in order to make decisions. This was apparent in the Tsunami of 2004 while the Landing Ship Tanks were sailing to Meulaboh. The planners on-board had many questions and no answers. It was an uncommon and uncomfortable position to be in but the planning had to

continue in the absence of information about the actual extent of the disaster. It is "a motivated, continuous effort to understand connections (which can be among people, places, and events) in order to anticipate their trajectories and act effectively".[18] Sense-making and possessing the cognitive flexibility to be adaptive are desired qualities that define the Thinking Soldier of the 3rd Generation Army of the SAF.

Understanding the Learning Army

All organisations are confronted with a world of unprecedented and unrelenting change across all its functional domains. To many, the only constant is change. In order to find a way through this uncertainty, organisations, especially the Army, must be able to manage this complexity by learning at the individual and organisational level. Learning is only the first part, the next activity is to interpret, adapt and change because stagnation is the beginning of retrogression. For profit centres, the inability to learn, adapt and change may mean the loss of millions or even billions of dollars in revenue in a competitive world, but for the Army it could mean destruction or the loss of countless lives. After all that has been said and done, the Army, its equipment, its systems and even its people are still untested in operations. We will only know what we do not know when we are put to the test and pitted against a thinking adversary. It is therefore critical that the Learning Army must have the DNA of a learning organisation, so that it is able to learn during operations, adapt and then overcome to win. Ong (2003)[19] argues that forming the bedrock of a Learning Army requires the organisation to put in place a culture, structures and processes that support learning and are guided by the Army leadership.

The term Learning Army may seem simple enough but it is certainly more than just learning. It is an entity that can learn, adapt and grow. The Army is a complex adaptive system, made up of people, units, networks, structures and systems bounded together by a mission and culture. Within and between these entities, there are patterns of interaction. Hence, the Army is a social construct where interaction, collaboration and relationships give it a shared collective awareness that provide the agility and flexibility to learn and unlearn, to break old schemas or mental models and form new ones, so as to avoid learning paralysis. However, in trying to achieve such a construct, culture must be the key enabler to support the learning. In 1990, Peter Senge defined the Learning Organisation as the organisation in which you cannot not learn, because learning is so insinuated into the fabric of life. The idea of a Learning Organisation is increasingly relevant to us, given the increasing complexity and uncertainty of the organisational environment and the operating environment that we are exposed to. Senge (1990) also mentioned that "the rate at which organisations learn may become the only sustainable source of competitive advantage". This shift in paradigm was the beginning of our transformation towards a Learning Army.

A Strong Learning Culture is imperative to building a Learning Army, as it provides the fabric or glue that binds

desired habits into an individual. This attitude to learn was espoused by senior leadership, and subsequently led to the adoption of the Learning Organisation and its respective tools. While culture provides the glue, it must be supplemented by the relevant structures to reinforce the desired behaviours. In an increasingly hectic environment coupled with temporal constraints, the culture for learning can easily be lost or discarded in the absence of structures that support the learning culture.

Structures in place over the last 40 years, that afford collaboration and cooperation, continue to facilitate the Army in enhancing its awareness and socialisation; which according to social constructivists is a key ingredient towards constructing knowledge.[20] The recent re-organisation of the Army into 'hubs' allows the optimisation of resources and processes, enhances collaboration, and most importantly engenders learning. This has brought the ability to learn to a higher level, that is enriched by the collective wisdom and awareness of the organisation. By enhancing the social capital[21], we have also enhanced the corporate capital[22] and at the same time the individual capital.

Our Journey – What the Army has Achieved thus far

Without a doubt, people are the key component of the Learning Army and they form the 'heart', 'mind' and 'spirit'. It is not technology that gives us the edge but rather the people who gives us the competitive edge that make

By enhancing the social capital, we have also enhanced the corporate capital and at the same time the individual capital.

a difference in today's multifaceted operational environment. The people in the organisation must be the central theme for the Learning Army and Thinking Soldier.

Developing a 3rd Generation Learning Army with Thinking Soldiers entails overcoming challenges in the learning, retaining, improving, using and re-using of institutional knowledge and wisdom that had accumulated over the past 40 years of National Service. Information must be translated into knowledge that is usable for the organisation; therefore a robust learning system is required to mine experience and knowledge from the reservoir of critical information. Such knowledge could be applied to activities undertaken by the organisation, with the desired learning outcomes flowing back into the knowledge reservoir. An Army that learns in turn becomes the foundation for the development of Thinking Soldiers.

A suite of initiatives had been introduced in recent years to develop this aspect of our Army. The Command Effectiveness Program (CEP) was conceived in 1997 with the intention to train commanders to lead more effectively. Organisational Learning (OL) was launched in 2000 to develop our capacity to learn. The SAF Leadership Framework and the Leadership Competency Model were developed in 2003 to systematise leadership development. Coaching was formally introduced in 2005 to the units and training institutes. Knowledge Management initiatives comprised of the Army Knowledge Portal (AKP), the Army WIKI, and the Enterprise System for Integrated Learning and Knowledge (ESILK).[23] In 2005, the concept of the Army Learning System (ALS) was articulated and in a concerted effort to achieve the vision of a Learning Army, the operationalisation of this concept is already taking place since 2007 through the implementation of learning tools and performance support information technology infrastructure for the entire Army.

The Army Learning System (ALS)

The Army understands that it needs to train its soldiers to think for themselves. The current operating conditions are too varied for the generic and efficient training programmes based on WWII-programmed instruction[24] to work. For example, the dreaded and elusive Improvised Explosive Devices (IEDs) have become a leading cause of battlefield casualties in Iraq. As fast as the US-led forces change their Tactics-Techniques-Procedures (TTP), the enemy insurgents quickly deployed other methods that invariably render new TTPs useless. As fast as the US forces are learning, the enemy is also learning from them. There is little choice but to allow the soldier to exercise judgement and make decisions against so many scenarios. The overarching framework of the Army Learning System (ALS) establishes a set of governing principles and inter-related learning processes that allows the organisation to reap maximum learning benefits from training activities. It comprises of 3 main components, namely, Self-Directed Learning, Learning Networks, and Knowledge Management (See Figure 1).
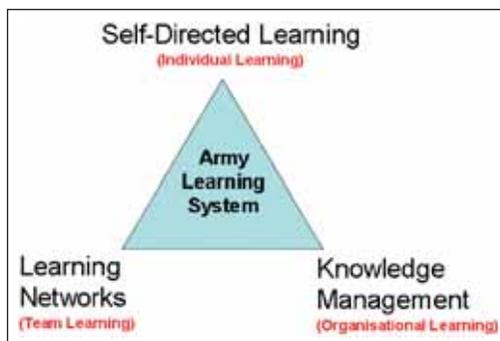
Figure 1. The Army Learning System (ALS).

Self-Directed Learning (SDL) requires individuals to take ownership of their learning. Our people must be able to recognise their knowledge gaps vis-à-vis the intent of higher command, and be independently motivated to close such gaps. Feasibility studies on the accreditation of courses conducted and subscribed by SAF have been undertaken to increase the motivation of our people toward SDL. The Organisational Learning (OL) initiatives introduced in 2000 serve to strengthen the desired Learning Culture that is imperative for SDL to take place.

Learning Networks elevate learning from the individual to the team level. Teams leverage on collective knowledge and wisdom through formal, informal and guided networks to develop new knowledge and insights, in tandem with an open sharing culture. A robust Information Technology system and effective team-building processes had been set in place to facilitate such an endeavour through the introduction of ESILK, and the infusion of Team-Building and Team-Learning (TBTL) sessions into SAF Route-of-Advancement (ROA) courses.

Knowledge Management (KM) in our Army is the system of organising relevant knowledge into a common repository, the Knowledge Reservoir, and the modes and means in which we access and update this Knowledge Reservoir. Relevant knowledge of our Army includes doctrine, standard operating procedures, tactics, techniques, procedures, training manuals, lesson plans and most importantly the operational learning from the various missions. For example, the experience and lessons learned for the Operations (Ops) Officers for the various relief missions must be documented and made explicit. The tacit knowledge of the Ops Officer in Bandar Aceh during the 2004 Tsunami was transferred to the Ops Officer for the Nias earthquake in 2005. The same was done for the Ops Officer deployed to the Yogyakarta earthquake in 2006.[25] KM amplifies the learning at the individual and team levels to the organisation at large, by ensuring that both current and new institutional knowledge and wisdom are efficiently organised and archived, and effectively accessible by everyone within the organisation so that it is not lost over time.

Training Philosophy and Principles

The Army's training philosophy is "Train as We Will Fight". Training is conducted based upon operational concepts, and the way we are expected to conduct a spectrum of operations other than war. Guiding the design of training are 3 Training Principles – Realistic Training, Outcome-based Training, and Progressive Training.

Tough, Realistic and Safe Training motivates our leaders and soldiers to reach a higher level of performance, through overcoming physical and intellectual challenges imbued into the design of our training. It builds competence and confidence, and inspires performance excellence through the fostering of initiative, enthusiasm

Tough, realistic and safe training builds competence and confidence, and inspires performance excellence through the fostering of initiative, enthusiasm and eagerness to learn.

and eagerness to learn. The training environment must closely replicate the envisioned operating environment. Emphasis is placed on training conducted to be operationally safe, without a compromise in training safety, whilst striving towards higher operational standards. Examples of such training include the six-day field camp during Basic Military Training; the varied levels of live-firing exercises conducted both locally and overseas, jungle training overseas, and manoeuvre training in the vast Australian outback.

Outcome-based Training measures training effectiveness by a pre-determined set of desired performance standards and outcomes, and affords the flexibility to adjust the training syllabus according to the training performance of the learners. Outcome-based Training is a shift in emphasis from the traditional Process-based or Prescriptive Training that we used to deliver, and it involves a change in perspective of the archaic notion that "more is good". This training methodology delivers a positive experience to the learners, and optimises training resources by defining clear training objectives and outcomes, so as to avoid irrelevant and repetitive training. Outcome-based Training is currently being imbued into the design of all Army courses and unit training.

Progressive Training allows our soldiers to develop confidence by honing their core competences through the progressive achievement of intermediate enabling objectives towards the terminal performance objective. Our soldiers are provided with the necessary learning scaffolds to progressively hone their knowledge and skills, prior to advancing to the next level of training. Progressive Training will further enhance their confidence and expertise in undertaking difficult tasks and missions, and such methodology has always been prevalent in our Basic Military Training.

The Pillar of the Army's Transformation

Our people are our most prized assets and they remain to be the pillar of our Army's transformation efforts. We must optimise our scarce human resource, and continue to invest substantively in the development of our Human Capital, especially in the competences required of our 3rd Generation Army. The Army as an organisation represents Corporate Capital from which we derive the collective wisdom, while our soldiers represent the Social Capital that facilitates individual and collective action, generated by networks of relationships, reciprocity, trust, and social norms. The construct of a Learning Army represents the structure, facilities and processes of an organisation to learn and create new knowledge. The Thinking Soldier is the desired product of the 3rd Generation Army, designed for a full spectrum of operations in a complex environment. When these two simple yet powerful ideas are brought together, the whole becomes greater than the sum of its parts.[26] Therefore the Learning Army Thinking Soldier, as a whole, becomes a key ingredient for the success of the 3rd Generation Army, as a Full Potential Force that can execute tasks across a spectrum of operations.

Conclusion

As the Learning Army Thinking Soldier matures, another paradigm shift will likely take place. Instead of 'doing things better', the new paradigm will be one of 'doing better things'. As we tread along and approach the end of the tunnel, the vision of the 3rd Generation Army becomes clearer. The notion of Learning Army Thinking Soldier must evolve to meet the needs of the future. To conclude, the future operating environment will most definitely see increasing complexities facing a networked-enabled Army with better educated and trained soldiers which the 3rd Generation Army will be more than capable of handling. Perhaps the real challenge then would be to harness the potential of a thousand thinking soldiers, empowered to manoeuvre at will, operate distributed and massing together to strike concentrated at the right time to fight the battle with a singular aim. ◉

Endnotes

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6   Complex adaptive systems are special cases of complex systems. They are *complex* in that they are diverse and made up of multiple interconnected elements and *adaptive* in that they have the capacity to change and learn from experience.

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8   *The Strategy of the Fighter Pilot* by Keith H. Hammonds. Retrieved from http://www.fastcompany.com/magazine/59/pilot.html..

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12   Sir John Moore has been described as "the greatest trainer of troops that the British Army has ever known" and credited as, "the father of the Light Infantry". The famous historian Sir Arthur Bryant wrote of him "Moore's contribution to the British Army was not only that matchless Light Infantry who have ever since enshrined his training, but also the belief that the perfect soldier can only be made by evoking all that is finest in man physical, mental and spiritual."

13   Cognitive flexibility is the ability to spontaneously restructure one's knowledge, in many forms as an adaptive response to radically changing situational demands in complex and ill-structured domains which is the challenge that our soldiers will most likely face today in most conflicts. See Spiro, R.J. & Jehng, J. (1990). Cognitive flexibility and hypertext: Theory and technology for the non-linear and multidimensional traversal of complex subject matter. D. Nix & R. Spiro (eds.), Cognition, Education, and Multimedia. Hillsdale, NJ: Erlbaum.

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15   Tip of the Spear: Leadership Lessons from the U.S.-led Armed Forces in the Middle East Published in Knowledge@Wharton on 17 May 2006.

16   Edward De Bono (1994) Thinking Course, pp1-4.

17   Edward De Bono (1994) Thinking Course, pp1-4.

18   Klein, G., Moon, B. and Hoffman, R.F. (2006). "Making sense of sensemaking I: alternative perspectives", *IEEE Intelligent Systems*, 21(4), pp70-73.

19   MAJ Andy Ong Kian Woei (2003). The Inner Game of Building a Learning Army. *POINTER Journal V29 N1 (Jan - Mar 2003).* Awareness, Environment, Leadership, Empowerment, Learning Culture, Infrastructure to Support a Learning Army, Intranet, Internet and Distance Learning and After Action Review (AARs) and a Knowledge Management System as

necessary to become a Learning Army.

20   Knowledge for the thinking soldier is the capacity for action. Knowledge is know-how which enables action. Knowledge gives the holder the capability to perform certain tasks and to achieve goals. It is this ability to enable performance-enhancing action that defines the value of knowledge.

21   James Coleman describes Social Capital as a neutral resource that facilitates any manner of action, but whether the organisation is better off as a result depends entirely on the individual uses to which it is put.

22   Coleman, James. "Social Capital in the Creation of Human Capital", *American Journal of Sociology.* 1994 Supplement, pp95-120.

23   ESILK is an enterprise architecture system that integrates the Learning Management System (LMS), Enterprise Repository Systems (ERS), Search Engines, Information Mapping software, and Authoring tools (such as LECTORA) into a user-friendly portal interface for both content and tools.

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26   Max Wertheimer, *Gestalt Theory*, Über Gestalttheorie [an address before the Kant Society, Berlin, 7th December, 1924], Erlangen, 1925. In the translation by Willis D. Ellis published in his "Source Book of Gestalt Psychology", New York: Harcourt, Brace and Co, 1938. Reprinted by the Gestalt Journal Press, New York 1997. Retrieved from http://www.gestalttheory.net/archive/wert1.html.

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Networking for Integrated Ground Operations

by BG Tan Yih San, COL Low Jin Phang,
MAJ Chua Eng Khim and CPT Yeo Lip Khoon

"Rather than follow the Make-and-Sell strategy of the industrial-age giants, today's successful companies focus on sensing and responding to rapidly changing customer needs. Information Technology has driven much of this dramatic shift by vastly reducing the time and space in acquiring, interpreting, and acting on information."

– Extract from Managing by Wire: By Stephen H. Haeckel and Richard L. Nolan
(*Harvard Business Review* on the Business Value of IT)

Introduction

We live in the information age. We experience the pervasive use of information technology in workplaces and homes that allow us to communicate across the barrier of time and distance. The processing power of computers helped us to overcome the limits and constraints inherent in human capacities to process information and make decisions with media-rich content. Largely driven by the commercial sector and growing tech-savvy population, these technologies have changed our way of life.

The military forces around the world are also riding on these trends to network and multiply their combat power. For us, our 3rd Generation Army will be a fighting force that is fully networked and integrated for comprehensive awareness in the battlefield so that we can optimise the deployment of our forces and fire-power to bear on the enemy. We call this concept Integrated Knowledge-based Command and Control (IKC2). This article discusses some parallels in commercial and military application of technology; as well as some considerations and challenges for implementation.

Enabling Networked Operations

In Sun Tzu's Art of War, he said, "If you know yourself and your enemy, you can win hundreds of battles". Indeed, this fundamental need for information to enable commanders and warfighters to make the right decisions and the right manoeuvre has not changed. In the simplest terms, the questions that commanders and warfighters will ask are: "Where are my forces and what are their level of readiness?" and "Where are the enemies and what are their intentions?".

With networks and increasing power of information technology, these fundamental questions can be answered in an instant, leaving commanders and warfighters to concentrate on their tasks at hand. Technologies to enhance capabilities such as Blue Force Tracking, achieving shared understanding, revolutionising information sharing, giving power to the edge and enhancing asset tracking will be discussed.

Blue Force Tracking

John is the manager of a toy assembly factory that exports products to several countries in the region. His day starts with a nice cup of Jamaican coffee and the morning papers in his studio apartment. He will then pick a shirt and suit that matches his mood for the day before making his way to the factory.

Today is not exactly a great day for John because his car has been in the workshop for the past two days. Two days ago, John had parked his car near some pubs to meet his old school friends for drinks. Unfortunately, some drunk had decided to vent his frustrations and smashed up his windscreen and side mirrors. As a result, John has to take a cab to work today.

John picks up his hand phone to call for a cab.

It is another sweet voice on the other end of the line, "Good day John, thank you for calling. Would you like the taxi to pick you up from home?"

"Yes, please. You sure you got the right John?" he replied.

"Yes, John. We got your number and address registered from the previous booking that you made." The nice lady said. "Let me see. I've got two cabs available in your vicinity… And one of them had just picked up the booking. The cab will be there in 5 minutes, John. Thank you and have a nice day!"

*"Wonderful. Thank you and goodbye."*

At the back of his mind, John thought to himself: "This is incredible. The cab company

had kept a database of its customers and is able to quickly identify and even anticipate customers' needs. Even more impressive, is the knowledge of the locations of their cabs and the ability to send messages real-time to the cabs and bring their services to the customers quickly… I should apply some of these ideas in the factory!"

Thousands of taxis in Singapore had been fitted with Global Positioning System (GPS) units that allow the taxi companies to monitor their instantaneous positions in a central dispatch centre. When a customer's call comes through, the central dispatch centre will send out the job request to all the taxis within 2km of the customer. The job request will then be taken up by one of the taxis with the press of a button and the customer can be picked up within minutes. The introduction of this system shortens the customers' waiting time because only the taxis within the vicinity will be informed of the job. It would also ensure a quieter ride for the customers as the job requests are no longer broadcasted over the in-taxi voice communication system.

The military had also deployed GPS in a similar way to achieve Blue Force Tracking capability. A study on the US Army 3rd Infantry Division in Operation Iraqi Freedom[1] revealed that their deployment of the FBCB2-BFT (Force XXI Battle Command, Brigade and Below – Blue Force Tracking) had allowed the battalion task forces to achieve better situational awareness of their forces. In the past, situational awareness of own forces was achieved through verbal reports from section commanders to platoon commanders and then to company commanders and eventually battalion commanders, over analogue military communications, which were plotted on paper maps. This generated large volumes of radio traffic just to find out where one's forces were. In addition, it only gave the situation at a given time and the accuracy of the information posted on the maps was dependent on how well the soldiers read and reported their own positions and how well the staff plotted the position on the map for the battalion commander. By deploying FBCB2-BFT, positions of the respective units were confirmed via GPS and shared through the digital systems across the task force automatically. Commanders and soldiers on the ground are now able to share situational awareness while reducing the amount of radio traffic across the chain of command. In addition, the quality and variety of map and imagery in the FBCB2 reduced the requirement to carry a large volume of maps. Commanders and soldiers had access to a wide variety of scalable maps and imagery that covered the entire area of operations at the level of detail desired. With these facilities in place, the commanders and soldiers could better concentrate on the fight rather than using the time to do position reporting. The level of situational awareness provided by the FBCB2-BFT also enabled the battalion commander to make decisions faster with a higher degree of confidence.

With the diagram, labels visible:

Legend:
- Communication between various Command Posts (CP).
- Data are received from the UAV and other shooting platforms

1 Enemy forces are spotted by the Unmanned Aerial Vehicle (UAV). The exact position and size of the force is fed back to the Command Posts (CP).

