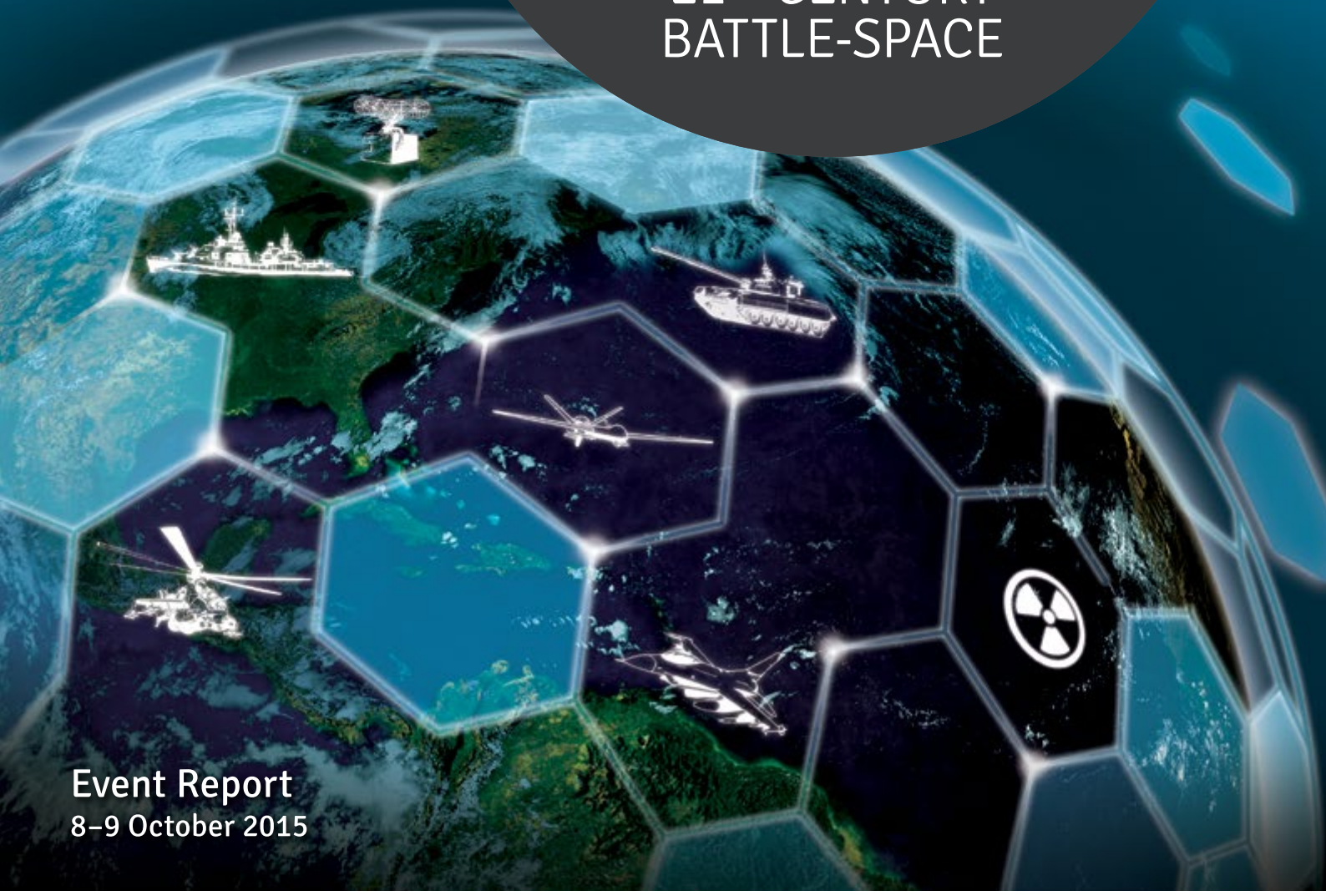
GOH KENG SWEE COMMAND AND STAFF COLLEGE SEMINAR 2015

THE ROLE OF TECHNOLOGY IN THE 21ST CENTURY BATTLE-SPACE



Event Report
8–9 October 2015

RSiS Nanyang Technological University | S. RAJARATNAM SCHOOL OF INTERNATIONAL STUDIES

SAF - NTU academy

Event Report

GOH KENG SWEE COMMAND AND STAFF COLLEGE SEMINAR 2015

The Role of Technology in the 21st Century Battle-space

REPORT OF A SEMINAR JOINTLY ORGANISED BY:
GOH KENG SWEE COMMAND AND STAFF COLLEGE (GKS CSC);
SAF-NTU ACADEMY (SNA);
AND
INSTITUTE OF DEFENCE AND STRATEGIC STUDIES (IDSS),
S. RAJARATNAM SCHOOL OF INTERNATIONAL STUDIES (RSIS),
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EXECUTIVE SUMMARY

Throughout history, new defence technologies have profoundly changed the nature of war and warfare. Indeed, military and world history would have been different if innovations such as aircraft, submarines, nuclear weapons and precision-guided munitions had not been introduced. The contemporary defence milieu is one marked by fast-moving developments and concomitantly, uncertainty. Contributing to this state of affairs is arguably the advent of disruptive technologies. While the 1990s were marked by the information technology-enabled Revolution in Military Affairs (RMA), the world today is seemingly on the cusp of a new RMA dominated by potential game changers like cyber weapons and autonomous systems. The implications of these technologies for the future battlespace would be immense.