UAV

F-16

3 Apaches and F-16s move in to destroy the enemy vehicles.

Apache

Enemy Forces

Ground Forces

Sensor Shooter

Combat Service Support

2 Additional information is also fed back via ground reconnaissance troops.

SPIKE (left) & PRIMUS (right)

4 SPIKE missiles and PRIMUS shells bombard the enemy.

5 Finally, SPIKE and PRIMUS add the finishing touch, with another barrage.

3 Using this information, the commanders order an attack.

Division Headquarters

With networks and increasing power of information technology, commanders and soldiers on the ground are able to share situational awareness, make decisions faster and with a higher degree of confidence.

Achieving Shared Understanding

As soon as John got back to the office, he quickly coordinated with his fellow managers from the other factories and put together a proposal for a common information system for the company.

Within the week, John received a call from the General Manager, Greg.

"John, this is a great idea! This will greatly improve the efficiency of the factories and production lines as they will all share the same information at the same time. This will reduce the number of meetings that we have to conduct in order to coordinate the production volumes between the factories. Well done!"

In the commercial world, the basis for awareness is to have common information systems and databases that are inter-operable and can share information. General Motors had pushed for a consistent information system for processes such as ordering

of manufacturing parts and purchase consolidation across its different divisions and sectors from 1970s.[2] While it took some effort and time, they eventually developed software to automate and streamline basic processes.

We wanted a better method for distributing information across the battle group. We didn't want it to make the warfighter's job harder. Rather, we wanted to prevent duplication of effort. We needed a dynamic warehouse of continuously updated information. Above all, it had to filter and format information, eliminating the spam, adding value to the information, and ultimately improving speed of command.

– Rear Admiral Thomas E. Zelibor[3], Commander of Task Force 50 for Operations Enduring Freedom

Operation Enduring Freedom saw the formation of Task Force 50 comprising 59 ships from Australia, Britain, Canada, France, Italy and Japan, with additional ships from the United States. Led by RADM Zelibor, the challenge for the multinational Task Force was that many of the ships had never trained or operated together. Through his previous experience of Network Centric Warfare (NCW), RADM Zelibor implemented transformational systems and practices that created greater capacity within his staff and enhanced situational awareness.[4] For his staff, the information systems that were introduced, allowed them to conduct daily activities more efficiently and effectively. For example, morning briefs were reduced from one to two hours to 30 to 45 minutes

as information was made available on the information system. Moreover, with the high tempo of the battle, the staff would be able to access the most updated information from the system. The reduced amount of briefing time also meant that the staff had more time and greater capacity for the staff to plan tactics and strategy. Ultimately, the plans and processes instituted by RADM Zelibor paid off. In fact, the staff was so successful at streamlining the daily operational process that they were able to make distinct changes that allowed them to experience a shared understanding of the battlespace, to collaborate, and to develop mission objectives more quickly.

Revolutionising Information Sharing

Feeling pleased with himself, John was surfing the Internet to look for more ideas and improvements for the factory.

"Hey, wait a minute!" He thought to himself. "I can easily pull information that I want from the Internet and I know best what information I need and when I need the information! As long as everyone posts the daily factory reports in the same way that the web pages are hosted on the Internet, we will be able to access what we need, when we need easily!"

With that thought, John quickly picks up the phone to call the programmer of the information system.

The Internet has revolutionised the way we share and find information. Since its humble beginnings in a test environment with just three terminals

under a project by Advanced Research Program Agency (ARPA), the Internet is now accessed by the millions of users with millions more servers, desktops and laptops connected to it. This allows massive amounts of information to be shared all over the world. Today, if we needed to find out what is the market price for the latest and most sophisticated laptop or Personal Digital Assistant (PDA), we can simply go online and google it. Need to know the breaking news for the day? Just go to any news portal. With the concept of the Internet, we no longer wait for information to be pushed to us, we simply pull information off the Internet.

A case in point is the Knowledge Web (KWeb) deployed for Task Force 50 during Operation Enduring Freedom. The system, much like the Internet, allowed the information providers to post the latest data online for information users to pull. In this way, the staff of Task Force 50 need not search through large chunks of information to find the relevant information that they required. This also allowed information to be made available across the Task Force simultaneously and ensured that the latest information had been downloaded. However, the implementation of the information pull was not straightforward. At the start, the staff of Task Force 50 was fearful that KWeb would increase their workload as nice web pages need to be designed and the information would need to be vetted through many layers to ensure that they are accurate. Understanding this, RADM Zelibor intentionally asked for the design formats to be kept simple and that trivial mistakes, such as spelling

errors, were to be ignored. He told his staff that he wanted people to give their best information estimates and that no one will be punished for making mistakes. With his strong leadership, the culture to share information in a timely fashion was built up to enable effective operations. With time, the confidence in the staff also grew and more accurate information was made available, resulting in better plans made.

Giving Power to the Edge

"John! John! You have the stock level of the little motors for the radio controlled cars from the other factory? We are kind of running low and will need some replenishment soon…"

"John! We will also need more of those new wheels as well…"

John was thinking to himself that there were far too many requests for information coming to him and perhaps it was time to look at dedicating more responsibility by granting greater availability of information to his subordinates. This could make the processes more efficient and responsive.

The book "Power to the Edge" suggested that distinct differences between the industrial age and information age soldiers.[5] The industrial age or the Napoleon Corporal's roles was to listen to orders that were drafted so clearly that no one could misunderstand. With the orders, Napoleon's Corporal will carry out his mission in the exact way required of him. On the other hand, the Strategic Corporal of the information age must be able to function across a range of missions and be able to

make decisions that have implications far beyond his responsibilities. With the high-tempo and dynamic battlefield today, the Strategic Corporal needs to be flexible to cope with different demands. In addition, with the prevalent involvement of mass media in the war, the Strategic Corporal can make a critical decision and action to influence its outcome. Therefore, in order to support the Strategic Corporal to make the right decisions and carry out the right actions, information has to be made available to the "edge".

In the high-tempo and dynamic battlefields of today, the Strategic Corporal require information to be made available to the "edge" in order to make the right decisions and carry out the right actions.

In addition, the way in which the Strategic Corporal is connected to the range of forces and weapons, also allows him to leverage on their strengths and fire-power to bear on the enemy. This means that soldiers on the battlefield no longer fight alone. He is supported by a larger system for the conduct of his mission. Effectively, the enemy not just faces the soldier in combat, but also the larger system-of-systems that the soldier is connected to.

Enhancing Asset Tracking

John had put in systems to monitor the work processes and machines in the toy factory. The systems have served him well over the last six months since they had been put in place. The factory is able to function more efficiently than before and materials for the production can be replenished just in time to reduce the amount of storage space needed.

Just as John was reflecting on the work done over the past year, Mark, the supervisor for deliveries came into his office.

"John, our urgent delivery through Federal Express has reached its destination."

"Thanks for the update, Mark!"

"Don't mention it. I am just a click away from knowing where our deliveries are with Federal Express."

Federal Express (FedEx) had invested a significant amount of its revenues on technological enhancements. They pioneered the first automated customer service centre and also launched bar code scanning to provide real-time tracking for shipments allowing them to know where each delivery package is located. Today, a FedEx's customer can even connect to FedEx's network to check the status of his package(s).

With the availability of low-cost technology such as bar codes, Radio Frequency Identification (RFID) and network capability, it is now possible to move towards a "Just-in-time" model for army logistics. The idea is to tag all our resources and know where, what, and how much is carried in each fighting

force and in each base through the network. With this information, when the resources for a particular fighting force is detected to be running low, the re-supply train from the base will be activated to re-supply the fighting force. In this way, the process can be more efficient. The overall force effectiveness will also be increased as warfighters can focus better on the tactical battle with the peace of mind that their basic needs will be taken care of.

Every evening, Wal-mart transmits the data about the day's sales to Wrangler, a supplier of blue jeans. They share both the data and common modelling software applications that interpret the meaning of the data. With this, they share the same interpretation of specific quantities of specific sizes and colours of jeans to specific stores from specific warehouses. This allows them to synchronise the delivery of jeans and minimise the storage space required in Wal-mart stores as the jeans would only be delivered to sufficiently stock up the store. In the military sense, this reduces the "logistics tail" of land force that require overheads of additional forces for protection.

Challenges to Implement Networks for Ground Operations

John thought to himself, it has all turned out well because he had invested for some of his workers to attend specialised training to manage the new computer systems. These specialist teams came back with full knowledge of the new systems and was also able to teach the other workers how to use the systems more efficiently. In addition, these

specialised workers also proposed some new work processes to further boost the efficiency of the production line.

While the introduction of the new systems went smoothly, John was initially worried that the systems might be too complex for the older workers and that they needed time to adapt to the changes in processes. But it seemed like the systems are quite user-friendly and the older workers have coped well so far knowing that it will benefit everyone in the long run.

Sometimes, we hear the term, "Change is the only constant". To stay ahead, we have to keep moving forward, hence change is inevitable. Since it is inevitable, we ask ourselves, how then can we better manage this change?

Training and Designing Systems to be User–Friendly

Technology alone would not improve the efficiency and effectiveness of commercial and military organisations. It is the people who operate them and make the best out of the technology that will make the difference. To achieve this, the staff in the organisations will have to be trained to creatively and effectively make use of the technology in place. Introduction of new technology meant new skills and competencies would be required and this would typically meet with resistance from the staff. To ease this transition, we should consider how we can design our systems to be intuitive and user-friendly so that they can be quickly adapted to. For military organisations in particular, we could consider how to leverage on the technological trends

in the commercial sector and how best to adapt Commercial-Off-The-Shelf softwares and products designed with ease of use in mind, for military use.

Technology alone would not improve the efficacy of organisations. It is the people who operate the technology and make the best out of them that will make the difference.

Building Culture for Networking

Besides the introduction of technology, organisational structure and work processes also have to be reviewed to implement a networked organisation. For our Army, the 2nd Generation Army was built on a strong foundation of the General Staff Headquarters and Senior Specialist Staff Officer (SSSO) Headquarters. As we transit towards the 3rd Generation Army, we have re-organised the Headquarters into networked hubs that are designed to strengthen command and control of operations, while creating concurrent capacities for capability development and governance. The fundamental idea of the new organisation is to use structure to drive the culture and mindset towards a more networked environment.

Creating Culture for Information Sharing

Timely information has to be extensively shared in a networked organisation for it to be effective. To do this, we also need to build trust and tolerance amongst our people. In the case of the implementation of the KWeb, the staff was afraid of making mistakes in the information and required the information to be vetted by several senior staff before it could be published. Even then, they were afraid that there might be some errors and people would be punished for that. In building an organisation that needs to push and pull information around quickly, we have to learn to trust that the staff has done due diligence and put in their best effort in offering the information available. At the same time, significant mistakes in the posted information have to be quickly acknowledged and amended so that the affected staff can quickly make changes to their plans or actions. Military leaders have to build this trust amongst the people and this would take perseverance, not just from the leaders but also the other staff within the network.

Creating Culture for Power to the Edge

With information comes responsibility. In traditional military organisations, information is mostly held at the higher echelons to support decision-making. Information is usually on a need-to-know basis. With the concept of Power to the Edge, the Strategic Corporal will have greater availability of information and greater

responsibility. There is a need to learn to trust the Strategic Corporal with the information at hand and to make the right decision when he is called upon. Therefore, every soldier on the battlefield has to be trained to be a thinking soldier. This creates a somewhat independent soldier. The challenge is to have enough of these knowledge soldiers to understand the higher intent so as to respond to the ground situations in the shortest possible time.

Maintaining a Sharp Edge

Whilst the promise of networking to fight as a system-of-systems will allow us to achieve greater synergy and combat power on the battlefield, the military organisations will have to balance this with the unwavering need to maintain the sharp edge for warfighting skills. It is afterall the lethal warfighting skills that will deliver a decisive victory with networked capability as an enabler.

Conclusion

Looking back at his achievements in the introduction of new technology into the toy factory, John felt a sense of accomplishment.

He knew deep down in his heart that it is the entire team at the factory who made it work. While it was tough at times during the introduction of the new systems, everyone persevered and never closed their minds to experimenting new ideas and processes. Now that the new systems are running, the factory is more efficient and the working environment has become better as well.

John reminded himself, "It was the people who made the difference".

The information age has opened up new concepts and new opportunities for both commercial and military organisations. For the commercial organisations, the information technology had translated to greater efficiency and better quality products contributing to greater profits. For military organisations, the key is to develop soldiers in their warfighting skills and leverage on networks of information to fight as a system. Soldiers will no longer fight alone; with sharper battle craft, the ability to fight as a system will allow them to deliver a swift and decisive victory.

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Emerging Capabilities –
A Precision Weapon of
Mass Destruction

*by BG Philip Lim, MAJ Shannon Michael Allan,
CPT Lin Maoyu and CPT Nigel Chan*

The current conflict in Iraq offers a study of two contrasting modern warfighting strategies: Precision Warfare and Asymmetric Warfare.

In Iraq, US forces employed precision capabilities involving pervasive high-resolution sensors, real-time command and control systems, and precision attack systems to accurately acquire and eliminate Iraqi targets with Circular Error of Probability (CEP) in the order of several metres. In 2002, the CIA was able to capitalise on real-time intelligence to strike a car carrying Qaed Senyan al-Harthi, al Qaeda's senior operative in Yemen, with a Hellfire missile launched from a Predator UAV.[1] This precision capability has enabled US forces to pursue surgical effects whilst minimising casualties. The ability to strike where and when, and also covertly, has also wrecked significant fear among the Iraqi insurgents. Nevertheless, there are many examples in the Iraqi conflict to suggest that such a kinetic approach continues to cause high levels of collateral damage, given its relative inability to discriminate between friends, foes, and neutrals.

Today, precision warfare remains exclusive to first world armed forces that have deep-pockets to fund the necessary technologies and the intricate know-how to operate such systems. By contrast, adversaries with more limited resources and access to such precision technology have favored the use of asymmetric strategies. Asymmetric warfare employs unorthodox and relatively less resource-intensive modalities such as terrorism and Improvised Explosive Device (IED) bombings[2] against technologically superior foes by circumventing conventional force-on-force decisive engagements.[3] A commonly cited example of asymmetric tactics is the use of suicide bombers or IEDs by Palestinians against the Israeli Defence Forces. More recently, Weapons of Mass Destruction (WMD) have also been brought into the fray. Prior to the outbreak of the 2003 Gulf War, the Iraqis were suspected of developing biological and chemical warfare capabilities with the aim of inflicting mass casualties. Asymmetric warfare's inherent unpredictability, compounded by its lack of proportionality[4], has emerged as an insidious but cost effective strategy to inflict disproportionate fear and paralysis upon its victims.

The Next Wave

Whilst we are likely to witness further growth in precision technologies and innovation in asymmetric techniques, both precision and asymmetric strategies have begun to reach the inflexion stage of their respective development. In particular, further progress in precision technology needed to overcome relatively cost-effective countermeasures is likely to become economically prohibitive. At the same time, nations and armed forces have also become much more resilient to the shock tactics of asymmetric warfare. While both precision and asymmetric warfare will continue to be the dominant doctrine at this stage, the gradual maturation of three technologies – biotechnology, nanotechnology, and unmanned technology may bring about a new form of warfare that could 'disrupt' precision or asymmetric warfare as the next dominant warfare doctrine.

Biotechnology – Propellant for a New Disruptive Capability

Prompted by the impetus of modern medicine, the progress of biotechnology has been staggering in recent years since its inception nearly three decades ago. This technology's double-edgedness, with potential misuse as potent as the new medical remedies it may provide, was recognised as early as the Cold War era.[5] This fear was exhibited and "made public in the 1984 edition of *Soviet Military Power*, an annual Defense Department survey".[6] In particular, three main trends have emerged that has repositioned biotechnology as an imminent candidate for bringing about the next disruptive military capability.

Trends have emerged and repositioned biotechnology as an imminent candidate for bringing about the next disruptive military capability.

The first trend is the ability to sequence whole genomes of various non-pathogenic and pathogenic microbes in a very short span of time ranging from just hours to days.[7] The second trend is the emergence of technologies that allow the creation and manipulation of such microbes. With these two trends, the genome of a pathogen can now be genetically modified and viruses synthesised from "scratch". Scientists from Stony Brook, New York, financed by the Department of Defense, showed that "it was possible to synthesise an infectious agent by in vitro [test-tube] chemical-biochemical means solely by following instructions from a written sequence".[8] This sparked fears that controlled access to biological agents has become increasingly redundant and of the "possibility that the same technique could be used by terrorists or rogue states to make other, more lethal and infectious viruses" such as Ebola, smallpox, and the 1918 flu virus.[9]

Modification possibilities were also demonstrated in this same incident. The poliovirus that was created from "scratch" was genetically modified to be an attenuated form as the scientists sought to demonstrate the ability to produce vaccines from "scratch".

In 2001, Australian researchers further demonstrated the feasibility of creating a more lethal virus or transforming a non-lethal micro-organism to a lethal one. They modified the ectromelia virus (mousepox) in the hope of developing a "virally vectored immunocontraceptive vaccine".[10] The modification, however, rendered the virus "lethal to mice that [were] normally genetically resistant".[11]

The third trend is the completion of the Human Genome Project. With the completion of the genetic mapping of the human genome, there are a myriad of applications which are being researched into – using genes as a basis for insurance, research into diseases that are genetically-linked, and modification of genes to produce designer characteristics and traits in human beings. On the nefarious side, the Human Genome Project has resulted in detailed studies of population genetics, such as the diversity or commonality of certain genes in a population that allows exact discrimination. Initial studies have already indicated the possibility of exploiting such 'precision' for highly specific ethnic targeting.[12]

These trends have raised the serious possibility of developing a low cost but highly discerning and destructive payload.

Nano–Sensors – Fuselage for a New Disruptive Capability

In 1959, Nobel prize-winning physicist Richard Feynman described his vision of constructing micro-structures by manipulating atoms. This has progressed over the years to become what is commonly construed as nanotechnology. According to the Los Alamos National Laboratory in the US, this refers to "the creation of functional materials, devices, and systems through control of matter on the nanometer-length scale; and the exploitation of novel properties and phenomena developed at that scale".[13]

Nanotechnology has diverse applications across a broad range of technologies and industries. One particular development trajectory has created significant interest amongst the military community. This is in the area of Micro Electro-Mechanical Systems (MEMS); and especially in the sub-specialist area of 'Smart Dust' technology. The "Smart Dust" mote comprises MEMS sensors, a transmitter and receiver component, signal processing, control circuitry, and a power source. Researchers are currently developing a carbon nano-tube radio that could serve to transmit between motes, as well as enable them to be cued into a larger communications network.[14] To provide organic steady power source at the microscopic level, scientists at Harvard University are studying nano-wire solar cells[15] or nano-generators.[16] By dispersing such smart dust motes across the battlespace, a self-sustaining network that could act as both sensor and payload release system would be created.
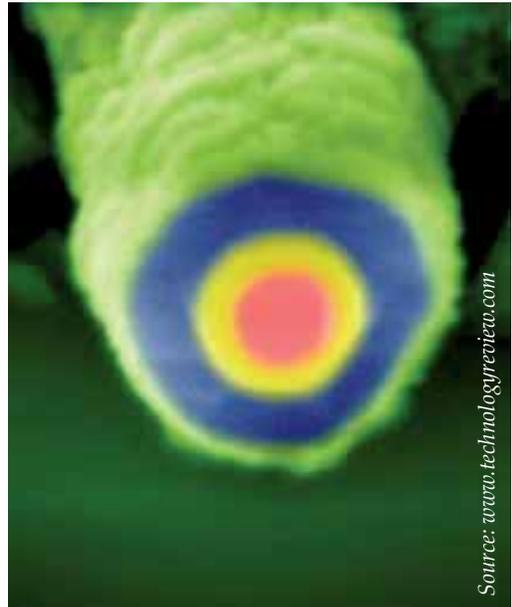
Cross-section of a nano-wire solar cell; just 300 nanometres wide, it could be used to provide organic steady power source at the microscopic level.

Given its minuscule scale, such a sensor and release network system would be almost invisible, undetectable and untraceable.

Unmanned Systems – Wings for a New Disruptive Capability

Unmanned systems have been in use for some time in all domains of land, air and sea. Without needing to carry a human being, such systems can be small and relatively cheap. Since the introduction of Unmanned Aerial Vehicles (UAVs) in the early 50s, we have seen rapid advancement in this area of development. Above all, the most exciting breakthrough is in the domain of miniaturisation. This has been made possible by advancements in materials, microelectronics, and signal-processing technologies. At Harvard University, researchers are working on

a fly-like robot which weighs only 60 milligrammes and has a wingspan of just three centimetres. In the Micro Air Vehicle program, the Defence Advanced Research Projects Agency (DARPA) has also developed an autonomous vehicle with dimensions not exceeding 15 centimetres.[17]

Coupled with stealth technology, such delivery vehicles could manoeuver and hover almost silently above, around, or even inside buildings.

A fly-like MAV; coupled with stealth technology, such delivery vehicles could manoeuver and hover almost silently above, around, or even inside buildings.

Precision Weapon of Mass Destruction

The use of biological warfare is not new. However, its effectiveness has been chequered. Manufacturing, packaging, and especially delivering biological agents have proven to be extremely challenging. Historically, the employment of biological warfare often resulted in large scale collateral damage and fratricide due to the indiscrimination in its targeting. Furthermore, the successful employment of biological

agents depends heavily on weather conditions which are beyond human control. Unsuitable wind conditions can result in the agents being blown in the wrong direction or not allowing them to linger long enough to infect the targets.[18] Humidity and ultraviolet radiation can also result in the rapid degradation of biological agents. Thus the historical application of biological warfare had necessitated employment of biological agents under the most favourable conditions.

With the rapid development and convergence of the three technologies; biotechnology, nano-sensors and unmanned systems, a new employment concept for biological warfare could emerge. Biological weapons could be the future precision weapon while retaining its capability for mass destruction. The precision would be two-fold in that it would be released at the most favorable conditions to ensure success while inflicting casualties confined to a specific target group. Unmanned "Smart Dust" sensors occupying the battlefield space would allow real-time, undetectable reconnaissance of targets and weather conditions of the area. Coupled with the delivery system of miniature unmanned vehicles with their genetically modified biological payloads, a timely attack with a high probability of success could be executed. The biological payloads would inflict casualties on a certain target group, preventing fratricide as they would be modified to act on a gene predominantly present within a particular population. Compared to current kinetic precision weapons, the price tag would be substantially lower, thus allowing once excluded parties or nations to acquire such a weapon.

Its destructive effects would be precise and yet also much more widespread than kinetic precision weapons due to its infection-proliferation-infect cycle which can only be broken by quarantine. Collateral damage or fratricide often associated with both asymmetric warfare and precision warfare would be reduced or even negated.

The psychological effects would be devastating, as it could circumvent international counter- and non-proliferation efforts, current Chemical, Biological, Radiological and Nuclear (CBRN) and medical surveillance and detection models. Furthermore, it would be near impossible to trace the perpetrators as such an attack could be masked as a medical pandemic or an epidemic rather than an intentional attack.

Conclusion

Coupling these three emerging technologies together could reinvent biological warfare in a manner that can be more precise than precision warfare and more devastating than asymmetric warfare in both physical casualties and psychological impact.

Biotechnology has provided man the ability to manipulate micro-organisms. Unfortunately, as with most new technologies, it can be used for nefarious or benevolent purposes. Less than two decades after governments and scientists recognised the fearful potential application of this technology, it became a reality, though unintentionally, as demonstrated by scientists from the United States and Australia. Precision could be incorporated using these same techniques. Just as the speculation of a bomb that could demolish an entire city became reality in 1945, a precision weapon of mass destruction could now become a reality.

Furthermore, with the possibility of transforming biological warfare from simply a weapon of destruction to a precision weapon with massive destructive effects, the ethical argument against its use could be undermined. Biological warfare has long been considered a "taboo" military strategy due to its uncontrollable spread and effects. However, if biological warfare can be refined through these technologies to be accurate and precise, it would be akin to a sniper picking out the senior commander from amongst a group, creating paralysis and fear. In such a scenario, would the application of biological weapons still create ethical dilemmas?

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The Citizen-Soldier and the City Fight: Threat Entrepreneurship on the Urban Battlefield

by BG Chan Chun Sing,
CPT Clarence Cai and CPT Iain Hoo

In recent years the discussion of military operations on urban terrain has turned from debating its desirability to coming to terms with its inevitability. The key features of urban terrain are its density and diversity. The city represents an exaggeration and hyperbolisation of rural areas. Military operations in such a complex environment corresponds to a hyper-war, hence its fearsome reputation and dreaded effects. Yet just as not all cities are the same, it is vital to note how not all armies enter the city as equals. In setting the conditions for the dominance of our forces in an urban environment, close attention must be paid to the characteristics of our forces and their relationship with the urban environment. We must not be blind to, nor seek unthinkingly to erase, our differences from conventional armies.

Singapore City is defended by Singaporean city-dwelling citizen-soldiers. In this essay we explore the consequences of this coincidence,

ultimately arguing that there is a latent affinity between the city dweller and the city fight that can be unlocked through an intelligent investment in what we term effects-based training. This latent affinity lies in the role of the citizen-soldier as a threat entrepreneur in the city fight.

The Latent Affinity of the City Dweller for the City Fight

The city-dwelling citizen-soldier does not have a straightforward affinity for the city fight. We must be wary of any suggestion that the peacetime urban experiences of our soldiers translate directly into combat power during urban operations. This is especially so if it provides a false optimism, that by virtue of their urbanity, our citizen-soldiers can be expected to perform like fish in water on an urban battlefield.

Unlike the jungle where local inhabitants have home ground advantage, the city under siege is an environment alien to both its hitherto dwellers and uninvited guests. There is thankfully little similarity in conditions between Hougang Central on a weekend and the *Rattenkrieg* ("War of Rats") that consumed contested European cities during World War Two. If the modern city is a collection of solutions *par excellence*, the urban city under conditions of conflict represents the breakdown of many of those solutions: invariably, shelter, plumbing, electricity and other modern conveniences that breakdown under conditions of hostility. The city dweller may also suffer from a vestigial false sense of security which may prove costly when danger lurks around every corner and behind every loophole. Indeed one might say that city dwellers are patently worse off when it comes to city fights since they are dependent on the crutches of modern living and are helpless as babes under conditions of war.

Where then might we find relative combat power in "a nation of shopkeepers", as Hitler once famously said of the United Kingdom? In order to recognise the latent affinity city dwellers have for the city fight we must look past discontinuities and recognise the city for what it will continue to be even under siege, an evolving collection of problems, solutions and problem solvers. Only then can we see the special place for a new kind of entrepreneur, the *threat* entrepreneur on the urban battlefield.

Although the city under conflict has most of its solutions to comfortable living compromised, the remnants of these previous solutions quickly provide the raw material for solutions of subsequent problems. The city dweller has surrounded him or herself with solutions for comfortable living, in like manner can the city fighter provide intelligence and organisation to the "rubble" in service of tactical and strategic ends. Urban terrain is human terrain; its very existence is testimony to its malleability. Just as a city is a commitment to altering one's environment, so too can it, under conditions of conflict be altered. Windows can be bricked up leaving embrasures; mouseholes can be broken into walls, sapper tunnels can be dug, booby traps laid. Buildings can be levelled, walls breached, streets, hallways, stairwells, doorways barricaded.

The malleability of the urban environment should not be thought of as a purely structural adaptability. Instead, the physical malleability of the city should be seen as a function of an even more unstable entity, the human capacity for problem solving (and giving) that shapes the urban environment. The humanity that both *adapts* as well as *adapts to* his or her environment is also the reason why such continued, relentless adaptation is necessary, as solutions compete, not with the demands of a static and predictable "natural" environment but against the ruthless ingenuity of myriad adversarial problem solvers.

This dynamism is especially apparent on an urban battlefield where troops find themselves in close proximity to the adversary for protracted engagements.[1] Each iterative combat encounter is a contest not only of wills but wits. This is the soul of the hyper-war. Adding fuel to fire, troops operating in an urban environment will find themselves inundated by tools. They can expect traditional military equipment and capabilities ranging from organic artillery support and small calibre mortars, to armoured and close air support. They will also have access to assets requisitioned from the "rubble" of the urban battlefield.

For the city fighter, fully utilising the range of capabilities available to him goes beyond his basic proficiency as a weapons operator. He needs to become something more of a threat entrepreneur, adapting and innovating weapons and his environment to constantly overwhelm an evolving enemy's defences. Threat entrepreneurship means that it is no longer enough to simply learn a solution well. This inadequacy was demonstrated in the terrible price German sappers paid in the battle for Stalingrad. Already veterans of city battles, they applied many of their tactics and strategies to their fight in Stalingrad where their tactics met with new and innovative answers that they were not prepared for resulting in heavy losses.[2] Threat entrepreneurship is the diabolical skill of thinking up new ways of hurting a similarly evolving enemy.

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In addition, the remaining inhabitants of a city can be counted upon to add a slippery complexity to the operational environment as they renege on alliances, build new ones, betray, supplicate, deceive, trust and seek protection. Threat entrepreneurship in the urban environment would have to take this web of intrigue into account as well. In other words, the confluence of abundant humanity and resources under desperate and violent conditions produce a evolutionary hothouse that favours an entrepreneurial and evolutionarily agile force. Recognising the "co-evolutionary" challenge of military operations, Scott Gerwehr and Russell W. Glenn in their study of deception in warfare[3] have proposed profiling the "adaptive index" of "battlefield elements". This index would describe the evolutionary agility of forces, the "capability, likelihood, and swiftness" of a group to adapt their operations.

At this point our discussion of what it takes to achieve dominance on the unpredictable urban environment intersects with our earlier discussion regarding the latent affinity of city dwellers for the city fight. Amongst the many questions military scholars Gerwehr and Glenn ask when considering the adaptive index of a military unit is, "How much baseline heterogeneity exists in the group?" The reason for asking this question is that adaptive solutions arise less out of the sheer genius of an individual but more often are pre-existing solutions that have been recovered from the collective experiences of members of the organisation, judiciously and creatively applied.

Groups like our city-dwelling citizen-soldiers possessing of great diversity in the skill sets, behaviours, languages and cultures of their members have an edge when confronted by extraordinary, non-run-of-the-mill situations. Indeed the less urban operations resemble recognisably "military" operations, the more these operations will call upon skills and behaviours beyond the ken of conventionally trained forces. Language skills, negotiative shrewdness and marketing savvy are examples of skills more associated with civilian endeavours than straightforward soldiering. The enormous heterogeneity inherent to the citizen-soldier thus represents a latent reserve of threat entrepreneurship that needs to be tapped.

Source: Army News

The less urban operations resemble recognisably "military" operations, the more these operations will call upon skills and behaviours beyond the ken of conventionally trained forces. The enormous heterogeneity inherent to the citizen-soldier thus represents a latent reserve of threat entrepreneurship that needs to be tapped.

Cultivating Threat Entrepreneurship via Effects–Based Training

This latent affinity city dwellers might have for the city fight needs to be both protected from and exploited by our Army. As an army, we need to better learn how to requisition the "street smarts" and entrepreneurial instincts of our men. If we know the key to force superiority on the urban battlefield is threat entrepreneurship, training as we expect to fight means exercising the threat entrepreneurship of our men. What this means is that training must respect, demand and reward initiative at all levels. The organisation needs to be trained to not only tolerate a certain amount of diversity, but accelerate the process by which good ideas and practices "catch on" and are improved upon.

Yet how should we go about exercising this entrepreneurship? While, as a trainer once remarked, "MOUT (Military Operations on Urban Terrain) is up to your imagination", surely not "everything goes". We suggest that providing men and commanders with *selective pressure* rather than *selected answers* to complete missions might hold the key to equipping our men for urban operations. Such selective pressure comes from providing more realistic feedback to our soldiers of the effects of their weapons systems and drills. We call such training that allows soldiers to feel the effects of their performance in the field *effects-based training*.

The danger of current training is the presentation of "floating head" solutions, i.e., solutions that are presented without an adequate sense of the problems that occasion their existence. Trainers have hitherto been faced with the unenviable task of conditioning an instinctive response to hardly imaginable tasks. Such training that bypasses the minds of our men is allergic to initiative and adaptation. If the comparative advantage of our forces in the urban battlefield lies with the exploitation of the heterogeneity of our men to create a highly adaptable force, training according to such a model would seem to be not only missing the point but blunting it.

In contrast to familiarising our troops with battle drills, effects-based training claims no such intimacy with "correct" or "proven" techniques. What we mean by effects-based training can best be described by asking ourselves where we locate ourselves as trainers and evaluators. Do we stand inside the room being cleared or outside with the clearing troops? Instruction must take place from the point of view of the most exacting referee – the intelligent evolving enemy. Effects-based training demands that the trainer observes from around the corner being scanned, inside the room being cleared. The effects-based trainer needs to be creative in how the selective pressure of operational constraints can be imitated and brought to bear on problem-solving troops, not dogmatic about the methods used to achieve those ends.

Some techniques for applying selective pressure have become more readily available in recent years. These include the more widespread use of simunitions as well as more sophisticated and robust sensors that better simulate

the effects of a whole range of weaponry including indirect fire.

Yet beyond the allure of such Gucci gear, it must be clear that effects-based training is a perspective on training, not merely a slave to cost and technology.[4] Effects-based training is not merely about more "realistic" training *per se*. To employ simunitions and sensors while remaining enslaved to some narrow orthodox vision of what the urban battlefield has to look like is to be conducting nothing more than an elaborate battle indoctrination course. More significantly effects-based training is about practising the dialogical process between problem and solution, evolving problem and evolving solution by releasing troops from the restraint of the trainer's imagination and experience and exploiting diverse experiences, skills and perspectives to simulate an evolving battlefield. It is here that the realism lies, not in a reality we can increasingly become familiar with but in one that will constantly de-familiarise itself to us.

With effects-based training, training is not merely a means to achieve some pre-determined standard cast in concrete. Rather training is itself the process by which we practise applying ourselves to situations of great constraints and adapting our solutions using techniques that have historically been successfully applied in combat whilst freely availing ourselves of ideas and innovations out of personal, diverse experiences.
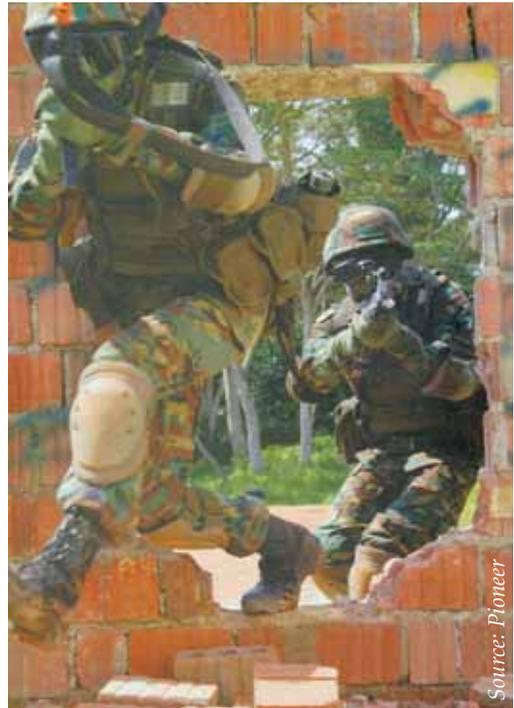
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For effects-based training to be effective, it must be self-correcting. After all, not all solutions are equal; just because we deny the monopoly of trainers on correct solutions does not mean that there are none. Carried out like this effects-based training would not be training adaptability, it would be breeding a circus. The effects-based trainer must serve as a mirror for his or her troops. This mirroring function can range from installing

literal mirrors or capturing images in various formats for troops to recognise their own vulnerabilities to role-playing enemies who have the ability to inflict hurt on the troops. This can be done either through simunitions or sensors followed by casualty evacuation or other consequences that make it worth their while for troops to update their own performances. These consequences need not all be unpleasant, competition for rewards and honours must also be taken into consideration when designing such training events. These consequences, whether pleasant or unpleasant, are necessary to providing the selective pressure that must be applied to the behaviours and strategies of our men as a stimulus for adaptation.

The effects-based trainer can and must exploit the unscripted nature of effects-based training to constantly update and vary the problems and scenarios troops are required to negotiate. One way of doing this is by repeating engagements with a twist, where troops might be required to adapt their previous solutions in the event of one man down scenarios, barriers to Route Of Advancement (ROA), alternate entry points, as well as numerous other what-ifs. If this task proves too much for the lone trainer, or if the trainer finds him or herself hampered by his or her own conventional wisdom, then force-on-force scenarios might prove to be a reliable source of adaptations. At any rate the emphasis of effects-based training must be on the policing of effects, not of methods or means. There is little to say that this policing might not be even better carried out by competitively vigilant troops themselves.

Conclusion

Far from suggesting the redundancy of drills, this essay is merely observing the limitations of such methods of training. Drills will still be necessary for equipping troops with skills that they can bring to the fight. Basic drills that equip our soldiers with good military practices and sound tactical sense will continue to mean the difference between life and death under most circumstances. Applied without an expiry date and an entrepreneurial edge however, these drills can prove a deathtrap. What drills must not do to our citizen-soldiers is amputate parts of them that are perceived to be incommensurable with the military and enforce a gulf between their rich civilian experiences and their military conduct. What these drills need is to be complemented by alternative forms of training that will cultivate what we have termed threat entrepreneurship and in so doing rehearse our citizen-soldiers for the unique challenges of co-evolutionary warfare in an urban environment.

In an urban environment, adaptability and initiative become the keys to force superiority in an evolving and fluid theatre of operations. Tried and tested solutions quickly become tired, tested and obsolete – if not dangerous, solutions. The urban warrior must not merely learn how to fight in the city. More importantly for his survival (and conversely for the demise of his or her enemies), the urban warrior must *learn how to learn how to* operate, in other words, to become a threat entrepreneur. In this light the heterogeneity of our citizen-soldiers in terms of their varied life experiences acquires a tactical

importance. This heterogeneity (as opposed to the homogeneity that is strived after and in most cases achieved in most modern professional armed forces) provides a strategic reserve of experiences that must not be too hastily disciplined away by standard military regimentation and drills. Rather, this reserve of heterogeneity must be preserved and exploited by respecting, demanding and rewarding initiative at the most fundamental levels of our infantry forces. Training must stop insisting upon what must necessarily be inadequate solutions. Instead, training must focus on providing the selective pressure that will allow our forces to practise the speed and judgement with which they reconsider tactics, strategies and behaviours on the ground.

Endnotes

1   G. J. Ashworth, *War and the City,* (Routledge: London, New York, 1991), p20.
2   Supposedly "consummate professionals" at street fighting, five battalions of "pioneers," German combat engineers were sent to Stalingrad to eliminate final pockets of organised Soviet resistance. An excerpt from William Craig's account of that fight shows up their complacency.
"The pioneers asked questions about the buildings and the cliff along the river. They were brisk, business-like, but when Rettenmaier [Battalion Commander of the German unit in Stalingrad the pioneers had been sent to reinforce he had thirty seven men out of four hundred remaining] and others tried to explain that the Russians in Stalingrad fought a different kind of war, that they hid in cellars and used the sewer system to good advantage, the pioneers said that they had seen the worst already, in places like Voronezh. They were prepared for such tactics."
Within days a third of that force of nearly three thousand shock troops had been lost. William Craig, *Enemy at the Gates: The Battle for Stalingrad* (London: Hodder and Stoughton, 1973), p155.
3   Scott Gerwehr and Russell W. Glenn, *The Art of Darkness: Deception and Urban Operations.* 2000. http://www.rand.org/publications/MR/MR1132/
4   An example of a creative method for applying selective pressure is provided by then Col Thomas X. Hammes of the USMC. In a 1998 essay for the Marine Corps Gazette, he writes of how an effective substitute for relatively expensive simunitions was found in Daisy lever action BB guns. 3rd Battalion, 5th Marines bought fifty sets of BB guns and paintball masks costing roughly 40 USD per head. After the initial investment, training is very cheap with BBs only a penny for 20. Thomas X. Hammes, "Time to Get Serious about Urban Warfare Training." *Marine Corps Gazette*, 1999.

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Making Sense of Sense-making

by COL Yeo See Peng, MAJ Seet Uei Lim,
MAJ Alan Yeoh Keat Hoe and CPT Colin Chu

"Know the enemy, know yourself;
A thousand battles, a thousand victories."

Sun Tzu

Introduction

History has no lack of military blunders when nations failed to make sense of what, in hindsight, seemed to be clear and present dangers. Take Post-World War I Europe for example, where in spite of the Germans' creation of independent armoured forces to achieve deep strategic penetration, the French doggedly proceeded to continue reinforcing the Maginot Line and establishing numerical superiority, i.e. preparing to fight the last war. Or the 1973 Arab-Israeli War, where Israel was surprised by a joint attack launched by its neighbours, Egypt and Syria, during Yom Kippur, despite several early warning indicators. The rest, as we know it, is history.