The introduction of these and other defence technologies is paralleled with the corresponding developments in how militaries operate. This dialectic has had an impact on the organisation and development of armed forces globally and in extension, the operations they carry out. Militaries today are faced with organisational challenges that their predecessors did not face. The global complex operating environment places operational challenges on militaries as stabilisation missions, kinetic operations and civil-military related operations all operate within the same sphere. To what extent would disruptive technologies shape future conflicts? How can the militaries of today integrate their operational demands and technological capabilities to achieve mission success today? These are some questions that were tackled in this year's seminar.

The seminar aimed to break mental horizons regarding the perceived roles of technology in contemporary operations. The seminar sought to build upon the extant corpus of literature on the nexus between defence technology and military operations by examining the following issues: (i) technology and the nature of war; (ii) operations in the Information Age; (iii) features of the future force; and (iv) battlefield application of technology. Change is an underlying constant shaping the 21st century battlespace, and the papers presented in this seminar suggest that militaries all over the world would have to be adaptive and agile to cope with this reality.

OPENING REMARKS

Rear Admiral Giam Hock Koon began by drawing attention to the primary focus of this year's topic "The Role of Technology in the 21st century battlespace". He pointed out that technology, while offering many positives, creates new demands on men that must be addressed. Technology is the primary motivator for development in military affairs. What makes this phenomenon more challenging is the difficulty of predicting the impact technologies would have on society. While military forces may predict with some accuracy the effect of advanced drone technologies, in the context of the battlespace, its effect on the society they seek to defend is a puzzle. The example given was the belief in the early 20th century that advances in technology would ensure a 15-hour work week. While such a society would be very welcome to most observers, this prediction proved to be ultimately false.

RADM Giam continued by describing three important questions the seminar would hopefully answer. The first of these is the potential impact emerging technologies will have on the conduct of war; what will the battlespace of the future look like? The second was the impact on military ethics; what will be considered ethical in the 'robotic' age? Third, and chiefly, how do we prepare for coming changes in the character, in this case the manner in which it is fought, of conflict?

KEYNOTE ADDRESS

Professor Lui Pao Chuen began his keynote address by arguing that lessons learnt during Singapore's early years of independence are still applicable today. He recounted that systems engineering began in Singapore in the Ministry of Defence in 1970. Then Defence Minister Dr Goh Keng Swee gave young engineers his personal authority to conceptualise, plan, implement and deliver major projects. Directors and systems engineers involved in these projects learnt on the job by making mistakes and correcting them. Prof Lui also stressed that the creation, accumulation, exploitation and sharing of knowledge is important.

He next shared the values learnt from Dr Goh, namely, frugality, agility, openness, and integration, adding that Singapore's future would be determined by imagination and courage. Singapore's well-being is also underpinned by factors such as economic development, national security, and social development, all of which are not mutually exclusive of one another, and together they contribute to the city-state's progress. Prof Lui also argued that defence systems are complex and their optimisation is derived from the effective integration of people, organisations, and society at the macro level. At another level, this involves the integration of land, infrastructure, technology, and systems.

Moving on, Prof Lui shared that the territory of Singapore comprises about 710 square kilometres of land and 690 square kilometres of sea. That being said, it is projected that a significant 19 per cent of land in Singapore will be used for defence purposes by 2030. Staying on the issue of national security, Prof Lui shared that the 2015 budgets for the Defence and Home Affairs Ministries are S$13.1 billion and S$5 billion respectively. Indeed, defence expenditure takes up the largest portion of the budgetary pie.

He went on to trace the development of the Singapore Armed Forces (SAF). To illustrate, he shared the vicissitudes of the V-200 armoured fighting vehicle, which was a technical success, but an operational failure as it often got stuck in mud. Indeed, there were no plans for the platform to cross soft ground initially, but this changed over time. As a result, the American-built V-200 was replaced by the M-113 that was more suitable for local conditions, and the takeaway from this episode was that users (of weapon systems) can change requirements over time. With regard to Singapore's naval capabilities, Prof Lui argued that any nation can buy a frigate, but few would dare to develop indigenous critical systems for the platform.

The September 11 attacks portended the advent of a new threat — that of religiously motivated transnational terrorism — and governments had to adapt to deal with it. In Singapore's case, there was a need to be prepared to fight against "unknown unknowns", and risk assessment and horizon scanning became critical tools for the government in the fight against terror. New capabilities gained during this endeavour came in very handy. For instance, the capability to deal with chemical warfare enabled Singapore to deal with the Severe Acute Respiratory Syndrome Crisis in 2003.

Going forward, Prof Lui maintained that the fundamentals shaping our defence policy would not change significantly owing to various constants such as Singapore's structural limitations, competition for talent and rising prices of weapon systems. That said, warfighting continues to evolve at an accelerated rate with precision-guided munitions, networks and cyber-warfare becoming increasingly important. To cope with future challenges, Singapore should leverage on its people coming together to share knowledge. To this end, there is a need for a shift from a "need to know" mindset to one that is of "need to share". Rounding up, Prof Lui, citing Dr Goh, argued that we should dare to dream, be different, and not be inert.

KEYNOTE ADDRESS
QUESTIONS AND ANSWER SECTION

An issue was raised about the point that Dr Goh once made on the need to be frugal and open at the same time. These two concepts are seemingly in tension as openness to new ideas invariably involves experimenting and concomitantly spending money. Prof Lui replied that frugality does not mean cutting costs, but making best use of the resources available; therefore, there is no contradiction between openness and frugality. Indeed, Singapore invested in a number of modern weapons systems despite the uncertainty of her early years of independence. Prof Lui also argued that the most important resource is actually people, adding that most military organisations usually keep their best staff in frontline roles and this results in a lack of experimentation. This state of affairs was why the Future Systems Directorate was set up — to let the brightest officers in the SAF come up with new ideas and break new ground.

A participant asked about the possible impact of the renewed emphasis on engineering at the national level on defence. To answer the question, Prof Lui first shared that annually, the number of engineering students who graduate from the National University of Singapore and the Nanyang Technological University is approximately 5,000. Of this 5,000, some 40 per cent are foreigners, and out of the 3,000 Singaporean engineering graduates, half of them do not eventually become engineers. The upshot is that there are a relatively small number of engineers in the public sector.

Prof Lui then suggested finding a way to integrate the work done outside the defence sector with work done within. He argued that positions featuring this integration are more professionally enriching and this would attract people into engineering. All in all, the Ministry of Defence can consider this proposition if it wants to recruit the best engineering talents.

Another participant asked if there exists the possibility of moving engineers within the different entities of the public sector so as to share best practices, among others. Prof Lui maintained that this is an excellent suggestion that is being looked into by the Engineering Programme Office in the Prime Minister's Office. He added that such a move would broaden engineers' horizons and enhance their careers.

The last question raised was about the ways to reduce vulnerability at the system level as defence systems become more network-centric. Prof Lui answered that the government is using computer modelling/simulation tools to tackle several national issues, and such tools would also be useful in reducing the vulnerability of defence systems. Future Systems and Technology Architect Rear Admiral Harris Chan then made the point that while technology is important, making best use of it requires the right people. In this light, and echoing Prof Lui, RADM Chan argued that an organisation's most important resource is its people.

PANEL 1
MILITARY TECHNOLOGY AND THE CHANGING CHARACTER OF ARMED CONFLICTS

TECHNOLOGIES CONVERGE AND POWER DIFFUSES

Dr Thomas Hammes began his presentation by arguing that the military environment today is characterised by extreme rapid technological change, especially in the five fields of (i) 3D printing; (ii) nano-technology; (iii) space capabilities; (iv) artificial intelligence; and (v) drones. He said such a development has a precedent in the period 1914–1939, where innovations in metallurgy, power systems, electronics and weaponry changed warfare.

Dr Hammes next discussed 3D printing, where there has been an enormous growth in capability and volume since the advent of this technology. For instance, he maintained that a 3D printer today can print 100 drones and 100 of such devices can produce an eyebrow-raising 10,000 drones. The advent of nano-energetics is particularly alarming because it can considerably enhance the lethality of explosives. Dr Hammes then discussed the rise of space capabilities. For instance, firms are working on systems that can duplicate the communications and surveillance functions provided by satellites.

With regard to drones, Dr Hammes maintained that these unmanned systems are relatively low in cost and thus would be easily available. Indeed, he revealed that researchers in England have prototyped a simple drone body that costs about US$9 a copy. He added that Explosively Formed Penetrators weighing as little as a few pounds would allow even small drones to damage or destroy armoured targets. Dr Hammes also discussed various other technologies like the Slocum Gilder, which is an autonomous underwater research vehicle that can patrol for weeks following initial instructions, then surface periodically to report and receive new instructions.

The convergence of aforementioned technologies favours non-state actors in irregular warfare as they have less bureaucracy to deal with and target discrimination is not as important for them as states. In addition, they have little infrastructure to protect. Compounding matters, global surveillance tools such as Google Earth or Google Maps facilitate the operations of irregular actors. The convergence of technologies also means that lines of communications can be attacked. Indeed, very long-range drone aircraft and submersibles give insurgents the capability to strike air and sea ports of debarkation and embarkation.

Dr Hammes then assessed the implications of these technologies on the various combat domains. In the ground domain, aerial drones are likely to be the predominant autonomous system and they offer mass precision at relatively low costs. That being said, unmanned land systems will evolve and the smart ground mine which has the ability to plant itself could complicate matters for land forces. Would these developments herald the return of mass forces? Would tactical defence become dominant now? These are some issues that defence planners will have to ponder. In the maritime domain, small drones may not be able to sink a ship, but they can bring about a mission kill. Equally worrisome is the threat posed by sea mines, which have become progressively smarter, more discriminating, and more difficult to find in recent decades. Today, there are mines that are self-navigating and even rocket-propelled. There are also efforts to use long-range unmanned underwater vehicles to deliver mines.