As our Army prepares for the Next Generation of Warfare (NGW), our military commanders are required to make sense of increasingly uncertain,

complex, vulnerable and ambiguous situations and environs. This raises the requirement for a better understanding of our own cognitive faculties that will enable us to navigate the chasm of challenges posed by NGW more effectively. In this context, there is an impetus to understand our individual and organisational cognitive tools and processes, known as "sense-making", more deeply and bring about the knowledge advantage over any potential adversary in any mission-task.

Aim

This article aims to examine the role and purpose of sense-making in a NGW milieu, and to study its practicability and application at the individual soldier, tactical and operational levels, with the hypothesis that sense-making quality can be qualitatively assessed.

Sense–making: A Cardinal Requirement

Sense-making[1] can be defined as an ability and process of creating enhanced situational awareness and understanding under conditions of high complexity, time pressure and uncertainty, both as an individual or as a group, to anticipate trajectories and enable collaborative planning and decision-making. It forms an essential component of the Integrated Knowledge-based Command and Control (IKC2) model, in creating the knowledge advantage critical for actions.

A Requirement in the Next Generation of Warfare

"The first, the supreme, the most far-reaching act of judgement that the statesman and commander have to make is to establish... the kind of war on which they are embarking; neither mistaking it for, nor trying to turn it into something that is alien to its nature"
Carl von Clausewitz, *On War*

Sense-making is not new to the SAF, our people have always been engaged in "making sense" of our mission, adversaries, own forces and operational environment. In response to the threats and operating paradigm so characteristic of NGW, the importance of sense-making is heightened manifold.

Unknowable Uncertainty

Martin Van Creveld famously declared that *"War is an irrational business par excellence[2]"*, and not only would this truism remain a constant in future conflicts, NGW augurs even greater uncertainties since it would no longer be confined to the Physical dimension of platform and force-on-force attrition, where the Mental and Moral dimensions[3] would enjoy greater salience in operations. For instance, in his testimony to Congress, General Petraeus remarked that the *"fundamental source of conflict in Iraq is competition among ethnic and sectarian communities for power and resources"* and not "the enemy" in the traditional sense. This lack of a tangible "enemy" has seen a shift towards

Effects-Based Operations (EBO), where both lethal and non-lethal means are employed against an adversary's centres of gravity, many of which are intangible and even irrational to us. Jim Schiender[4] also noted that increased precision and lethality of weapons have resulted in increased dispersion of assets, which may lead to an "Empty Battlefield". In such environments, appropriate sense-making frameworks would greatly assist our analysis and appreciation of situation, thereby enhancing survivability, protection and mission success.

Varied Complexity

Operation Iraqi Freedom (OIF) is the latest testament that wars have grown in scope and complexity. The 3-Block war requires an Army to be cognitively adaptable to changing context, able to sense-make and prescribe relevant approaches to complex problems. Additionally, urbanisation has led to operations in labyrinthine conditions, often compounded by the presence of non-combatants masking militias. Future operations are also likely to include multiple coalition partners who may not share our intent and strategy. In NGW, sense-making can no longer be directed towards a particular physical entity with a singular intent but would require navigating through an intricate web of varied entities with multiple intents, notwithstanding the tacit need to appreciate one's coalition partners.

Close–In Vulnerability

Close Quarter Combat and sub-unit skirmishes are likely to be the norm in NGW. These would require our ground troops to perform instinctive immediate-action drills, while exercising superior sense-making in the determination of friend or foe, and the application of the corresponding appropriate level of force.

Asymmetrical Threats

Asymmetry is the tactic of choice by insurgents, terrorists and militias, when pitted against superior armed opponents. These threats strike at targets of opportunity, and dissipates as quickly as it appears, leaving little or no trace for our shooters to target. In these situations, the emphasis on sense-making for pre-emption becomes critical, vis-à-vis capable weapon platforms. Dealing with these threats effectively warrants an understanding not only of the physical but social and moral dimensions of the Area of Operations (AO) to shape perceptions and operating conditions. Effective sense-making employing minute indicators and clues to populate a frame and single out vulnerabilities and entrapment opportunities, would be key in the fight against asymmetrical threats.

Learning Army Thinking Soldier

In answering these challenges, an adaptive and smart Force, built upon a culture of organisational and operational learning is paramount. Aptly, the concept of *Learning Army Thinking Soldier* addresses this need, with its two-pronged focus on the system/organisation and individual soldier, and this is where sense-making plays an important role.

The Learning Army

A Learning Organisation is one where After Action Reviews (AAR) are habitually conducted and the lessons learnt are promptly documented, disseminated and used, such that no mistake is committed twice and through experiential learning (i.e. building cognitive repositories as part of sense-making), we emerge as an adaptable organisation that is able to transit seamlessly through the continuum of operations. A Learning Army would also be sensitive to indicators of change and nuances through effective sense-making to avoid fundamental surprises. It would thus be comfortable working in the realm of uncertainty, being attuned to developing patterns in the theatre of operations and agile in responding to operational requirements.

The Thinking Soldier

A story from the first phase of Operation Iraqi Freedom was recounted, when U.S Marines occupied a Shiite town in Southern Iraq. A Marine Corporal was leading a patrol through the town when it encountered a funeral procession coming the other way. The Corporal immediately ordered his Marines to stand aside and take off their helmets as a sign of respect. Word of that action quickly spread around town, and it helped the Marines' efforts to be welcomed as liberators, which in turn had the operational impact of keeping Shiite Southern Iraq, through which American supply lines had to pass, peaceful. The opposite effect could just as easily occur, the Abu Ghraib Prison being a case in point. Nowhere in military history has the individual soldier's decisions and actions had

such strategic impact, which is further heightened by the presence of the media giving real-time coverage to a worldwide audience. Thus, to borrow an old maxim, "every soldier a sensor, every soldier a sense-maker", is a requisite reality in the prosecution of NGW operations.

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An Integral Component of IKC2 – Organisational Perspective

The *Learning Army Thinking Soldier* initiative therefore positions us well by providing our soldiers and command teams a foundation set to stay ahead of the challenges of NGW. Supporting it is the key enabler construct of IKC2, whereby sense-making forms the integral component in delivering the knowledge advantage, empowered by its Network Centric connectivities.

Integrated Knowledge

IKC2 enhances combat power with speed and precision[5], through its network-enabled and knowledge-driven Command teams. At the heart of this value proposition is the promise

to enable Commanders to out-OODA the adversaries OODA loop. For instance, the collection of more data do not necessarily lead to more accurate explanations and predictions.[6] In fact, campaign studies suggest that increasing data may lead to worsened decision quality[7], as evident in the Yom Kippur war, where decision makers had more than sufficient data but their difficulty was in analysing and interpreting these data correctly.[8] By being Integrated and Knowledge-based, we can "make sense" of the voluminous data we Observe, or in OODA terms, to Orientate ourselves to the collected information more rapidly and effectively, to distil trends and arrest emerging patterns. Sense-making then is pre-supposed in IKC2 and its effectiveness is dependent not so much on the quantity of data[9], but the quality and richness of insights that is derived from its timely and precise analysis.

Network Centric Warfare (NCW)

As a system of systems to integrate individual parts, units and nodes, the capability-outcome of NCW is greater than the sum of its parts. Here, sub-units are plugged into an information, decision-making and communication network where there are cross-domain and cross-functional sharing of information, thereby empowering Commanders with the ability to not only sense-make the situation within his own area of interest, but also in a better position to appreciate the situation in his adjacent and higher Commands and provide data points for higher headquarters to sense-make the global situation.

A Guiding Principle for Training the 3rd Generation SAF – Individual Perspective

The idea that every individual is a sense-maker, who has a role in ensuring mission success must be imbued and cultivated from the moment one enters the system, and periodically reinforced. This will require a re-look into training methodology and pedagogy that aims to ignite our naturalistic cognitive functions to "Ask" and "Question". Varied experiential exposure that increases the library of experience to deal with uncertainty and complexity should be a key component of any training course.

In NGW, we would need to also shift our mental models, to appreciate that wars are no longer limited to being fought in the Physical time and space dimension, but also in the Mental and Moral battlefield. The recent Lebanon conflict is a case in point. Although the IDF literally won every tactical engagement, in the minds of its neighbours, it did not win the war, as word got around that the once invincible IDF failed to prevent a rag-tag Hezbollah from launching rockets into Israel; witness Hezbollah launching the same number of rockets onto Israel on the last day as it did on the first.

Sense-making: Practical Construct

Thus, effective sense-making will drive our Army forward and must be applied at every level of Command. Sense-making begins with knowledge of oneself and how one's cognitive faculties interact and interpret stimuli,

which we will now explore deeper in deriving its potential application niches.

Today, there is no shortage of theoretical cognitively-enabled constructs supporting sense-making, both at the individual and organisational level. To name a few, the OODA Model developed by Boyd[10] addresses the concerns of military decision-making process with the 'Orient' sub-model, attempting to capture the cognitive processes involved in sense-making; the Situation Awareness Model by Endsley[11] defines situational awareness into three distinct levels that differentiate perception of elements within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future; the Data/Frame model by Klein[12] argues sense-making as a process of framing and re-framing, fitting data into a frame or mental model, and fitting a frame around the data; the Cynefin Model by Kurt and Snowden[13] explores the effect of problem type and environment (ordered and un-ordered domain) on sense-making and decision-making capabilities.

Drawing inspiration from the wide interests in this field, the SAF Military Centre for Experimentation (SCME) and the Future Systems Directorate (FSD) have embarked on an experimentation journey over the past couple of years with the aim of driving the development of sense-making capability, so as to achieve a Cognitive Edge (i.e. ability to make faster and better decisions than the adversary) for the 3rd Generation SAF. To date, added clarity on the fundamentals and requirements of sense-making have been gained through several field experimental trials that led to the formation of a broad sense-making framework, articulating the key sense-making challenges at hand versus the desired outcomes, and the lists of possible conceptual solutions.[14] Moving forward, for these constructs to be useful, practical forms of application for these solution sets have to be designed.

While the term "sense-making" may have come into fashion in recent years, its form and function have always been in existence across the Command echelons, down to the individual soldiers. The immediate issue beckoning is however not the type of sense-making construct needed, but the level of cognitive edge, or simply, the quality of sense-making attained. Therefore, before one could aptly apply any sense-making solution sets, it is necessary to first gain a level of qualitative appreciation of the sense-making quality achievable, while in cognisance of the underlying contextual background (i.e. echelon level) and its related intrinsic/extrinsic requirements of sense-making.

In the context of military operations, the quality of sense-making may be defined as the level of knowledge (i.e. appreciation and understanding) of the real intent of the adversary (i.e. state and non-state) in his conduct of operations, and accounting for his shifting and changing strategies, amidst the dynamics of battlefield conditions. This stems beyond merely knowledge of the adversary's dispositions and layout, but to the heart of his intent driving his courses of action. This is analogous to playing a chess game where full

situational awareness of the various pieces and rules of engagements do not necessarily guarantee a win, but victory goes to the one with superior cognitive ability (i.e. predicting and countering the movements of the opponents).

A broad understanding of the inner mechanism of sense-making is essential to draw any specific correlations of any quality-determinant parameters. The dynamic model of situated cognition (i.e. sequence of situated acts) designed by Shattuck and Miller[15] provide a purist understanding of the mechanism of sense-making in terms of data flow from the environment, through sensors and other machine agents to the human agents in the system (see Figure 1).

Using this model, one can safely draw the hypothesis that the sense-making quality, Q(SM), at both individual and team level should largely be a qualitative function of both the technological systems and cognitive systems parameters, as illustrated in Figure 2.
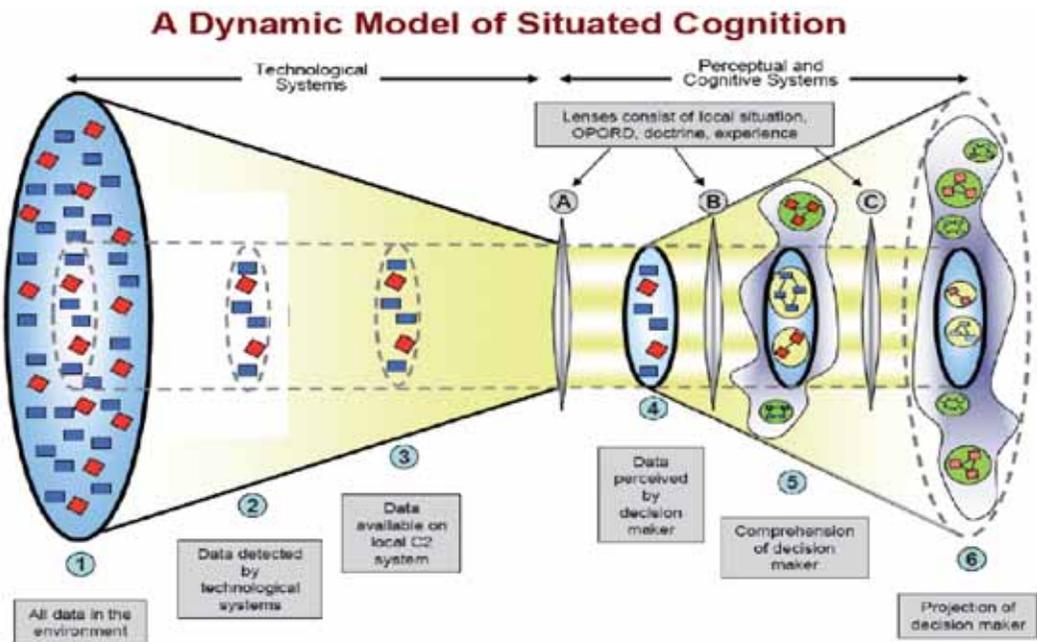
Figure 1. A Dynamic Model of Situated Cognition

Source: Shattuck and Miller, 2004
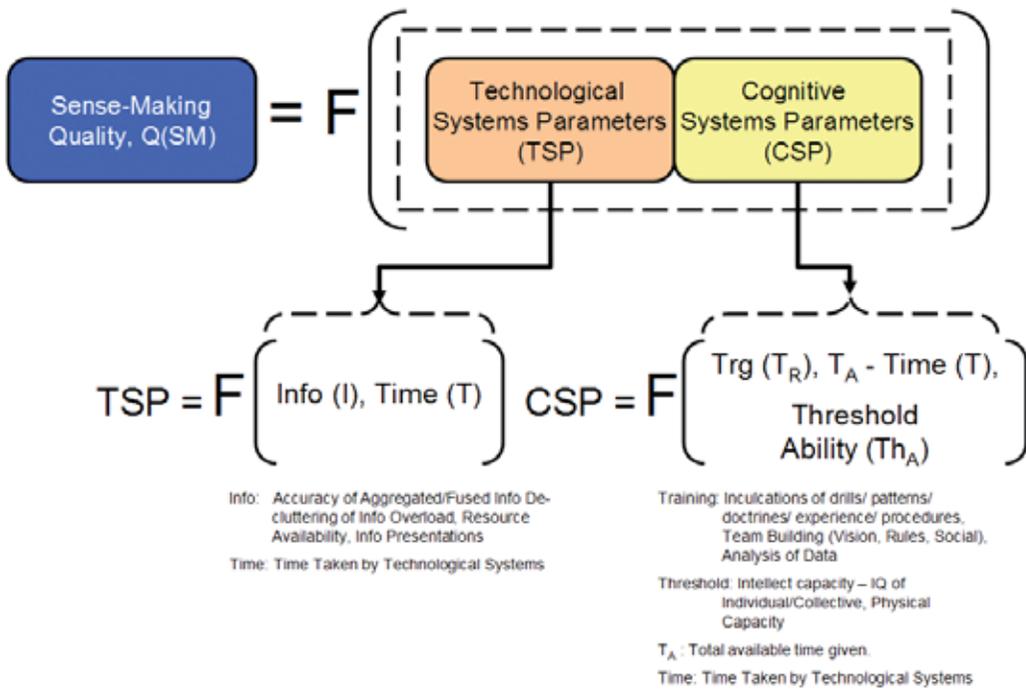
Figure 2. Simple Analytical Representation of Sense-Making Quality

This analytical representations premise itself on the assumption that the qualitative value of both TSP and CSP are directly proportional to the final sense-making quality attained, given the boundary constraint of a fixed total time available (T_A) for the sense-making process. By breaking down the key determinant parameters of TSP and CSP further, one can postulate a broad qualitative function of both information quality (I) and time (T) for TSP, and a qualitative function of training quality (T_R), time (T) and cognitive threshold ability (Th_A) for CSP, with the following assumptions:

Information quality (I) is a collective qualitative representation of how data is collected from various sources given the available resources, correctly fused and collated with accuracy, and supported by an information system that would be able to reduce information overload through filtering and Man-Machine Interface (MMI) presentations.

When more time is given to the individual/organisation, there would be overall improvement of the quality of TSP and CSP, regardless of its incremental value or diminishing value effect, if any. Time (T) here is defined as the time taken by the technological system to collate and process the information. Whilst a high time (T) may improve the quality of TSP, given a fixed total time available (T_A), the quality of CSP may degrade due to shortage of time i.e. T_A- T, and vice versa. This is also based on the simplistic assumption that the cognitive thinking process will only commence after the technological processing of information has completed, though in reality this may not be so.

$$Q(SM) = k\,F\left[I \times T \times (T_A - T) \times T_R \times Th_A\right] \quad \text{where } T_A : \text{total time available}$$

*Figure 3. Mathematical Model of Sense-Making Quality (k : constant)*
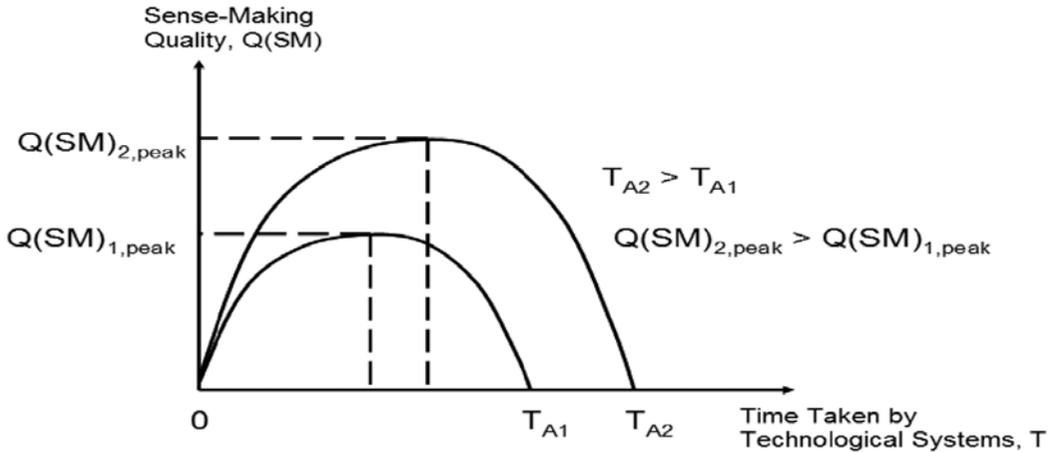
Figure 4. Hypothetical Qualitative Influence of Time to Sense-Making Quality (Assume: all other parameters being constant)

Training quality (T_R) takes on the forms of battle drills/procedures, recognition of patterns/doctrines, experiential learning and application of knowledge, team building values (i.e. roles, rules and relationships), and the analysis of information.

Every individual or team in an organisation has a characteristic collective threshold level (Th_A) of intellectual and physical capacity, in terms of intelligence quotient and cognitive capacity to handle mental tasks, which would uniquely differ from individual to individual or team to team.

Mathematically, the sense-making quality could be dimensionally represented as shown in Figure 3. An interesting find is that the time taken parameter (T) has an inverse hyperpola relationship with respect to the sense-making quality and is therefore an influential parameter to study. This hypothesis posits that an optimal sense-making quality can be attained by

weighing between the amount of time devoted to technological and cognitive solution sets (see Figure 4). This simple qualitative hypothesis of sense-making quality would next be applied at the individual, tactical and operational level to crystallise the specific requirements and the type of possible solution sets needed.

Sense-making: from Theory to Action

Individual Level

At the individual level, soldiers are directly exposed to battlefield elements and their sphere of influence is often small, largely determined by the operational range and specifications of the weapon systems they operate. Soldiers constantly monitor and assess their immediate physical environment in order to predict or pre-empt how the situation will unfold and often adopt the appropriate immediate action posture. The time available for sizing up the situation and for decision-making is brief (i.e. low T), and to overcome this shortcoming, Q(SM) suggests that the information quality (I) presented to the individual and the training quality (T_R) he receives now play a dominant role.

Information presented has to be naturalistic to our soldiers so that situational awareness is easily grasped, for instance through a soldier's personalised Battlefield Management System (BMS). The cognitive processes adopted to handle information need to be examined in depth so as to sieve out the key intrinsic stimuli that facilitate quick processing and expanded capacity to handle more information.