In the realm of space warfare, swarm attacks incorporating hundreds or even thousands of drones can be sent to attack airbases. This will cause support nodes such as radars, fuel systems, and ammunition dumps to be highly vulnerable. As for the space domain, the availability of commercial satellites will enable a middle power to develop a space programme for surveillance, communications and even attack. In addition, high-altitude and long-endurance balloons and drones can take the place of satellites but at a fraction of the cost. In the realm of cyber-warfare, it must be noted that all networks have nodes in the real world. Some of these nodes such as key fibre optic network lines and switches are quite exposed, making them vulnerable to attack.

Dr Hammes rounded up his presentation by delineating the operational and strategic implications of the various technologies discussed. In the operational realm, power projection will be much more difficult as bases and logistical modes will be more vulnerable to attack. In addition, dominance in any domain will be contested and cross-domain attacks will be made easier. With regard to the strategic implications, there will be a shift of power to smaller entities — small powers and non-state actors — as they can now inflict higher costs on their great power adversary. The pressing issue is that though the traditional military functions will remain, how can militaries change to take into account these game changing technologies?

STRATEGIC TRANSFORMATION AND MILITARY MODERNISATION IN THE ASIA PACIFIC REGION

Dr Michael Raska began his presentation by stating that he sought to explore the manner in which strategy may determine technology rather than vice versa. He presented his argument as being different to his seminar counterparts because of its lack of a technological component. The crux of his argument is that new strategic realities are responsible for the creation of new regional powers, which in turn determine what form future conflicts take. Technology therefore takes a back seat; while strategy and geopolitics takes prime position. He hoped to illustrate why this was the case by concentrating on four key topics.

The first of these topics was the geostrategic transformation of East Asia, the central playing field of the Asia Pacific region. Dr Raska examined the history of East Asia and divided it into four blocks corresponding to the dominance of a different regional system. The first of these blocks was the 19th century rebalancing that took place after the arrival of the Western powers. The second was the Cold War era, which created two competing ideological alliances. The third was the emergence of U.S. hegemony in the wake of the Soviet Union's demise. Finally, the last block focused on the future of the region in response to China's rise. Dr Raska's premise was that China's rise heralds the end of U.S. hegemony; therefore, understanding what form the new regional system would take is crucial.

He noted that three major elements are influencing this shift in contemporary Asia. The first is a number of chief strategic drivers, such as accelerating great power competition and technological progress, which are fostering change in the region. The second is the complex security dilemmas that currently exist in the region, which include the unresolved territorial disputes and the continued importance of history in inter-state relations. Finally, the third driver is the convergence of the four Revolutions in Military Affairs that is making the character of war change very rapidly.

Moving on to the second topic, the military challenge posed by China, Dr Raska mentioned that virtually every major security issue in the region includes China in some form. While the level of Chinese involvement varies, the country is still a crucial actor and in some cases the instigator of numerous challenges. Dr Raska described this as being the result of China's strategic priorities, the maintenance of internal stability and territorial sovereignty. This focus means that China finds it difficult to define concrete long-term objectives. Instead, it concentrates on short-term objectives and acts on situation specific scenarios. Such an approach has led the People's Liberation Army (PLA) to implement changes in its military strategy, mainly by focusing on asymmetric methodologies. Indeed, nearly all segments of the Chinese military are in the process of developing these capabilities through investment in research and development, and the acquisition of cutting-edge weapon systems. Because of this, China's defence budget has doubled in real terms since 2005, a large portion of this (20 per cent) going to procurement alone. This process hopes to culminate in the establishment of a modern military-industrial sector, capable of developing advanced technologies independently.

This statement led to the third issue being examined: China's historical path of dependence in military development. Lacking a modern military-industrial sector, China was unable to develop weapon systems based on their own designs. Therefore, the PLA had to derive both doctrine and technology from outside sources. Now under the Xi administration, China is on the cusp of being able to do away with this model in favour of an independent industrial complex. Yet at the same time, the path that the PLA placed itself under decades ago has left it with an asymmetric focus. Indeed, the main threat posed to the U.S. is the product of a military doctrine that was pursued in the 1970s.

Moving to his final topic — the patterns of future conflict — Dr Raska made it clear that hybrid warfare and the like will be dominant. The PLA's focus on asymmetric negation ensures that any conflict between the two states will resemble hybrid warfare far more than a straight-out conventional war. Indeed, Beijing's strategy is to target American weaknesses and ignore their strengths. For this reason, the Asia Pacific will see a focusing of the current cycle of military modernisation on developing the weapons and concepts that function under hybrid warfare. He concluded by suggesting that it was imperative for regional states to learn about hybrid warfare and conduct military reform appropriately.

PANEL 1
QUESTIONS AND ANSWER SECTION

The first question asked was whether the speakers agreed with Martin Van Creveld's argument that war is driven by technological transformation. Dr Hammes quickly dismissed Creveld's argument. He maintained that Clausewitz was indeed correct in identifying three societal elements, social-political-economic, as the origins of war. Dr Hammes then directed attention to Africa, where states that have the technology to fight wars of attrition, fight tribal wars instead. He argued that this is because their societies have not reached the level of development necessary to take advantage of modern weapons. In short, the level of advancement in a society drives technological acquisition, without it, weapons and concepts will be too difficult to understand. Dr Raska agreed with Dr Hammes's views, adding that technological advances can influence a state's strategic intentions.

The second question on whether the threshold of the use of force will be lowered due to drone warfare was posed to Dr Hammes. He responded by arguing that the use of force will remain a political decision regardless of technology. Even terrorists would make political decisions when they decide to blow up something. What he did admit would change was the potential damage the use of force may bring about. Advanced technology will allow a smaller number of actors to commit far greater acts of violence. As the potential damage increases, the societal impact would become far greater.

The third question, how small regional states should cope in the face of competition between the U.S. and China, was directed at Dr Raska. He responded by suggesting that China's rise was a pressing issue on the strategic level. In particular, knowing how to balance between the two states would be crucial for regional actors. Even more crucial is how smaller states will react if they are forced to pick a side. On the operational and tactical levels, technological developments in both the U.S. and China will be profound. For U.S. allies, developments in American technology will force a decision on which technologies to pursue. As U.S. allies are expected to integrate with American forces, determining which weapon systems they will choose to procure will be interesting. This will fundamentally reshape the nature of alliances in the region, for better or worse.

The fourth question, regarding the various moral and ethical issues of autonomous weapons systems and how they should be managed, was posed to Dr Hammes. He stated that it is important to remember that autonomous weapon systems have been utilised for quite some time. The ethical question that needs to be addressed is whether it is ethical to kill, not what methods are ethical. The decision to kill is already a momentous step that should incorporate the means. Dr Hammes concluded by asking the audience whether opponents that embraced autonomous weapons quicker was ethically dubious.

The final question, how states should deal with new threats that do not possess existing norms, was directed at both speakers. Dr Raska mentioned that it is important to have an international community bound by law. While the United Nations might be "unnecessary", it is also the most "necessary unnecessary" organisation as the existence of such bodies and of international law give states a framework to buy into. By placing norms or ethical constraints on new defence technologies, states can take the time to learn about their potency and devise an appropriate response, Dr Hammes contended. Also important is the existence of nuclear weapons, another example of norms in action. Indeed, international norms combined with the inherent negativity surrounding the usage of nuclear weapons have made conflict less likely, if not impossible.

PANEL 2
OPERATIONS IN THE INFORMATION AGE

CIVIL-MILITARY RELATIONS AND INTERNATIONAL MILITARY COOPERATION IN CYBERSPACE

Ms Caitríona Heinl began by briefly touching upon the need for greater cyber cooperation. She laid out the objective of her presentation, which was to illustrate the importance of developing such cooperation in both the domestic and international scenes. Ms Heinl then discussed the notion of cyber-threats and cyber-security. She mentioned that countries have different models in this area depending on their needs. The emergence of cyber-threats is challenging the pre-existing notion of civil-military cooperation, forcing states to adapt. For instance, existing arms control treaties do not mention cyber-warfare at all. Devising a cyber-warfare clause in arms control is both necessary and feasible. Another issue that cyber-threats contain is the grey area they operate in; identifying what is criminal behaviour and what is harmless is very difficult.

Taking a broader view of these issues, Ms Heinl identified four areas in which improvements could be made. The first area is about imbedding cyber-security into public infrastructure. Public infrastructure is the preview of many different government ministries, each controlling a segment of the “pie”. States will need to find a method of establishing a universal cyber-security policy with or without the support of these entities as this would minimise bureaucratic waste and allow for a quicker response. Such measures are already being considered, for instance, the coordination of cyber-defence becoming the purview of the Prime Minister’s Office in the U.K.

The second area for improvement is the need to clarify the relationship between the civilian and military realms. Keeping the armed forces in the policymaking process is crucial given its role in national defence. It was also pointed out that modern militaries require civilian infrastructure to function, in which case they too have a stake in civilian cyber-defence. Summing up, Ms Heinl maintained that a clear chain of command would mitigate the effects of a cyber-attack.

Turning to the third issue, the need to build trust, Ms Heinl accepted that achieving cooperation requires trust between all relevant actors. Building up ties would also be beneficial in identifying points of common concern, allowing actors to devise concrete and wide-reaching measures. The example of the EU Cyber Defence Policy was cited, in which it states that working together on projects in turn leads to greater security for the continent.

Moving on to the final area in need of improvement, managing limited resources and finances, Ms Heinl made it clear that she understood the limitations states face today. Regarding resources, there are too few cyber experts willing to work in the field. Discovering a way to lure cyber experts back into the public sector is necessary. Similarly, too few public officials understand the challenges of the cyber age. A process of education would be needed to bring them up to speed with the demands of the 21st century. Regarding finance, including academia and business in devising a solution would keep costs down and build trust between all parties. Going further and including other civilian bodies, such as law enforcement, would make this process even more effective.

In her concluding remarks, Ms Heinl maintained that synergy is the key to success in cyber-security. Cooperation between states is needed to prevent escalation. Military forces naturally prioritise achieving victory in war as their main focus, but they should never forget that they are obliged to maintain the peace as long as they can. As cyber has developed, the impact on trust has become greater. Devising the means to maintain this trust is needed. Cyber-warfare is not inevitable, just as conventional conflict is not either.