With the dynamism of the next generation battlefield with regard to both conventional and asymmetrical threats, this cognitive requirement of the individual is gaining greater importance. Recognition-Primed Decision-Making (RPDM) process (i.e. Klein[12]) in the form of pattern matching would also be useful in this respect, where familiar patterns of the situations, or scenario-based training, are drilled and recognised by the individual to facilitate the execution of immediate action drills. Training forms are needed to notice and quickly diagnose anomalies through the exposure to a range and richness of possibilities, especially with regard to asymmetrical threats. Honing the experiential level of the individual to operations also play an important role in building up and applying these patterns effectively.

Tactical Level

In this study, Tactical Level is defined as the Brigade level and below. Unique to this level would be the presence of team operations that introduce other dimensions to sense-making. Collective thinking and team dynamics become more apparent, and it is arguably sound that more time needs to be devoted for the cognitive processes as compared to individual level. It is also at this level where a common ground situational awareness is crucial to bridge a common appreciation of situation for all, and to allow for self-synchronisation. The primary workspace for this has traditionally been the Geographical Information System (GIS) based interfaces or simply the map. By creating a common awareness for all individuals in the team construct,

more time would be freed (i.e. lower time taken for technological systems), and this is crucial in the race to out-wit, out-pace and out-do the adversary.

In tactical operations, sense-making needs to be adaptive during the two distinct stages of operations: planning and execution. Fluxes in terms of movement of units and engagement of forces are often lower during the planning stages vis-à-vis execution, when often combat exchanges and the ensuing outcomes (i.e. attrition) shape the courses of action, and time available for decision-making (i.e. quick battle procedure/fragmentary orders) is shorter, particularly for mobile operations.

Much research and experimental work has been done by FSD with regards to the planning stage. In collaboration with the Swedish Armed Forces, a theoretical Team Insight Model (TIM)[16] was derived to develop a tactical level battle procedure, termed the Planning Under Time Pressure (PUT) model[17]. Whilst more research work is needed in this field, some degree of success was reported in cutting the amount of deliberate planning time needed to conduct an operation.

The Plan-As-You-Execute (PAYE) model architecture introduced by Ntuen[18] provide an interesting insight to cope with the dynamics of non-traditional battlefield conditions and processing complex information during the execution stage. Often battlefield realities seldom match the assumptions and postulations made about the adversary during the planning stage, as espoused by Clausewitz (1780-1831)[19]

who maintained that war is inherently uncertain due to the unreliability of Intelligence and the interaction between opposing forces. The PAYE model is a collection of cognitive models designed to improve on the OODA model by capturing multiphases of sense-making enactments along operations cycles, one of which include a Question and Answer sense-making query system that constantly probe and query the how, why, when, which, what and who.

Although it is said that planning assumptions often run contrary to what happens in combat, the value proposition that deliberate planning provide to elevate the cognitive ability of the Headquarters (HQ) cannot be undermined. It is through the hours of deliberate consideration and formulation of the plan that a powerful cognitive map is painted and ingrained in every individual to prepare him for operations and to be adaptive for contingencies. The crucial point is to ensure that each of these cognitive maps are consistent for everyone such that the Commander's Intent is well-understood and the various execution steps are internalised. This also alludes back to the need for training and war-gaming, as part of the Recognition Primed Decision Making (RPDM) process to entrain patterns whilst being exposed to irregularities.

Operating in a team environment does not necessarily lead to collective wisdom. Team composition, along with team roles and leadership quotient, and the established rules and relationships of the team, impacts on the quality of sense-making. Communication

amongst individuals within the team, be it through face-to-face, Command, Control and Information Systems (CCIS) or video conferencing, forms essentially the bridge in conveying thoughts and opinions. Whilst at times diversity of perspectives from different knowledge domains are essential to create awareness and provide alternative views for decision-making (i.e. promote dissent), diversity without order may be disastrous and time-wasting. On the other hand, the hierarchy in military structures, or the dictates of time pressure, may hinder the harnessing of collective wisdom. The key is to create a structure or operating environment that would be able to strike a good balance between both extremes.
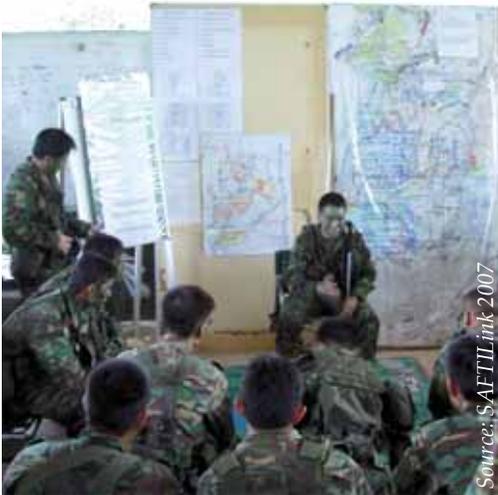
After hours of deliberate consideration and formulation of the plan, it is crucial to ensure that the cognitive maps are consistent for everyone such that the Commander's intent is well-understood and the various execution steps internalised.

Operational Level

Operational level in this study is defined as the Division and Force/ Service HQ level. It is essentially an extension of the considerations given to Tactical Level. At this level, the area of operations are wider, situations are far more broad, complex and uncertain with expanded civil, media and political dimensions, and would evolve over longer stretches of time. The HQ is relatively static throughout operations, with the exception perhaps for mechanised forces. Nevertheless, the HQ must be able to collectively make sense of the adversary's dispositions, intentions and capabilities, as well as anticipate the effects of their own forces' actions. Averting fundamental surprise would be the aim, and the challenge for sense-making would be to select an effective frame, levering on computing technology, to be able to sieve out patterns or anomalies amidst massive amount of data i.e. cognitive agility.

Data mining techniques on voluminous data could be used to trace and identify the adversary's intent through the tracking of its movements and deployments of units, and given enough information, the systems could even perhaps augment decision-making by postulating intelligent inferences. For instance, the sightings of a mobile armoured force could be linked to a specific parent unit(s) based on prior understanding of the order of battle.

Operational level planning is also contingent upon the integration of a common accurate ground situation picture from the various sub-units, so as to achieve shared situational awareness amongst all stakeholders, vertically with higher/lower HQs and laterally with adjacent forces for self-synchronisation. This becomes particularly crucial when the battle unfolds and the situation develops.

Conclusion – A Recapitulation of Sense-making

Sense-making is a key enabler in the IKC2 framework for the successful prosecution of NGW, where complexity and uncertainty prevail. With a robust and networked 3rd Generation Army, ground Tactical Commanders are empowered and have access to timely, accurate and relevant information for greater shared awareness and collaborative decision-making. This is the bedrock for self-synchronisation across the Command echelons with minimal co-ordination, guided by the Intent. Such modus operandi would answer the challenges of a NGW environment, such as urbanisation, and provide a platform to deal with the irrationality posed when dealing with asymmetrical forces. It would create the knowledge advantage necessary to attain a cognitive edge over the adversary. Having examined the various roles of sense-making in the context of NGW and its applicability at the various echelons, it is concluded that sense-making at the Individual, Tactical and Operational levels, is a cardinal requirement for the Army.

Moving forward, our Army needs to examine ways to employ and develop enabling technological systems, the cognitive capacity and ability of its soldiers to sense-make, as well as enable Command-team integrated and collaborative decision-making. Whilst information technology can do much to enable such capabilities, the man-behind-the-loop and his cognitive ability remains pivotal, particularly at the tactical and operational level when team dynamics set in. The hypothesis is that the quality of sense-making can be quantified, and there exists an optimal balance between technological versus cognitive solution sets, depending on the context. This should be developed further and validated through the conduct of experimental trials. Key training pedagogies and core competencies of soldiers has to be reviewed and shaped, in order to fit into the sense-making frame that is necessary to facilitate command and control for enhanced mission effectiveness.

Endnotes

1   Gray Klein defined it as a motivated, continuous effort to understand connections (which can be among people, places and events) in order to anticipate their trajectories and act effectively. Klein, G., Moon, B. and Hoffman, R.F. Making Sense of Sensemaking I: Alternative Perspectives, *IEEE Intelligence Systems*, 21(4), 2006, pp70-73.

2   Martin Van Creveld, *Command in War*, (Cultured Lotus, 2001), p16.

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4   Jim Scheiner, "The theory of the empty battlefield", *JRUSI*, Sep 1987.

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Tethered Operation of Autonomous Aerial Vehicles to Provide Extended Field of View for Autonomous Ground Vehicles

by MAJ Phang Nyit Sin

Abstract

This thesis is part of an ongoing research conducted at the Naval Postgraduate School to achieve greater collaboration between heterogeneous autonomous vehicles. The research addresses optimal control issues in the collaboration between an Unmanned Aerial Vehicle (UAV) and an Autonomous Ground Vehicle (AGV). The ability to integrate the UAV and the AGV effectively will mean that the AGV would be able to tap into the advantage of stand-off reconnaissance by the UAV, thus allowing the AGV to have a fast response to any obstacles and a longer time to effectively change its planned mission or path. The stand-off reconnaissance ability would provide advance warning to ground vehicles on ambushes within its path, and thus increase the survivability of the ground vehicle and allow better force preservation. While the full thesis addresses three main problems associated with the integration, this abridged version focuses on the design of a UAV control law that takes into consideration the relative speed differences between the UAV and the AGV, with the assumption that the UAV has a greater speed compared to the AGV.

1. Introduction

The rapid advancement of computer and sensor technology in recent years has resulted in an increased number of unmanned vehicles being employed in the battlefield to accomplish various dangerous tasks; one such application is the employment of unmanned vehicles for the detection and avoidance of mines and Improvised Explosive Devices (IEDs). The employment of unmanned vehicles for the above-mentioned task usually has little interaction with other unmanned vehicles.

The current trend of employing unmanned vehicles in the battlefield has extended beyond a single vehicle operation and is moving towards the gathering of real-time information using multiple unmanned vehicles. This could potentially impact a wide variety of

military missions. The employment of multiple types of unmanned vehicles is a challenge for developers for a number of reasons. First, there is the communication necessary between the vehicles. Since the vehicles are generally small, the communication equipment carried on the unmanned vehicles is usually size- and power-limited therefore resulting in corresponding limitations in bandwidth and range. Second, new guidance controls are necessary for developing collaborative behaviors between unmanned platforms. Third, there are always logistic and maintenance issues associated with using an unmanned vehicle and these issues are multiplied by the number of vehicles used.

The control of a single unmanned vehicle has been explored intensively and much success has been achieved. These successes have been demonstrated in the obstacle avoidance and re-routing capabilities of unmanned vehicles like Micromouse[1], a competition that started in the late 1970s, with small robot mice solving a 16 x 16 maze autonomously. Seydou Soumare[2] has discussed, in depth, the uses of active vision sensors and laser sensors for real-time obstacle detection and avoidance in an indoor environment. Juan Carlos Rosete Fonseca[3] has discussed the use of obstacle avoidance in the path planning of polar robots that allows the unmanned polar robots to perform path planning for greater autonomy and robustness.

The obstacle avoidance and path planning technology has extended beyond the UGV to UAVs as presented by Stephen Griffiths.[4] These articles presented the ability to incorporate obstacle and terrain avoidance into real-time path planning by miniature aerial vehicles (MAVs), while taking into consideration the limitation of the MAV, which requires moving at a speed of 10-20 m/s to maintain flight. The limited payload of a MAV, as addressed in the articles, restricts the size of the onboard computer and the sensors that are employed to effectively survey the environment.

This thesis looks into the problems of developing a new guidance control law for a UAV to operate collaboratively with an AGV. For the vehicles to work collaboratively, the UAV guidance law must compensate for the manoeuvring AGV. Vladimir N. Dobrokhodov[5], has discussed extensively the influence of the AGV ground speed on the performance of the UAV following the flight path generated. The proposed concept of a circular flight path for the UAV could be adapted for the integration of a UAV and an AGV, which would allow for speed compatibility/adjustment of the fast-flying UAV with the slower-moving AGV. This concept will be used in the construction of the simulation in this thesis.

Communication and collaboration between the UAV and the AGV is of paramount importance to the success of a forward ground reconnaissance for a trailing convoy mission. The limited payload allowed on the UAV poses as a problem to incorporate a larger and higher power transmitter

for long-range communication. Thus, the communication range between the vehicles is limited by the capability of the communication equipment that is carried by the UAV. This was highlighted by Stephen Griffiths.[6] One solution that is proposed by Douglas P. Horner[7] is the use of an artificial potential field for UAV guidance and optimisation of WLAN communication, which would optimise the communication between the UAV and a series of AGVs using the signal strength ratio. Another method is in using the received signal strength to form a linked control to limit the extended range of the UAV; such control mechanisms are referred to as "tether control" in this thesis.

The tether control uses the received signal strength between the UAV and the AGV to effectively control the flight path of the UAV and ensure reliable communication between the two vehicles. The method employed essentially makes use of the received signal strength to form an artificial dome around the AGV to demarcate the limits of reliable communication. If the UAV flies beyond the dome, communication is assumed to be disrupted, thus the artificial dome contains the furthest flight path of the UAV to be within this field.

The effectiveness of the UAV greatly depends on its ability to keep the onboard camera pointing at a fixed distance forward of the AGV. The camera system available on the UAV in the study has a zoom control and a two-degree-of-freedom (DOF) motion, namely, pan and tilt. The UAV in flight has a six-DOF and it is essential that the camera is able to operate in such a manner that it complements the state condition of the UAV to effectively point the camera at a fixed position forward of the AGV. Vladimir N. Dobrokhodov[8] has discussed the use of vision-based tracking and motion estimation for moving targets using small UAVs. The concept proposed integrates UAV gimbal control with guidance of the UAV that allows tracking of a moving coordinate ground vehicles. This concept requires several geometrical transformation mathematical computation, which is within the capability of the computer onboard the UAV. This thesis will adapt the algorithm discussed for the implementation flight control of the UAV.

This thesis was set forth to research the problem associated with integrating the existing UAV (Scan Eagle) with an AGV to provide real-time communication between the vehicles in a truly cooperative environment in order for the vehicles to achieve their mission. The model uses Matlab Simulink Version 6.4 (R2006a)[9] to simulate the UAV flying in six-DOF and incorporate the onboard camera to point at a fixed distance forward of the AGV. The AGV in the simulation has two-DOF and is programmed to travel on a road using a GeoTiff Map.[10, 11]

This thesis uses the operational concept of an AGV travelling along a road and a UAV is tethered to the AGV to provide reconnaissance images of a fixed distance forward of the AGV as shown in Figure 1.

The vehicles are equipped with standard WiFi 802.11 communication equipment (ITT Mesh Card) that has a limited range of communication. The assumption made in this thesis is that the signal-to-noise ratio (SRN) of the communication equipment is a linear function of distance. The figure above shows the field of view (FOV) of both vehicles. The AGV has a limited FOV due to the obstruction from the natural feature on the ground, however, the UAV, due to its operating altitude, is able to acquire a better FOV and identify a possible ambush site. The UAV images are transmitted to the AGV for further analysis. As a result of the analysis, the AGV can change its planned path or prepare for a counter attack.
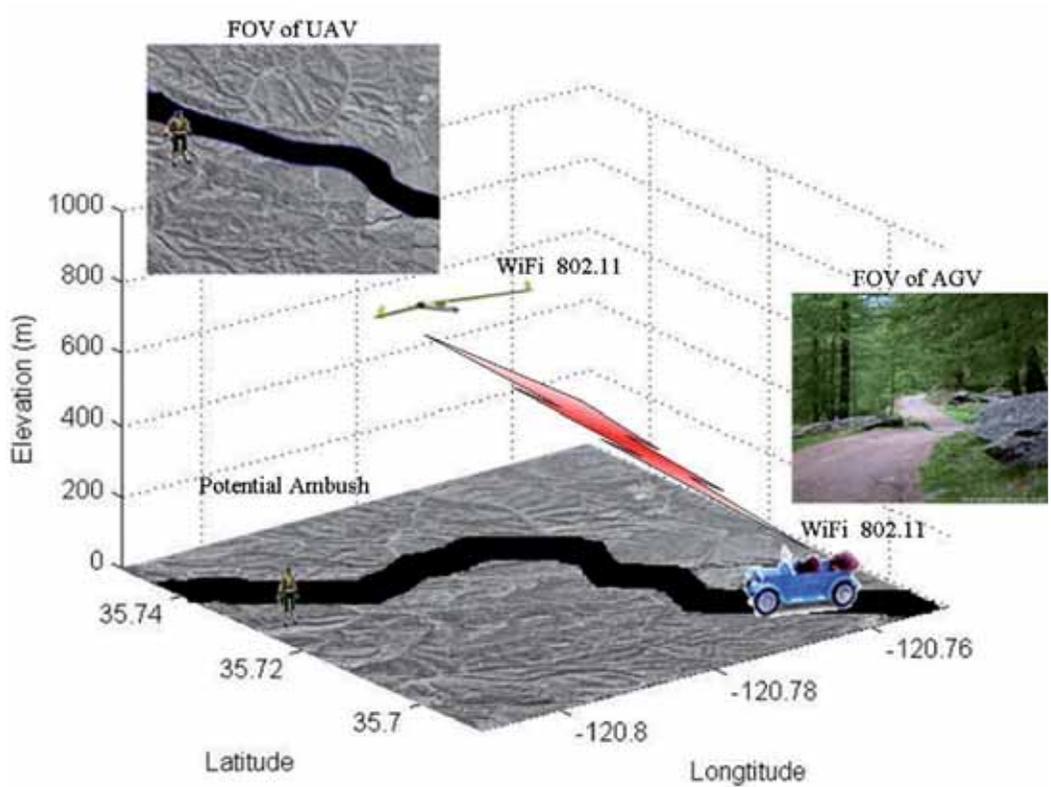
Figure 1. Operational Concept

II. Theoretical Approach to Modelling the Tether Operation of the UAV and AGV

A. Overview of the Model

The approached taken for this thesis is based on modelling using Simulink Version 6.4 (R2006a) as shown in Figure 2. The model is divided into five components, namely, the six-DOF model for the UAV, the camera gimbal control model, the camera keystone model, the UAV flight path control model, and the tether control model. The model is adapted from the work done in.[12]
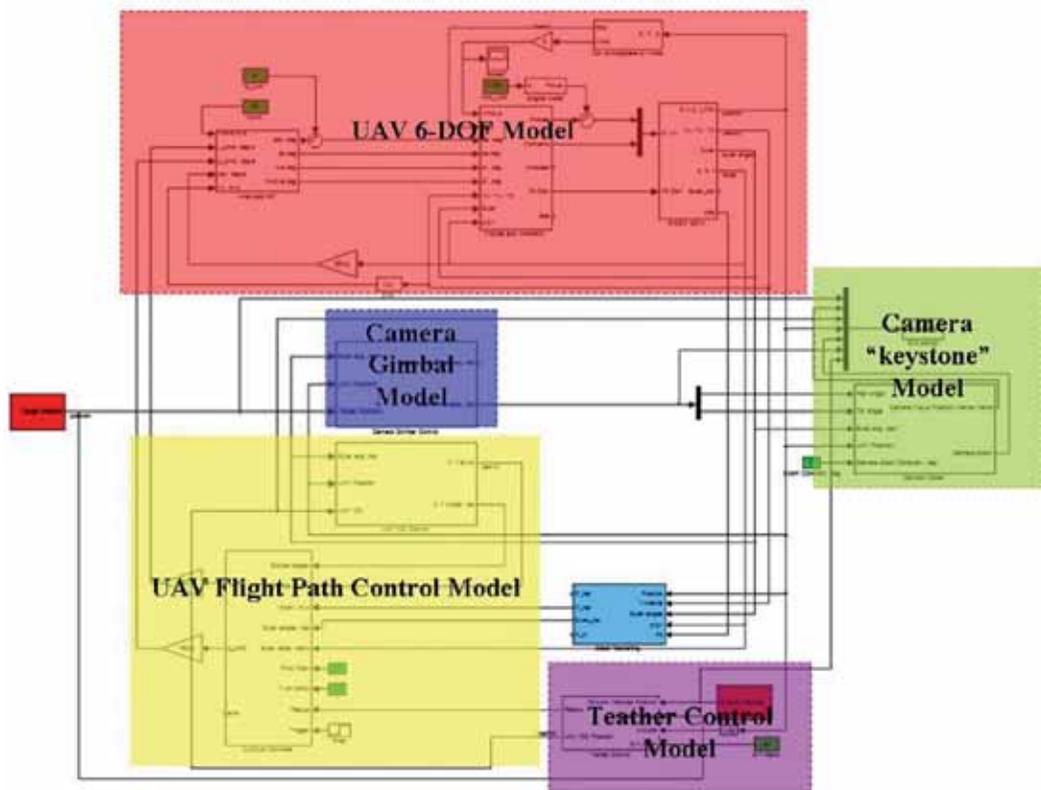

Figure 2. Overview of Model[13]

B. UAV Flight Path Control Algorithm

The UAV in flight is assumed to travel at a higher speed compared to the AGV and it is crucial to control the flight path in accordance with the average speed of the AGV. The flight path control algorithm achieved this by commanding the UAV to fly in a circular motion with respect to an imaginary moving target called the UAV CG. The UAV CG is controlled by the tether control algorithm to achieve a constant communication link between the UAV and the AGV. The flight path of the UAV is illustrated in Figure 3 below with a moving UAV CG.