THE ROLE OF SOCIAL MEDIA IN THE STRATEGIC OUTCOMES OF CONTEMPORARY CONFLICTS

Mr Eddie Lim sought to look at the inevitability of the rise of social media and its impact on strategic affairs and implications for the military practitioner. Indeed, such is the importance of Internet access/social media today that it may also be added to the list of basic needs in Maslow's theory of the hierarchy of needs. On one hand, social media helps in areas such as aiding public engagement. On the other hand, it accentuates the threat of radicalisation as it could be a medium of extremist ideas. Besides these, social media manifests itself by being a mobilising force of people and ideas, with the Arab Spring being a pertinent example of this. Other examples include the Umbrella Revolution in Hong Kong and the Red Shirts protests in Thailand.

In order to relate the implications of this phenomenon to the military, Mr Lim argued for the need to refer to the Clauswitzian "trinity" of the people, military, and government. Social media can be an emotive force that can trigger passions in the "people" aspect of the trinity. Mr Lim then provided a case study of the *Usman Harun* saga where Indonesian marines Usman Haji Mohamed Ali and Harun Said were found guilty of the McDonald's House attack and were ultimately hanged. In subsequent years, conscious gestures by Singapore and positive bilateral relations ensured that the past was buried. However, tensions between the two countries intensified when an Indonesian warship was named after the two marines.

Mr Lim then explained the methodology used in the case study, which comprised a comparison of official policy statements and emotive comments made on traditional and social media by Singaporeans and Indonesians. This was to show the contrast between the two state's official policy and the views of their own citizenry.

Mr Lim then shared the major findings over four ascending stages of intensity. The first stage was "Simmering", in which fairly straightforward concern without emotive language was voiced by the Singaporean foreign minister over the ship's naming, which in effect triggered surprised responses in the social media. Indonesian official statements defended the decision and underplayed the Singaporean reaction, saying that it was due to a difference in perspective; on social media, there was angrier defence of the decision. In the second stage, "Churn", the Indonesian defence minister stated that there was no rationale for changing the name as inter-state military relations were smooth but on social media there were contradictory messages which objected to the naming. On the other hand, many Singaporean netizens said that this issue undermined established military relations.

During the third stage, "Damage Control", the Indonesian government claimed that the issue had been resolved already. In social media, however, Singaporean grievances were assuming emotive proportions as they spoke of the violation of honour and international law. The saga culminated in its last stage "Tapering off", in which the Indonesian traditional media reflected apologies and sought to close the issue, although it was only an official position and not a popular one. Singaporean netizens then expressed dismay over their government's acceptance of Indonesia's apology.

Lastly, Mr Lim discussed the challenges that the social media raises for the military practitioner, one of which is that it can distort perspectives. He showed the audience a photo of an election rally which people would assume to be from the 2015 Singapore General Elections when it was actually not. Mr. Lim concluded the presentation by stating that the interpretation of issues in the context of social media is a personal responsibility.

TECHNOLOGICAL DIFFUSION IN HYBRID WARFARE

Assistant Professor Ong Weichong began his presentation by drawing the audience to the crux of his argument: that technological diffusion empowers hybrid warfare rather than acting as a limiter. Organisations and militaries that utilise hybrid warfare are enjoying the capabilities this technological renaissance is providing them with. He described this process as being one of the most pressing challenges in today's world, one that societies must face now and in the future. Understanding this threat and devising counters was thus in the best interest of global society. For this reason, Asst Prof Ong touched upon the crucial points that needed to be understood.

Asst Prof Ong first focused on identifying what technological diffusion actually implies. The definition he utilised was that diffusion was the "Process by which an innovation is communicated through certain channels over time". By this, he referred to the process by which new technologies are assimilated by international and domestic actors. He pointed out that as certain technologies mature, their price drops. This ensures that new technologies become affordable which in turn leads to greater diffusion. Another driving force identified was the need to maintain a technological advantage over others; being left behind in the past was never a good option. This process has existed throughout history; the fundamentals are therefore well understood. What has changed is that previously 'lesser' actors, for instance non-state actors, have become capable of assimilating new technologies at the same or even faster speeds than states.

Moving away from the contemporary implications, Asst Prof Ong turned to the 19th and early 20th centuries to illustrate how the process functions. He noted that these periods were ones in which the Western powers were the dominant military actors. States in the Asia Pacific, that understood they were outclassed, felt obliged to modernise their armed forces via western methods. The western model was eagerly implemented by Meiji Japan, a decision that bestowed great power status on it. In contrast, Qing China became failed in its modernisation effort. Asst Prof Ong suggested that this failure was due to the Chinese's refusal to modernise their organisation system and state, instead focusing on technological acquisition. Therefore technology on its own is not enough, understanding how to utilise it is part of the diffusion process. Taking this to the modern era, Asst Prof Ong discussed several new technologies, such as drones and 3D printing, which will require the same level of adaption for mastery to take hold.

Continuing onward to hybrid threats, Asst Prof Ong highlighted the mixed nature of hybrid warfare. Comprising diverse elements, such as conventional weapons and criminal activity, hybrid warfare is almost entirely divorced from conventional warfare. By combining conventional and irregular forms of war together, hybrid warfare becomes something else entirely. He emphasised the fact that hybrid warfare focuses on short decisive campaigns rather than long-term operations. To illustrate these unique qualities, he examined two case studies. The first of these was Hezbollah, an actor that views hybrid war as a norm. Blending cutting-edge weapons (e.g. missiles, jamming equipment) and a disciplined body of men, with guerrilla tactics has led to a fighting force that is fundamentally unique. Such a force is capable of causing damage equal to a conventional force whilst leaving their opponents unable to strike back. The second example, Russian forces in Ukraine, revealed how even states have become interested in the ideas pioneered by Hezbollah.

Tying all these together, Asst Prof Ong described a world where technological diffusion is speeding up the changing nature of war. The interplay within hybrid warfare between advanced technology and guerrilla tactics is becoming more accessible as technology becomes more accessible. The western world order which has always been associated with its dominance in military affairs is increasingly being challenged. Technological diffusion, while offering many benefits is thus capable of supporting agents of instability. As technology spreads, hybrid warfare will become more common. In the case of Singapore, an attempt at fracturing a multi-ethnic society could be disastrous. Concluding his discussion, Asst Prof Ong called upon the audience to think on how to create an resilient society.

PANEL 2
QUESTIONS AND ANSWER SECTION

The first question, as to whether ASEAN should seek to emulate the EU's Cyber Defence Policy, was directed at Ms Heinl. She began by stating that ASEAN should do so in an ideal world, developing complementarity between all of the world's regions would do much in countering cyber-threats. However, she cautioned that one must also be aware that ASEAN and the EU are fundamentally different organisations; the EU is more centralised than ASEAN for a start. This would make it a challenge for any regional state or organisation to follow in the EU's footsteps. Nonetheless, it is possible for ASEAN to learn from the European example. Studying the strengths and weaknesses of the Cyber Defence Policy would allow regional actors to incorporate effective ideas into their own cyber policies.

The second question, regarding whether the military should continue to assist the civilian world in cyber-defence, was again addressed to Ms Heinl. She stated that the establishment of the Cyber Security Agency in Singapore was directly tied to this question. This new organisation combines military and civilian elements in order to tackle cyber-threats. Cooperation is certainly a key factor in achieving success and thus should be encouraged. However, as this is a new organisation, policymakers should wait and see to determine whether the model is effective.

The next question, regarding how the increasing publicity of SAF operations might affect Singaporean society, was addressed to Mr Lim. He responded by stressing that in the context of Singapore and the SAF, a greater social media presence does not hamper defence in any way. Every Singaporean plays an active role in the defence of the nation, thus increased publicity does not make a difference. On the contrary, all parties should applaud a more open SAF. Greater links between the military and civil society will contribute to a safer Singapore, thus a greater social media presence and the likes is a great development.

The fourth question was on how militaries should derive maximum value from technological developments. Asst Prof Ong agreed that it is indeed true that modern military weapon systems are far costlier than their 20th century counterparts. The best way to manage this increase is to develop greater synergy between the different sectors of society. This would allow militaries to sidestep the perils of bureaucracy and achieve real savings in both weapon development and acquisition. States should definitely also be more courageous in funding long-term research projects, only through these can real game changers come about.

The fifth question, regarding how the diffusion of the ability to harm would affect civil-military relations, was directed to Mr Lim. He argued that developments in cyber-technology and the like have allowed individuals and terrorist networks to cause great harm to social cohesiveness. The use of social media by the ISIS has allowed it to win the hearts and minds of many young Muslims globally. To counter this, there is a need to create a credible narrative that the population can believe in. A potential long-term strategy is to attempt 'hardening': making targets more secure.

The final question, regarding the notion of cyber sovereignty and whether it exists, was directed at Ms Heinl. She argued that the concept of cyber sovereignty is bogus as the Internet was developed as a global medium of communication. Thus, attempting to create a "national Internet" defeats the very purpose of its existence. Existing international law, which supports an open Internet, continues to apply in all cases. An area that is certainly worthy of further discussion is how to address the "grey zones".

PANEL 3
DEVELOPING THE FUTURE FORCE

SEEKING OUT DISRUPTIVE AND GAME CHANGING TECHNOLOGIES

Rear Admiral Harris Chan started his speech by delineating the forces that would shape the future, namely: geopolitics, social factors, technology, economy, politics and governance, and energy issues. With respect to geopolitics, there is a discernible trend of the rise of China and a revisionist Russia. And with a distracted U.S. shifting its attention away from Asia, there is a likelihood that China will become more assertive and ASEAN unity might be affected. As for social factors as a driving force, increasing global connectivity could affect social cohesion and dilute national identity, with more people becoming loyal to an ideology instead of their country.