The UAV flight path control algorithm adapted the control algorithm[14] and is shown in Figure 4.
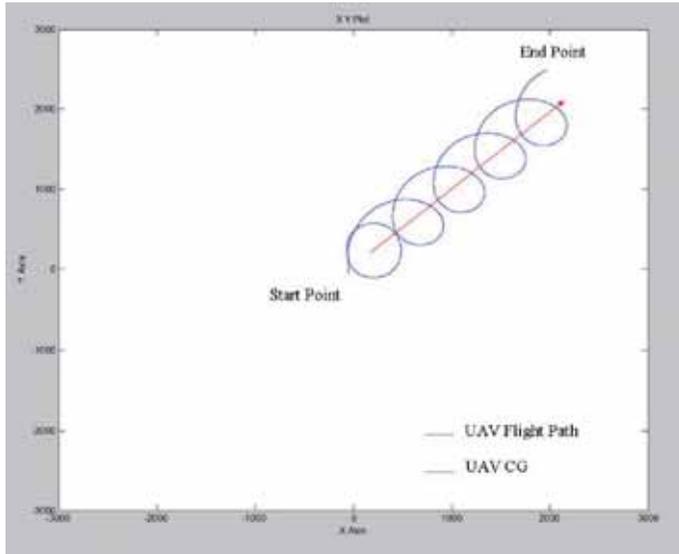
Figure 3. Flight Path of UAV with Moving UAV CG
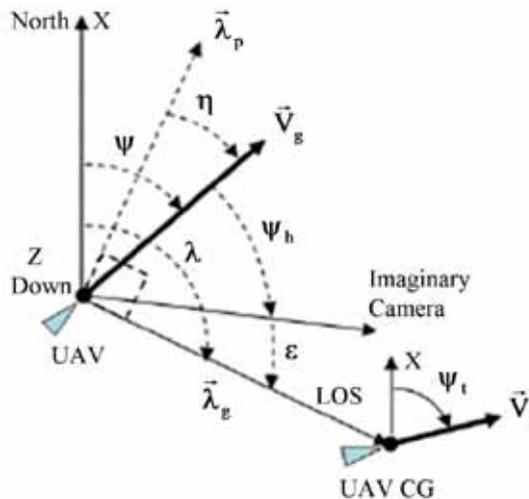
Figure 4. UAV Tracking of Imaginary Moving Target[15]

From Figure 4, $\vec{V}_g$ is the UAV ground speed, $\vec{\lambda}_g$ is the line of sight (LOS) vector, $\vec{\lambda}_p$ is the vector perpendicular to $\vec{\lambda}_g$, ε is the angle between the LOS vector and the camera heading, λ is the LOS angle, ψ is the UAV heading, ψ_h is the gimbal pan angle , η is the angle between the $\vec{V}_g$ and $\vec{\lambda}_p$ vectors, $\vec{V}_t$ is the speed of the imaginary target and ψ_t is the heading of the imaginary target. The tracking problem kinematics for the target are given by:

$$\dot{\eta} = -\frac{V_g \cos\eta - V_t \cos\left(\psi_t - (\psi - \eta)\right)}{\rho} + \dot{\psi} \quad (1)$$

$$\dot{\varepsilon} = \frac{V_g \cos\eta - V_t \cos\left(\psi_t - (\psi - \eta)\right)}{\rho} - \dot{\psi} - \dot{\psi}_h \quad (2)$$

$$\dot{\rho} = -V_g \sin\eta + V_t \cos\left(\psi_t - (\psi - \eta)\right) \quad (3)$$

ρ is the range from the UAV to the imaginary target. The objective of the control system is to drive ε and η to zero using the UAV turn rate ψ and pan rate ψ_h as control inputs, thus the control law is as follows:

$$\dot{\psi} = \frac{V_g}{\rho_h} \cos\eta - k_1\eta \quad (4)$$

$$\dot{\psi}_h = k_1\eta + k_2\varepsilon \quad (5)$$

where ρ_h is the desired horizontal range to the target as user-adjustable input variables and, k_1 and k_2 are gains for the control.

The UAV flight path control model results in the UAV flying in a circular path with respect to an imaginary reference point on the ground (UAV CG). The camera vector shown in Figure 4 is an imaginary camera and does not represent the actual onboard camera of the UAV. However it is used for the control law development. The coordinated (camera and UAV guidance) control law eliminates the need for the AGV to constantly control the flight path of the UAV and reduce the computation burden of the AGV. It also allows the UAV greater flexibility to modify its flight path to avoid obstacles or adjust its height to avoid detection. The control law also allows greater autonomy to the UAV and thus forms the backbone for the successful implementation of the tether control. The onboard camera is controlled by a separate control algorithm called the camera gimbal control algorithm.

C. Camera Gimbal Control Algorithm

The camera gimbal control algorithm allows the camera to operate independently from the flight path of the UAV. The camera is programmed to point on the road a fixed distance in front of the AGV. This is achieved by giving a position coordinate called the "target" to the camera gimbal control model as illustrated in Figure 5. The camera is initially set to zero degree pan and tilt. When a target coordinate is received, the camera gimbal control model will compute the required pan and tilt angle for the camera gimbal servo mechanism to position the camera.
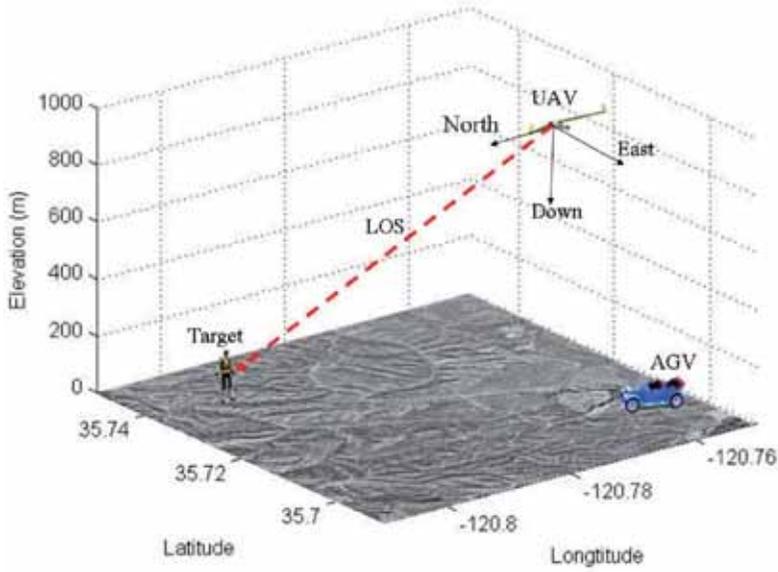
Figure 5. Camera Tracking of Ground Target

From Figure 5, Δ_x, Δ_y and Δ_z were defined as the relative position of the UAV and the ground target in ABC; ϕ_p and ϕ_t is the desired pan and tilt angle of the camera. The objective of the control law is to provide the pan and tilt error, ε_p and ε_t, to a proportional and integral controller, which in turn, commands the camera to adjust its position as follows:

$$\phi_p = \tan^{-1}\left(\frac{\Delta_y}{\Delta_x}\right)_{ABC} \qquad (6)$$

$$\phi_t = \tan^{-1}\left(\frac{\Delta_z}{\sqrt{\Delta_x^2 + \Delta_y^2}}\right)_{ABC} \qquad (7)$$

$$\varepsilon_p = \phi_p - \phi_{cp} \qquad (8)$$

$$\varepsilon_t = \phi_t - \phi_{ct} \qquad (9)$$

The control algorithm uses the relative position of the UAV and ground target in the NED coordinate and translate them to ABC using the following formula:

$$\begin{bmatrix} \Delta_x \\ \Delta_y \\ \Delta_z \end{bmatrix}_{ABC} = B \begin{bmatrix} X_t - X_u \\ Y_t - Y_u \\ Z_t - Z_u \end{bmatrix} \qquad (10)$$

X_t, Y_t and Z_t is the position of the ground target, X_u, Y_u and Z_u is the position of the UAV in the NED coordinate and B is the Direct Cosine Matrix for transformation from the NED coordinate to ABC as follows:

$$B = \begin{bmatrix} \cos\theta\cos\psi & \cos\theta\sin\psi & -\sin\theta \\ \sin\phi\sin\theta\cos\psi - \cos\phi\sin\psi & \sin\phi\sin\theta\sin\psi + \cos\phi\cos\psi & \sin\phi\cos\theta \\ \cos\phi\sin\theta\cos\psi + \sin\phi\sin\psi & \cos\phi\sin\theta\cos\psi - \sin\phi\cos\psi & \cos\phi\cos\theta \end{bmatrix} \qquad (11)$$

This control allows the camera to track an independent ground target, taking into consideration the state position of the UAV, thus decoupling the flight control of the UAV from the camera.

D. Integrating the Model

The UAV six-DOF flight model acts as the backbone for the simulation. It provides the state conditions of the UAV that are used by the rest of the model. The AGV and the desired fixed distance forward of the AGV are designed to travel on a road represented by a series of discreet coordinates along the route with one meter spacing. These coordinates are based on a relative position referenced to a fixed point on the GeoTiff maps. The speed and starting location of the AGV and the forward fixed position are controlled by the user in the model.

The tether control model uses the position of the UAV and the AGV, the received signal strength, and the UAV altitude to compute both the UAV CG location and the desired horizontal range for the UAV. The UAV CG location and the desired horizontal range are passed into the UAV flight path control model to generate the desired flight path for the UAV. The UAV flight path model outputs the pitch and yaw command for the UAV six-DOF model to compute the state condition of the UAV.

The flight path of the UAV, with respect to a moving UAV CG location, is shown previously in Figure 3. It shows that the UAV is travelling in a circular path to compensate for the slower speed AGV. An alternative, commanding the UAV to adopt an "S" curve flight path to compensate for the slower speed AGV, has been explored and is illustrated in Figure 6. Such a flight path was deemed
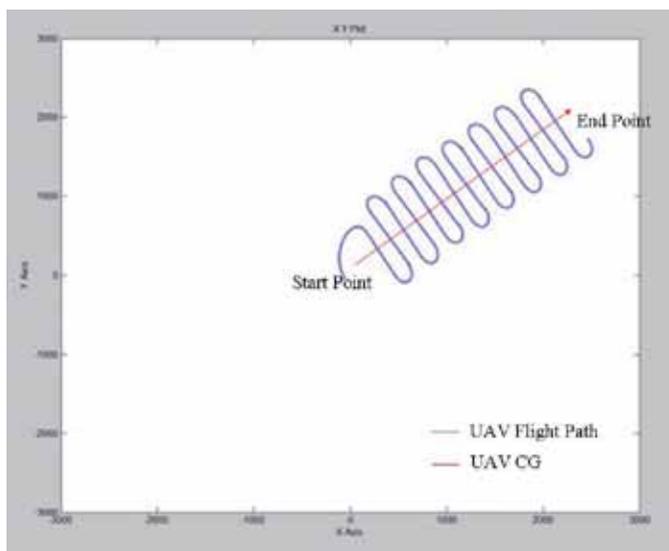

Figure 6. "S" Curve Flight Path

ineffective and undesirable as the error generated for the camera during the turn is large and caused the camera to momentarily lose its focus on the desired location.

The camera gimbal controller uses the state condition of the UAV from the UAV six-DOF model and the fixed position forward of the AGV to determine the pan and tilt angle for the camera. The pan and tilt angle is sent to the camera keystone model to derive the positions that the field of view of the camera projects onto the ground.

The model uses the GeoTiff map of the Camp Roberts, CA area (in the vicinity of 35.7N, 120.7E), for visualising the simulation. The location of the UAV, the AGV, the fixed position forward of the AGV and the UAV CG are superimposed over the GeoTiff map to provide a sense of location. The keystone effect is shown on the GeoTiff map. The model uses relative position for all computations and is subsequently translated into the GeoTiff map coordinates using a conversion factor for the location as follows:

Latitude conversion factor = 111119.99966 m / degree

Longitude conversion factor = 91023.79479 m / degree

The conversion factors are applied to the x-coordinate and y-coordinate only. The z-coordinate is unaffected due to the flat earth assumption that the model is using.

III. Simulation and Result

The camera is out of focus from the fixed position forward of the AGV at the start of the simulation. This is due to the time lag of the camera pan and tilt mechanisms that are incorporated into the model. The initial pan and tilt angle of the camera is set at zero degrees, which requires the camera gimbal control algorithm to correct the camera pan and tilt angle in order to track the ground target. This is shown in Figure 7.

The initial speed and heading of the UAV plays an important part for the UAV flight control algorithm. From Figure 8, it can be seen that the UAV is further from the UAV CG location. The relative position of the UAV and the UAV CG is larger than the desired horizontal range determined by the tether control algorithm. This is due to the start location of the UAV, which is set at 35.71N, 120.77E and the initial heading of the UAV is set to due east. It can also be seen that the UAV is correcting its path toward the UAV CG by changing its heading gradually to north. This gradual movement is due to the minimum turning radius that is related to the flight characteristic of the UAV.

The output of the simulation shows that the UAV is able to accurately point the camera at the fixed forward position of the AGV along the road while following the flight path generated by the flight path control algorithm. The outputs are shown in the following figures.
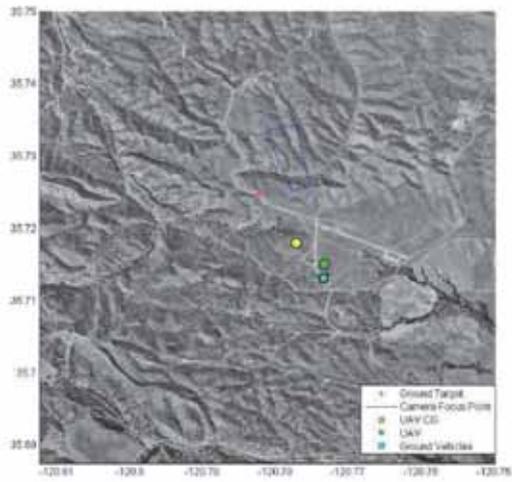
Figure 7. Camera Start-up Error
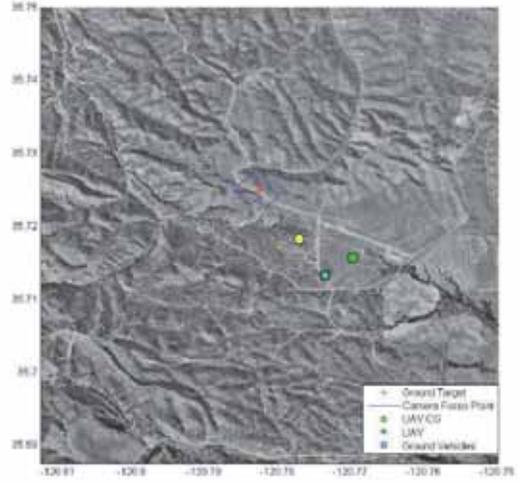
*Figure 8. UAV Initial Flight Correction*
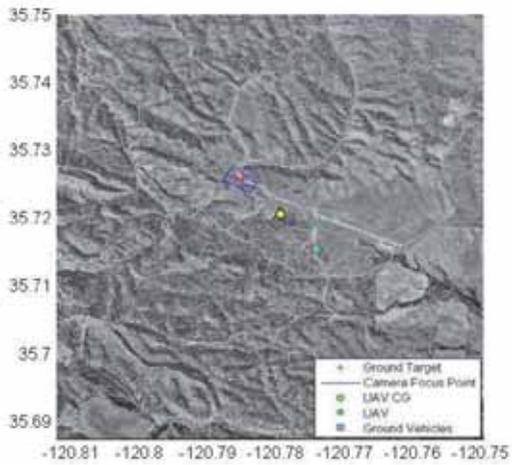
*Figure 9. Output of Simulation 1*
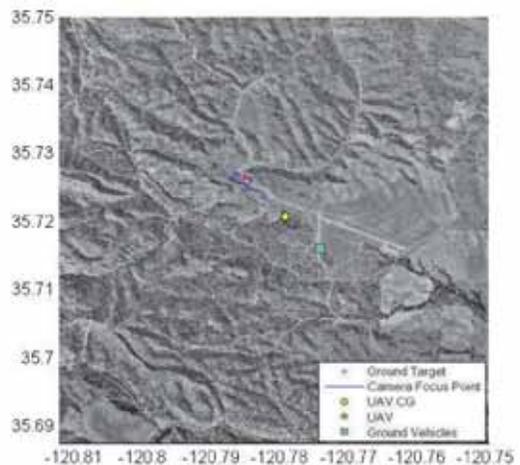

Figure 10. Output of Simulation 2
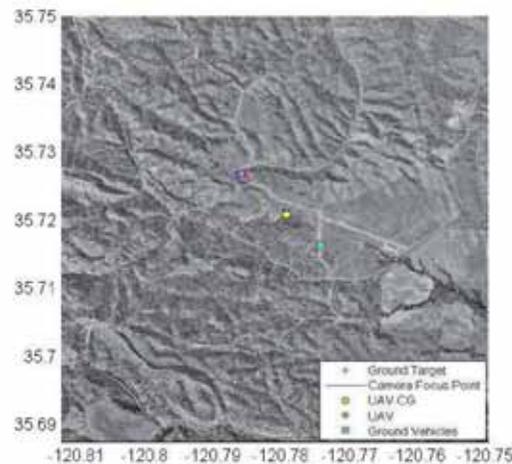
*Figure 11. Output of Simulation 3*
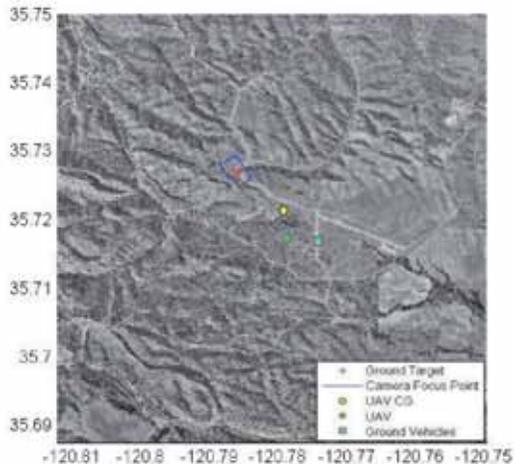
Figure 12. Output of Simulation 4

From Figures 9 to 12, it can be seen that the UAV is flying in a circular path around the UAV CG with a relative constant desired horizontal range. The AGV and the fixed position forward of the AGV are moving along the road shown in the GeoTiff Map. The area in which the image is captured by the onboard camera shows that the camera is able to track the fixed forward position effectively. The keystone effect is also shown.

This simulation shows that the area captured by the camera image is constantly changing due to the position of the UAV. The area captured is bigger when the UAV is flying further away from the fixed forward position. This is undesirable and further work should be done to provide an active zoom control to create a constant area captured by the camera that is independent from the UAV position.

From the simulation output above, it is noted that the location of the UAV CG does not follow a road. This is due to the fact that the UAV CG is an imaginary target location for the UAV flight control algorithm to take as a reference for planning the flight path of the UAV. The UAV CG location is determined by the tether control algorithm, given the signal strength of the communication between the UAV and the AGV. The location of the UAV CG is strategically positioned to be between the target location and the AGV to achieve the optimum effect of creating a flight path that is near the target and within communication range.

IV. Conclusion

The ability to integrate a heterogeneous mix of unmanned vehicles has great potential in enhancing military operations and provides better real-time situation awareness of the battlefield. This research focuses on the design of a UAV control law that takes into consideration the relative speed differences between the UAV and the AGV, with the assumption that the UAV has a greater speed compared to the AGV.

The results show that this problem associated with the integration of the UAV and the AGV can be overcome by using a circular flight path for the UAV to compensate for the slower speed AGV.

A camera gimbal control algorithm was also derived to allow the camera to operate independently from the flight path of the UAV. This control allows the camera to track an independent ground target, taking into consideration the state position of the UAV, thus decoupling the flight control of the UAV from the camera.

Acknowledgments

using Small UAVs" as a reference for the development of the simulation for this thesis. He would also like to appreciate his wife, Natalie Chee, for her support and understanding during the period of research.

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Uncomfortable Bedfellows – Realism and International Collaboration

Navies and Maritime Security – A Republic of Singapore Navy Perspective
by RADM Chew Men Leong

security. Secondly, there is a need for international collaboration to promote maritime security. The underlying premise for these developments is the globalised nature of the threats to the maritime security of Singapore, Indonesia and Malaysia.

RADM Chew's essay stands out because it illuminates the way forward in how maritime security in our immediate region can be safeguarded. However, certain pitfalls must be addressed lest one takes for granted that maritime security has been adequately dealt with by Singapore and its immediate neighbours. This article seeks to address two of these pitfalls in both theoretical and practical terms. Firstly, the idea of international collaboration will be dealt with using International Relations theory. Secondly, Singapore's efforts at promoting maritime security will be examined using the concept of deterrence as a yardstick.

Introduction

In his essay "Navies and Maritime Security – A Republic of Singapore Navy Perspective", RADM Chew Men Leong contends that safeguarding maritime security has necessitated two key areas of development. Firstly, it was argued that domestically, Singapore has to coordinate and synergise the energies of those agencies responsible for maritime

Uncomfortable Bedfellows – Realism and International Collaboration

Globalised threats have little regard for national boundaries. This means that joint international efforts have

to play bigger roles. In the original essay, good examples of international collaboration were given. These included the coordinated air and sea patrols of Singapore, Indonesia and Malaysia and the efforts of the Five-Power Defence Arrangements (FPDA) and the Western Pacific Naval Symposium (WPNS). However, as threats become globalised, the international system may not necessarily follow suit.

In today's world, political realism is still very much alive – the world is still rigidly separated into individual nation-states. These states will continue to pursue and safeguard their national interests, and state-based actors such as domestic lobby groups will continue to affect state actions in the international system. In short, power politics and sovereignty are still powerful and relevant concepts.[1] Unsurprisingly as a result, globalisation theorists such as David Held have noted that a powerful school of globalisation-sceptics exist.[2] Certainly in South-East Asia, such national interests are much pronounced. For example, the Association of South-East Asian Nations (ASEAN) still firmly upholds the concepts of non-interference and territorial sovereignty despite the recent ASEAN Charter championing lofty community-based ideas. In addition, territorial disputes are still hotly contested in the region as can be seen in the Ambalat Islands dispute between Indonesia and Malaysia and the Pedra Branca case between Malaysia and Singapore. These disputes have the potential to undermine international collaboration. Domestic pressures can also sour state-to-state relations. A recent example is the decision by Malaysia to reduce the number of foreign workers in the country.[3] Since Indonesians make up two-thirds of such foreign workers, the issue has political implications.

A combination of hawkish domestic lobbies and bilateral tensions can also serve to disrupt international collaboration as evidenced by Malaysia's pull-out of a major FPDA exercise in August 1998.[4] Lastly, in keeping with the globalisation theme, it can also be argued that increased global financial and economic interdependence can also pose a threat to international collaboration. The coordinated efforts of Singapore, Indonesia and Malaysia to patrol the Malacca Straits were launched in 2004 – a time of relative economic stability in the region. However, it remains to be seen whether the states' commitment can withstand an economic crisis like the 1997 Financial Crisis.[5] Therefore, international efforts to enhance maritime security, no matter how impressive they look now, are by no means secure. They will be subject to the vagaries of various factors which no one country can control.

Security Committee? What Security Committee?

Moving on from globalisation theories, we can take a more practical and straightforward view of the problem of maritime security. Applying this to Singapore's domestic context, the original essay argued for a need for coordinated measures among domestic agencies to enhance this security. It was mentioned that Singapore apparently possessed a Maritime Security Committee which coordinates the efforts of various domestic ministries

and agencies concerned with maritime security. Given the high priority placed on maritime security (due to the importance of sea-borne trade to Singapore) and the effectiveness of Singapore's bureaucracy, there is little doubt that such a body would be significant and effective in synergising the efforts of the various agencies involved. However, if one is to deter those who seek to undermine maritime security, one should not only possess superior policing capability but also effectively *show* that one has such a capability.

Yet, a moderately thorough search through the official websites of the Republic of Singapore Navy (RSN), the Ministry of Home Affairs, the Ministry of Foreign Affairs and the Defence, Science and Technology Agency by this author reveals no mention of such a Maritime Security Committee. In addition, there has been negligible press coverage of such a Committee or Singapore's efforts to coordinate its agencies.[6] Such examples merely underline the urgent need to highlight Singapore's efforts at *all levels* to promoting maritime security. As the original essay mentions "[a] defensive measure taken by the maritime security forces must be visible and send a strong deterrence message". It would be naive to think that the force of deterrence is only most effectively portrayed on the ground through "hard" power i.e. 'a show of force'. "Soft" power calling to attention our readiness and capabilities can also be transmitted through public media.

Conclusion

As Thomas Friedman mentions in the chapter "The Dell Theory of Conflict Prevention" in his book *The World is Flat*, "[t]he flattening of the world is too young for us to draw any definitive conclusions".[7] It is premature to speak of a new paradigm of national security at the moment; despite a "flattening" i.e. globalising world, what have endured are the old concepts of state politics and old-fashioned deterrence.

Understanding these concepts can enable us to keep ahead of would-be threats yet at the same time we are reminded of the truth of the matter: much work remains to be done.

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Endnotes

1   http://www.globalpolicy.org/nations/future/rvsc.htm – See Barry Buzan's defence of the relevance of realism

2   David Held et al, *Global Transformations: Politics, Economics and Culture*, (Stanford, California, Stanford University Press, 1999), pp6-7

3   *The Straits Times*, 22 January 2008, p21.

4   http://www.malaysia.net/lists/sangkancil/1998-08/msg00908.html

5   One might do well to look for signs of tension and buck-passing amidst the on-going economic slowdown involving recession in the US and sub-prime mortgage issues.

6   Apparently, the best mention of Singapore's Maritime Security Committee was in a speech by Colonel Sim Tiong Kian at the 6th Regional Seapower Symposium For the Navies of the Mediterranean and Black Sea Countries. This speech mirrors the original article; http://www.marina.difesa.it/symposium/kianing.asp

7   Thomas Friedman, *The World is Flat*, (London, Penguin, 2006), p521.

Singapore's Ideational Stewardship in Maritime Security Cooperation

A common train of thought strings up the three naval articles – the importance of maritime security (MARSEC) cooperation and the reviewer will attempt to review all three articles though at the risk of not doing them full justice. The new Chief of Navy (CNV), RADM Chew Men Leong[1] drives in on the importance of MARSEC in setting the new national security paradigm, founded on strong inter-agency cooperation and greater international collaboration (p6). LTC Irvin Lim[2] further elaborates on 'incremental willing-partner "building-block" approach with maritime hubs forging bilateral and multilateral intra-regional information-sharing networks, even as they seek to link-up with maritime regions beyond the region' (p16). After assessing the futilities of current top-down and bottom-up approaches, MAJ

Victor Huang[3] argues for a 'neutral multinational framework' (p28) where extra-regional powers can influence Southeast Asia incrementally through 'sharing ideas via multilateral forums, supporting intra-regional initiatives and working through international organisations' (pp39-40).

What is also evident in these articles is Singapore's stewardship, not leadership, in these regional MARSEC cooperation. CNV wrote on the RSN's role in operationalising information-sharing systems such as the Regional Maritime Information Exchange (ReMIX) to be used amongst WPNS (Western Pacific Naval Symposium) navies and another trial system under the Malacca Straits Patrol Initiative (p11). The other authors both elaborated substantially on the siting of ReCAAP Information Sharing Centre in Singapore and our initiative towards a one-stop maritime information and response coordination centre – Changi C2 Centre (comprising Singapore MARSEC Centre, Information Fusion Centre and Multinational Operations and Exercises Centre) (pp17,19-20,37-8).

Interestingly, Singapore's survivalist state mentality fuels its fervour to be a willing steward of such initiatives and precisely being a small state does give Singapore the leverage to do more for MARSEC cooperation. In all seriousness, how much damage can our 'little red dot' deliver to the region? Besides, we are reluctant, as a matter of well-considered defence policy and/or fear of international politico-economic backlash, to use our military power unless deterrence fails. Singapore just wants MARSEC for

regional peace and prosperity (period). Hence, there may be less skepticism or politicking against Singapore when we propose cooperation initiatives vis-à-vis large maritime nations like the US (Proliferation Security Initiative [PSI] and Regional MARSEC Initiative [RMSI]) and Japan (Ocean Peacekeeping Force) (pp32-6).

Next, Singapore should do more for regional peace because we have the can-do spirit and are willing to contribute, when given a chance. Our public service is world class, and where parallels arise and interests converge, other nations (China and Middle East) are willing to hear us share via our government's not-for-profit Singapore Corporation Enterprise (SCE) and/or former Permanent Secretary Ngiam Tong Dow's private consultancy 'IGlobal Advisors'.[4] There is seeming consensual trust amongst quite a few nations on the Singapore Inc. – her people, her ideas and her delivery of supranational goods. Our SAF's double quick-time response to Indonesian tsunami crisis won some international accolade; but there is much room for improvement and we should capitalise on this trust to do more and improve ourselves.

This survivalist way of foreign policy is our modus operandi and most countries are already accustomed to it. We are practical idealists as Tommy Koh, our successful steward in the drafting the UN Convention of the Law of the Sea (UNCLOS), sums it up.[5] We are small; we have to be rational and pragmatic (i.e. change strategy, though not objectives, in light of changing facts [Rajaratnam]) and

do things realistically possible whilst balancing power with morality and law (Tommy Koh).[6] Coupled with our Asian values of community interests, thrift and order (Lee Kuan Yew), the resultant practical win-win solutions fulfill the interests of many states (small and large alike) and we increasingly work towards a communion of regional cultures in governance and diplomacy (Mahbubani).[7] That Singapore played a substantial role in the successful lobbying for ASEAN Free Trade Area (AFTA), and ASEAN Regional Forum (ARF) and initiative in setting up Asia-Europe Meeting (ASEM) and East Asia-Latin America Forum (EALAF)[8] are sterling examples of the nation's stewardship in supranational issues. Hence, the RSN can ride on our Singapore brand to contribute more.

In conclusion, MARSEC cooperation is a win-win supranational public good that is realistically possible and navies are, by virtue of their vocation, diplomatic (thus the diplomatic term, port-calling). As international stewards, we are not global leaders *per se*; hence we need to remind ourselves that political realities dictate that we respect the other littoral states and the delicate balance amongst the regional powers – US,

Japan, China and India. Nevertheless, our willingness to contribute towards regional peace and order can help us to persuade the global / regional re-looking into the many existing maritime initiatives for greater synergies of overlaps and filling of gaps.

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2   LTC Irvin Lim, 'Comprehensive Maritime Domain Awareness – An Idea Whose Time Has Come?', *POINTER: Journal of the Singapore Armed Forces*, Vol. 33 No. 3, 2007, pp13-26.
3   MAJ Victor Huang, 'Building Maritime Security in Southeast Asia – Outsiders Not Welcome?', *POINTER: Journal of the Singapore Armed Forces*, Vol. 33 No. 3, 2007, pp27-44.
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The Starfish & The Spider: The Unstoppable Power of Leaderless Organisations –
A Fresh Perspective on Contemporary Terror Organisations

by CPT Alvin Tan Sheng Hui

Introduction

Six years into the 'Global War on Terror', the West has seen considerable successes against foes such as Saddam Hussein, al Qaeda (AQ) in Afghanistan, and Jemaah Islamiyah (JI) in Southeast Asia. However, we now witness the emergence of a trend that is responsible for denying us a 'conventional victory' in the Global War on Terror. The US now finds itself in a quagmire in Iraq, AQ cells from France to South Asia seem insistent on continuing to promulgate

anti-West rhetoric, and clear successes against terror cells and insurgent groups in our region seem elusive.

A Timely Treatise

Ori Brafman and Rod Beckstrom's *The Starfish and the Spider: The Unstoppable Power of Leaderless Organisations*[1] is timely in this particularly phase of dealing with terrorism. They argue that centralised organisations are like spiders and can be destroyed with an attack to the head. Decentralised organisations transfer decision-making to leaders in the field. They are like starfish. No single blow will kill them, and parts that are destroyed will grow back. Cut off a spider's leg, and you'll have a seven-legged cripple. Cut off its head, and you'll kill the spider. On top of regenerating an amputated limb, a starfish's severed arm will also grow an entirely new body. Starfishes can achieve this remarkable feat because, unlike spiders, they lack central control – their organs are replicated across each arm. Starfish are decentralised, and starfish organisations are made up of many smaller units capable of operating, growing and multiplying independently of each other, making it very difficult for a rival force to control or defeat them.

New Rules and a New Playing Field

The authors argue that when you fight a starfish, all the rules change. They cite the example of Israel, which was used to fighting wars with spiders. They observed that Israel would cripple the spider's leg (e.g. grounding the Egyptian air force in the Six Day war), critically weakening it in the process. But in 1982, when Israel entered Lebanon, its spider strategies no longer worked. The more Israel attacked, the more dispersed its opponent became. Israel would whack a terrorist cell on its head, but that just produced new cells to take their place. They assassinated strategic leaders, but again, new leaders would emerge. For the first time in its history, Israel faced a battle it didn't win. Traditional tactics will not work when fighting a starfish. There are no headquarters to bomb. Remove the leader, and another one will replace him. Eliminate circles, and new ones will spring up. They warn that parallels to the current fight with AQ are too striking to ignore. With each attack, we make AQ stronger. We destroy cells, only to have AQ regenerate across the globe. We kill a leader, only to have a previously unknown terrorist take his place. The more we attack, the more decentralised AQ becomes. The authors call for a need to recognise that we are facing a starfish, and recommend three strategies that will work against a decentralised foe:

1) **Change ideology.** Eliminating AQ or JI leadership and taking out individual cells is futile. The authors argue that by establishing schools, providing services and creating cultural bridges, the authors argue that we can counter the ideology that fuels AQ and JI. For example, the authors say the West should help fund public schools in terrorist hotbeds where parents now send their children to radical madrasahs because these institutions feed and educate their children. Relief efforts after the Kashmir earthquake and the Asian tsunami represent such strategies.

2) **Centralise the opponent.** The authors cited the example of why the Apache Indians in North America lost after two centuries of independence and insurrection. As compensation for moving to reservations, the Americans gave the Nant'ans cows to distribute among the tribe. With this scarce resource came real, as opposed to symbolic, power. As a result, the Apaches became more centralised, and therefore much easier to control. Rather than pursuing AQ leaders, the authors suggest that we look for ways to centralise the organisation. An example of this would be to let Hezbollah go ahead and govern in Lebanon. Hezbollah is defined as a terrorist organisation by the United States, Australia, Canada, the United Kingdom, the Netherlands and Israel. But it is more centralised than AQ and is funded by the centralised government of Iran. Centralised governments are easier to persuade and/or defeat than independent cells.[2]

3) **Decentralise ourselves**. The authors illustrated how starfish organisations like *Craigslist* threaten the media hegemony of newspapers. The obvious military example here is to expand special operations and give small units the freedom to complete missions without oversight and second-guessing from command and control. Beckstrom cited a senior special operations officer telling him that the current US efforts to combat terrorism was like handing a soccer team a pigskin and expecting them to play soccer – It was a different game with different rules. The kind of forces that could defeat AQ would look much more like special-ops units than a centralised army.

Personal Insights on Terror Inc.

The parallels drawn between modern terrorist organisations and commercial start-ups in the book offer a fresh insight and opens up the neo-liberalist discourse of market versus the state. Osama bin Laden is the first terrorist leader to have studied economics and public administration, and cut his teeth in his family business in Saudi Arabia. But long before becoming a household name, he was creating an organisation so flat and decentralised that it could plot destruction from cells in about 65 countries from his caves. Craigslist founder Craig Newmark stated that "Decentralised organisations can be more effective and resilient", and concluded that companies such as his have something in common with AQ. He added that people who are passionate and can work independently could get more done than a centralised organisation. However, the caveat is that the more one gives others freedom to succeed, the more freedom they get to make costly mistakes.

Shared Narratives and Shared Doctrines

Trends indicate that the current network of terrorist and insurgent factions has no central leadership. For these loose organisations, consultation, coordination and consensus must substitute for central direction. But far more than simple coordination is required if these organisations are to be effective. Networks need what John Arquilla and David Ronfeldt call *shared narrative and doctrine* to maintain their cohesion and focus.[3] The narrative is the story the network tells to communicate

a sense of cause, purpose, mission and to engender a sense of identity and belonging among members of the network and potential recruits. The insurgents' narrative centres on the fact they are patriotic and pious freedom fighters battling to expel a foreign occupier and overthrow an illegitimate regime. By simultaneously emphasising nationalism and Islam, this narrative offers something for everyone and bonds groups who have little in common.

Rohan Gunaratna recently warned that it is not organisations like AQ that we should be worried about, but the increasingly prevailing influence of the Global Jihad Movement. Shared doctrine enables the network to operate in an integrated manner without central control. They compensate for the lack of central leadership by emphasising operational and ideological cohesion.

For example, insurgents now share information about IED operations: techniques, tactics, enemy vulnerabilities, and target priorities. This allows groups acting independently to conduct IED attacks in a coherent pattern. In our region, particularly in the Southern Philippines, the assumption that terrorists are operating according to some strict Bolshevik discipline is wildly misplaced. An individual Islamic terrorist might have *multiple associations* with one or all of several organisations – the Moro Islamic Liberation Front (MILF), Abu Sayyaf Group (ASG) or JI.

Counter-terrorism tactics which assume that the enemy is pursuing the organisationally disciplined "People's War" model may end up implementing irrelevant "divide and rule" counterinsurgency schemes. For example, the Armed Forces of the Philippines has been attempting to negotiate a political settlement with MILF, designating them a "peace partner", providing their personnel with certain immunities and promoting "confidence building" measures among them. But the weakness of that approach was illustrated when it became known that JI had been training its cadres inside MILF areas. Because the insurgency was based on "narrative" rather than Bolshevik discipline, the terrorists could move between organisational boundaries which were really only meaningful to the counter-insurgent. The Western policeman may stop pursuit at an organisational or international border, but a terrorist driven by narrative will walk right through it.

If organisational fluidity is an enemy strength, it is also an enemy weakness. Some Filipino counter-terrorism operators understood this and countered by enlisting the help of Islamic insurgents with whom they had "personal" relationships and arranged for elements of the MILF to carry out raids against JI. This tactic may not always work well, but it illustrates how counter-terrorists can turn "network" and "narrative" against the enemy.

Similarly in Southern Thailand, no one has yet claimed responsibility for the constant attacks. The insurgent movements are decentralised and Thai authorities do not know who to negotiate with. Conciliatory efforts have also yielded poor results.

Unabated attacks are a testament to the decentralised structure and shared narrative subscribed to by the different insurgent groups

Conclusion

The Starfish and the Spider offers insights into the forces that are massively altering the very bedrock of organisational cultures in the world. It is an enjoyable read and one that helps frame certain issues that are of particular concern to the security community. In our counter-terrorism efforts, we need to evaluate, after arguably successful clampdowns on regional groups like JI, how sustainable our methods are in curbing their regenerative abilities. Splinter cells are already forming in our region despite successes against known terror organisations.

We must be aware of the changing organisational landscape of our non-conventional enemies and ensure that we are configured appropriately to be able to function effectively in such a dynamic environment. To paraphrase Winston Churchill's famous statement about architectural determinism (Man shapes his buildings; thereafter they shape him), "We shape our organisations; thereafter they shape us."

Endnotes

[1] Brafman and Beckstrom's (both Stanford alumni) are young authors boasting exciting credentials. Together with Beckstrom, Brafman co-founded Global Peace Networks, which catalysed a network of CEOs working on conflict resolution and economic development in Africa and the Middle East. Beckstrom was a pioneer in the field of derivatives trading and risk management, and is a protégé of Nobel Laureate William F. Sharpe. Both have been consulted by representatives at the Pentagon for their work on *The Starfish and the Spider*.

[2] Google's decision in October to buy YouTube for $1.65 billion is the business equivalent. The move has already tamed YouTube into respecting intellectual property rights, because Google, with a $140 billion market value, has deep pockets and must worry about lawsuits.

[3] Arquilla, John and Ronfeldt, David, "Networks, Netwars, and the Fight for the Future", *First Monday*, vol.6 no.10 (Oct 2001).

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Ori Brafman and Rod Beckstrom

Ori Brafman

Born in Israel and raised in Texas, Ori Brafman has led a charmed life and is the epitome of the lifelong entrepreneur. Brafman holds a Bachelor of Arts in Peace and Conflict Studies from UC Berkeley and a Master of Business Administration from Stanford University's Graduate School of Business. While in college, he co-founded Vegan Action, an organisation that prides itself on establishing a network with 36 national and international chapters.

Brafman is a true advocate of the causes he believes in. His list of sensational accolades includes him leading marketing campaigns for UC Berkeley's Young Musicians Program. Ever passionate about healthy eating for one's holistic well-being, he prevented fast food companies from advertising in schools and led marketing efforts for a healthy fast-food start-up. Above and beyond noted contributions to society, Brafman is also a founding team member of Courtroom Connect,

a courtroom technology company. In partnership with Rod Beckstrom, Brafman co-founded Global Peace Networks, which catalysed a network of CEOs working on conflict resolution and economic development in Africa and the Middle East.

Brafman and Beckstrom, co-wrote the spellbinding publication *The Starfish and the Spider: The Unstoppable Power of Leaderless Organisations*; a book that has captured the attention and imagination of thousands worldwide. Pierre Omidyar, CEO of the Omidyar Network, and Founder and Chairman of eBay Inc., fittingly described the book as "compelling and important", adding that the book is "rich with examples of how decentralisation is fundamental to the right environment – one that promotes equal access, rich connections, and 'skin in the game' for participants". It is often said that if we don't value anything intrinsic or subtle, then we have very little depth. Brafman, in line with Omidyar's views of the publication, remains a master of profound, cultured reticence – his influence on society leaves an extraordinary and lasting impression. In 2001, while he was working on a courtroom technology start-up with classmates, the 9/11 tragedy occurred. As if seeking comfort and strength in the arms of a parent, it dawned upon Brafman that it was time to return to his roots, and he co-founded a network of CEOs working on peace and economic development projects. The network was based around tiny networks of 8 to 12 individuals. More notably, no one in particular was in charge, but Brafman had faith that small, flat circles are more powerful than commonly imagined.

Indeed, many of these networks went on to achieve remarkable results. *The Starfish and the Spider* was undeniably the brainchild of Brafman and Beckstrom born when they tried to elucidate the success factors behind the networks.

Brafman's official website states that as an alumnus of Stanford Business School, the entrepreneur returned as a facilitator to his favourite course, Interpersonal Dynamics. This testifies to the fact that his passion for academia and business organisational structure is exceeded only by his passion for people. *The Starfish and the Spider* is a result of five ground breaking years of research, and staying true to Brafman's people-centric focus in life, the revolutionary "starfish" speaks volumes of the power of relying on peer relationships. Brafman's focus is undeniably mirrored in the brilliance that is *The Starfish and the Spider*. The book provide insights as to why small organisations like Napster shook up the music industry and, paves a way for glowing optimism. We can seek renewed relief and hope in the idea that a simple belief can flourish with enormous success if the ideology is shared over a simple platform for communication. The Internet is the perfect portal for that growth.

Ori Brafman is an inspiration to thousands, and his works continue to captivate and excite. He is the personification of endearing confidence, and through his accomplishments, we're reminded to hold true to our dreams and beliefs and be empowered to make them a reality. Since the publication of *The Starfish and the Spider* in October 2006, Brafman has been invited to speak at numerous prestigious events around

the world. He is currently working on his second book, *Pull*, with his brother Rom, who was a collaborating partner on *The Starfish and the Spider*. We at *POINTER* look very much forward to his forthcoming masterpiece.

Rod Beckstrom

Rod Beckstrom is an entrepreneur and catalyst who effectively created new businesses and transformed recognised ones through his innovative solutions, "commanding concepts and fervour." The co-author of *The Starfish and the Spider*, Beckstrom graduated from Stanford University with a Masters in Business Administration and a Bachelor of Arts with Honours and Distinction. He served as President of the combined Stanford student body and was a Fulbright Scholar at the University of St. Gallen in Switzerland. Beckstrom is currently Chairman, Co-Founder and Chief Catalyst of TWIKI.NET, the industry-leading open source enterprise Wiki. Beckstrom is also Chairman of Global Peace Networks, Trustee of Environmental Defense and Director of Jamii Bora Africa Ltd., a micro-lending group with 140,000 members.

Given Beckstrom's dazzling array of accomplishments and the degree of his influence in modern organisations, it certainly isn't far fetched to say that when Beckstrom speaks, "he changes people's lives and organisations' strategies" (as quoted from his official website). Like Brafman, it seems that the primary focus and motivation of Beckstrom's life is *people*. His life story

really does read like an epic novel – he visited the palaces of kings and titans, worked with rocket scientists in Silicon Valley, conducted businesses in no less than 35 countries, spoke with people in areas of unrest and even lived in a mud hut in the poorest slum in Africa. From his sublime, all-embracing exchanges with people from all ranks of the social order in both the Middle East and Africa, Beckstrom is in the ultimate position to impart priceless perspectives to anyone, be it the entrepreneurial businessman or the everyday reader.

Beckstrom is a triumphant entrepreneur and thought-provoking catalyst in many diverse environments. He started his first company when he was 24 in a garage and nurtured it into a worldwide enterprise with offices in New York, London, Tokyo, Geneva, Sydney, Palo Alto, Los Angeles and Hong Kong. That company, CAT•S Software Inc., was later publicly listed and successfully sold off .

Beckstrom was instrumental in starting off more than half a dozen non-profit groups and initiatives. This includes Global Peace Networks which eventually gave rise to a peace network of CEOs that now has a membership exceeding 4000, Silicon Valley Social Venture (SV2), the Environmental Markets Network, and the Miracle Wine Fund for Micro-lending, which has assisted to move more than $20 million into micro-lending projects on an international scale.

The Starfish and the Spider and Beckstrom's illustrious achievements, it becomes evident to the reader that, like Brafman, Beckstrom provides

tools and a very apparent optimism to let us understand that with the right attitude and portal, we can very readily release the energy of our own passions. Undoubtedly, every individual on earth is but a subset of a bigger, greater order, and we all seek to find a purpose and leave a lasting impression in any organisation that we may be associated with. Beckstrom's framework, which teaches us how to unleash our potential remains the benchmark by which all other teachings are measured. Beckstrom is also a speaker on Global Warming, and provides insights on how we, the human race, can emerge triumphant in this figurative climate of uncertainty. Beckstrom's current fascination is with wikis, a new collaborative software technology. There is much to be learnt from how they positively and radically transform teamwork and productivity inside firms, be they Multinational Companies or Small and Medium-sized Enterprises, and across society in general.

The Starfish and the Spider is a result of the collaboration between two heavyweights in their own fields, the synthesis of success and the epitome of triumph. It will empower organisations to expand their outreach and scale of influence and equip the individual with the necessary skills to grow holistically. With unquestionable credibility, Brafman and Beckstrom are like the endearing starfish. Tossed by waves and currents in a turbulent sea, they both hold steady to their personal beliefs and continue to flourish as authoritative speakers and authors in today's erratic geopolitical environment. *POINTER* is thrilled to highlight these mesmerising personalities in this issue's Featured Authors.

Ramon Magsaysay

Introduction

Ramon Del Fierro Magsaysay (1907-1957) was an outstanding Filipino leader who managed an exemplary counter-insurgency campaign which ended the 8-year communist Huk insurgency. As the Secretary for National Defence (1950-53) and as President of the Philippines (1953-57) he played a critical role in this success. Magsaysay understood the contest for hearts and minds and knew how to leverage on his material advantage. His clean reputation and a hands-on approach transformed abusive security forces into agents of state generosity and social change. As a former anti-Japanese guerrilla leader, he understood the value of good intelligence, precision tactics and economy of force in combating insurgency. The Huk emergency lost steam after rebel leader Luis Taurc surrendered to Magsaysay in 1954.

Early Life

Magsaysay was born in Iba, capital of Zambales province, Luzon in 1907. He had a working-class childhood and had no problem interacting and identifying with the masses even after his family fortunes improved dramatically during his youth.[1] Magsaysay started work as a mechanic and then as a superintendent at TRY-TRAN Transportation Company in Manila. In the latter job, he refused kickbacks from suppliers while giving

loans to needy workers. By then, he had grown to become a mature and reliable adult respected by his peers and superiors alike.[2]

Guerilla Leader during the Japanese Occupation

When the Japanese attacked the Philippines in December 1941, Magsaysay joined Captain Ralph McGuire's USAFFE guerilla team as a supply officer. He eventually became a Captain and Executive Officer of Zambales Military District (ZMD) and was made the Military Governor of Zambales province upon General Douglas MacArthur's triumphant return to the Philippines in 1944.[3] His World War II experience gave him insights into the vulnerability of a materially inferior insurgency and the importance of holding the moral

high ground which can ensure timely intelligence and information on hiding places.

Military Governor to Congressman

After the end of World War II Magsaysay joined the Liberal Party and entered politics. Capitalising on his working-class and guerilla credentials, he adopted "a homespun, easy style" of campaigning which defeated better-known and well-financed rivals and became the Congressman for Zambales in 1946.[4]

Magsaysay lobbied hard to become the head of the House Committee on National Defense. He championed veterans' rights and reform of the Armed Forces of the Philippines (AFP), successfully obtaining passage of the Rogers Hospitalization Act in the United States (US) Congress in aid of mentally disabled Filipino ex-guerillas. Magsaysay was one of less than ten Congressmen not implicated in the 1948 "immigration quota racket" and chosen as one of ten outstanding members of the House of Representatives.[5] By the time his first term ended in 1949, Magsaysay acquired a reputation for incorruptibility and efficiency. He was also considered the House's leading expert on defense.[6]

The Hukbalahap Rebellion

The Hukbalahap (Huks), a communist-led guerilla group much like the Malayan Peoples' Anti-Japanese Army, garnered much prestige and armed strength during World War II with their outright resistance against the Japanese. Post-World War II Philippines was ripe for a communist insurgency which started in 1946. The lot of the masses, predominantly peasants, was largely ignored by the urban elites which dominated the government. The Huks promised land reform and social justice. They executed abusive landlords, favoured the poor and became the peoples' champions.

The administration of President Elpidio Quirino initially assigned the Military Police, later renamed the Philippines Constabulary (PC) to deal with what it deemed to be a simple security issue. However bad tactics, corruption, non-discrimination between civilian and insurgent and poor logistical support hamstrung counter-insurgency efforts and drove the disaffected masses into the arms of the Communists. The US, pre-occupied with the Korean War and wary of charges of neo-imperialism was reluctant to intervene directly.[7]

Initial Problems and Mistakes on the Government's Side

Before Magsaysay's appointment as Defense Secretary, lack of logistical support meant troops had to return to base after dark, relinquishing the night to the Huks. Serious efforts to root out insurgent camps were usually undertaken with much publicity only after some sensational insurgent attack. Supply shortages also forced the security forces to resort to looting, which increased the resentment amongst the peasants they were supposed to protect.

There was also the problem of politically-connected landlords who lived above the law and evicted tenant farmers on flimsy legal grounds. Land reform legislation was hampered by lack of enforcement. Thus morals and morale on the government side were very low.

Lack of intelligence on the part of security forces led to reliance upon brute force and numbers, which resulted in significant collateral damage and the giving away of positions and intentions. Communist fighters simply laid low and hid amongst the peasantry as they knew government offensives lacked staying power.

Magsaysay as Secretary of Defense

Magsaysay, the ex-guerilla leader, was the natural choice to lead the fight against the Huk insurgents as he was reputedly incorruptible and highly respected by soldiers and the masses alike. He was appointed Secretary of Defense in September 1950. Magsaysay frequently went to the field which forced otherwise slack commanders to stay on the ball. He would promote the capable, sack the incompetent and cut red-tape, which uplifted the morale of soldiers frustrated by the interference of corrupt local officials. It also earned the Department of National Defence (DND) a reputation for action. As the Cabinet official responsible for quelling the rebellion, Magsaysay would requisition assets, overrule normal practices and protect responsible commanders from political reprisals. His actions helped to remove the administrative obstacles that prevented the Armed Forces from doing its job.

Magsaysay's reputation was also directly responsible for the initial intelligence boon which led to the capture of the entire politburo of Communist Party at the beginning of his term as Defense Secretary.[8] Taciano Rizal, great-grand nephew of national hero Jose Rizal agreed to betray his Huk colleagues because he trusted Magsaysay's sincerity in addressing the country's social ills.

Operational Changes

Magsaysay injected a strong dose of professionalism in the fight against the Huk rebels. Despite vocal opposition from some politicians, Magsaysay convinced President Quirino to merge the poorly-equipped PC with better-trained Army units.[9] Militia and Home Guards were quickly recruited and supplied from AFP stocks, releasing Battalion Combat Teams (BCTs) for mobile search-and-destroy missions. Meticulous intelligence-gathering by specially-trained Ranger units allowed the BCTs to dispense with clumsy mass sweeps. They could pinpoint key food-growing, ammunition production and training areas, allowing for more precise targeting and greater economy of effort. The insurgents retreated to barren regions where they could neither grow nor procure supplies. Knowledge of the size of enemy units allowed the Army to infiltrate formations small enough to avoid detection yet large enough to overcome their targeted adversaries. Time and initiative were thus no longer on the side of the Huks.[10]

Magsaysay was also quick to adopt and disseminate the unorthodox methods of the very successful 7th BCT led by legendary commander Napoleon Valeriano.[11] Government troops disguised as a rebel unit would enter a hot zone where insurgent communications were known to be problematic. They would mingle with real Huks and wait for enough to gather before turning on them at an opportune moment. Conventional units would ambush survivors at exit routes. This killed large numbers of rebels and sowed confusion amongst the Huks, some of whom attacked one another for fear of being taken by surprise!

Such methods brought the fight to the elusive insurgents, allowing government forces to train newcomers fully before deployment while denying this luxury to the enemy. In time, counter-insurgency methods were refined based on experience and information gained from surrendered Huks. The use of cavalry and dogs, contrived from Magsaysay's wartime experience, further increased the mobility and tracking abilities of the AFP.[12]

These effective tactics greatly boosted the competence and confidence of government troops. Magsaysay's lavish use of rewards and stern discipline restored belief in the system, removing widespread cynicism and inculcated a sense of purpose among his men. Military success bought time for more fundamental changes to take effect, which would eventually remove the need for the disaffected to resort to armed insurrection.

Socio-economic and Political Support

Magsaysay understood that winning the psychological contest with the Huks was the key to making the government's material superiority count. He attached a Civil Affairs Office (CAO) to every BCT, allowing it to bring improvements to the lives of the people through infrastructure development and medical aid. Seven corrupt PC district commanders were court-martialed while AFP lawyers represented landless tenants against tyrannical landlords. Soldiers well-supplied with food and candy started to give rather than take from the masses. "I want every soldier to become a public-relations man for the Army", Magsaysay declared. Ordinary folk thus began to see the presence of government troops in a positive light. Intelligence flowed in the direction of government forces, helped by generous bounties on rebels and arms. Psychologically separated from their supposed constituents, the Huks were forced to resort to terror and coercion to survive. The fight for the hearts and minds of the masses was thus won, making eventual victory a forgone conclusion.

Public Relations and Publicity

Magsaysay always brought journalists on his frequent forays into the field. He dressed like a field commander to boost his image as a man of action.[13] News of initial successes allowed him to start voluntary contribution funds amongst Manila's elite, giving him the spending power to carry out his plans. Large cash

rewards for the capture of key guerrilla leaders were complemented by generous land grants to Huk soldiers who turned themselves in, provided they were not wanted for any specific serious crimes. Surrender leaflets were airdropped and these listed the rewards awaiting those who "came in". Magsaysay exploited his favourable public image by having his photo printed on these leaflets. News of successful resettlement of former Huks made its way to other rebels thanks to the co-operation of the press. Only hardcore Communists would hold out against such generosity. Magsaysay thus effectively separated the ideologically-inspired members of the rebellion from those who were fighting because of genuine material hardships. The once-popular Huk uprising became little more than a law and order issue in the end.

Magsaysay the Field Defense Secretary[14]

Extinguishing the Flame of Revolution

In 1953 Magsaysay resigned from the Quirino Cabinet to become the opposition's candidate for President. He won the elections and kept his word to open Malacanang Palace to the public and reserved most working mornings to receiving ordinary citizens in person. Anyone could send him a telegram for ten centavos, or if they could not afford it, the Presidential Office will pay the bill. Top Huk leader Luis Taruc only agreed to turn himself in because he thought he was surrendering directly to President Magsaysay and not the army district commander.[15] Magsaysay only served four years as President as he died in a fatal plane crash in 1957.

Magsaysay Receiving a Provincial Farmer on the Presidential Grounds[16]

Conclusion

Anti-insurgency experts usually cite the Malayan Emergency as the archetypal example of a successful campaign. The Huk rebellion was comparatively harder to defeat. The mainly Chinese MPAJA could never win the Malay community over with

atheistic Communism. Corruption and rural poverty were also less of a problem in the former British colony. In comparison, the Huks were easily identifiable with the peasants they claimed to champion. Their message of land reform could not be countered with anything less than sincere, deep-rooted changes to an age-old social structure. Sir Gerald Templer was an outstanding leader with extraordinary vision but even he cannot match the quality and performance put in by Ramon Magsaysay.

No politician or soldier even comes close to maintaining the amount of direct contact Magsaysay had both with troops doing the fighting and the people they were fighting for. Luis Taruc, the Huk leader, paid the man his greatest tribute when he declared that "the belief of the people in President Magsaysay is Communism's greatest barrier to power in the Philippines. Until we have destroyed this belief, we cannot get anywhere…".[17]

His charismatic leadership aside, Magsaysay left behind relevant lessons for all counter-insurgency fighters. His success refuted the common misperception that insurgent movements have a natural advantage over a large force on the defensive, a myth propagated by the popularity of Mao Tse-Tung's ideas on revolutionary guerilla warfare. Insurgencies thrive on bureaucratic inertia, moral decadence and professional incompetence, all of which negate material superiority. Magsaysay showed that a well-orchestrated counter-insurgency effort could overcome such problems and that

security forces can achieve psychological and moral success. He demonstrated that like the jungle, the hearts and minds of soldiers and the masses are neutral ground. They will favour the side with clearer vision, greater sincerity and sharper skill.

Endnotes

1 Magsaysay's father was a carpenter, a handcraft instructor at an American-run school, a public works foreman and a blacksmith while his mother learned to sew dresses and looked after their *sari-sari* (small groceries) shop. Some early biographies exaggerated Ramon's humble beginnings. For a balanced account, see Jose V. Abueva, *Ramon Magsaysay A Political Biography,* (Manila: Solidaridad Publishing House, 1971), pp10-46.
2 Ibid, pp54-64, Carlos P. Romulo and Marvin M. Gray, *The Magsaysay Story,* (NY: Pocket Books Inc. 1956), pp29-30.
3 Abueva, *Ramon Magsaysay*, pp65-80.
4 Ibid, pp106-8.
5 Many Filipino politicians accepted cash payments in return for sponsoring immigrants from China.
6 Ibid, pp131-8.
7 Anthony James Joes, *America and Guerrilla Warfare,* (Lexington: University Press of Kentucky, 2000), pp189-193.
8 Ibid, pp160-1, 167-9, Romulo and Gray, *The Magsaysay Story,* pp102-5.
9 Abueva, *Ramon Magsaysay,* pp147-8. This also overcame legal barriers to releasing US military aid to the civilian PC.
10 Joes, *America and Guerrilla Warfare*, pp194-5.
11 Colonel Valentino subsequently fought in Vietnam, Columbia and Cuba, acquiring a reputation for ruthlessness. See Napoleon Valeriano, *Conference Notes,* Counter-Guerrilla Seminar, Fort Bragg, 15 June 1961, web version at http://www.icdc.com/~paulwolf/colombia/hukcampaign15june1961III.htm, accessed 28th December 2007.
12 Romulo and Gray, *The Magsaysay Story,* p102.
13 Abueva, *Ramon Magsaysay*, p176.
14 Ibid, chapter 10.
15 Gloria Martinez Santos, "The Presidents of the Post-war Republic, 1946-1965" in Ed. Rosario Mendoza Cortes, *Philippines Presidents: 100 Years,* (Quezon City: New Day Publishers, 1999), pp198-9. Magsaysay apparently broke the terms of the agreement to prevent Taruc from repeating his 1947 feat of turning a highly romanticized surrender into capital for a future comeback.
16 Romulo and Gray, *The Magsaysay Story,* chapter 10.
17 Ibid, Foreward, piv.

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