Another driving force of the future is local politics. With more well-educated and vocal citizens, government policies will have to be more consultative and it will be difficult to implement initiatives that are unpopular but beneficial to the people in the long-term. Equally important is the role of the economy. With greater internationalisation, will countries have to restructure their economy? In addition, the emergence of alternative trade routes will have economic implications for the nations affected. RADM Chan then discussed the impact of rising global energy demand. As more countries become urbanised and industrialised, the demand for energy resources will rise and the search for viable alternative sources will intensify.

Next, RADM Chan analysed some of the technological trends that will shape the world from now till 2030. An example of such a trend is the proliferation of “smart” cities, where their inhabitants are well connected to the world. Indeed, some 72 per cent of the world will be urbanised in 2050 and new domains have emerged for the execution of non-kinetic attacks in cyberspace and infospace. In smart cities, the impact of a cyber-attack would be far greater than that of a bomb. Furthermore, social media platforms could also be exploited to conduct information operations and shape public sentiment. Another technological trend is the emergence of space as the next frontier as more major powers take to the skies. While space provides opportunities for beyond line-of-sight communications, it also facilitates cyber-attacks and communication disruptions.

The proliferation of autonomous systems is also discussed. Worth considering is the possibility that unmanned systems in the future will become more human like with the use of neuromorphic chips for human-like processing. Militaries could also exploit robots to address manpower challenges and replace humans in conducting dull and dangerous tasks. Another technological trend is that the commercial sector continues to lead in terms of spending on research and development (R&D). Indeed, the civilian sector will present more dual-use innovations, such as drones and 3D printing, which the military can leverage on. This will put less pressure on military R&D spending.

Another trend is that the West continues to lead in defence R&D spending, and it will remain the leader in defence innovations. Indeed, the U.S. spends more on defence than the next seven highest-spending countries combined. In a related development, the East will increase spending in technology niche areas. That said, regional militaries should monitor these developments closely and start building linkages for possible collaboration vis-à-vis defence technology in the future. RADM Chan then discussed the commoditisation of advanced military technology. With easy access to cutting-edge systems, defence capabilities can be bolstered more rapidly, and this will further quicken the pace of technological innovation as countries try to gain an edge over one another.

Rounding up, RADM Chan warned of potential disruptions to the aforementioned technological trends. For one, there is the balkanisation of the Internet, which could result in restricted global connectivity. There is also the threat of the “Dark Web”, which is basically the secretive dimension of the Internet where illegal activities such as crime are carried out.

OPPORTUNITIES AND CHALLENGES OF USING COMMERCIAL TECHNOLOGY FOR FUTURE CAPABILITY DEVELOPMENT

Mr Henry Chang Weng Foo began his presentation by stressing the importance of his topic. In his view, commercial technology is now at the forefront of the technological progress and the strategist must bear this in mind. Two reasons underlie this, the increasing limitation of global militaries research capabilities and the rise of civilian technological giants. Combined, these trends are set to reinvent the manner in which we view technological progress.

Mr Chang illustrated his argument by turning to the case of Singapore. A nation with very limited resources, Singapore had to spend significantly to develop a strong defence technological base. As a result, the SAF evolved from a first-generation military to a modern one. The state was thus the primacy motivator for technological sophistication, not the private sector. While this process could be seen as a great success, the future strategic environment is shifting.

In particular, Singapore's low birth rate is imperilling the conscript based security apparatus currently in place. Combined with the lack of natural resources, the lack of human assets will only further ensure that technology remains the most crucial component of Singapore's defence. Yet, military technology is becoming ever more expensive across the world; personal costs are also rising as the population ages. These two factors suggest that Singapore's limited resources will be stretched to a breaking point. The old state-driven model is therefore unsustainable when faced with demographic pressures found across the modern world. The one positive development has been the increasing role of the civilian world in research and development. Venture capitalists in the U.S. are now spending more on research than the military, a first. The private sector is now the leader in areas as diverse as space, manufacturing and big data analytics. The private sector can thus be seen as the driver of technological innovation in the developed world, something that must be understood and utilised by states.

The military in particular must not be afraid to tap into this wave of innovation coming from the private sector. Adopting commercial technology offers a multitude of benefits that could reinvent military expenditure. For instance, Mr Chang revealed that commercial technology offered militaries lower costs and reduced delivery times. In an era of expensive military technology, saving money and reducing acquisition time can mean the difference in military potency or weakness. Challenges do exist, namely that commercial technology is not as rugged as it need be for military usage, but this point was argued to be manageable.

With this in mind, Mr Chang outlined four strategies that would make commercial technology much more readily acceptable to the military. The first was the need to develop a modular and open system architecture that would be capable of supporting a wide variety of different components. The second was the need to use some commercial technology as it is, there is no need to "militarise" everything. The third was in regard to developing complimentary cyber-defence systems between the military and civilian worlds. Finally, there is a pressing need to become more accurate in predicting which technologies are becoming obsolete. Mr Chang argued that implementing all these steps would ensure that Singapore remains safe and secure.

U.S. AIR FORCE SPACE COMMAND: CURRENT MISSION, TECHNOLOGY PERSPECTIVES, SMALL SATELLITES, AND PERSONNEL DEVELOPMENT

Colonel Martin France began his presentation by prioritising three objectives. First, he felt it was necessary to present the current state of the U.S. Air Force Space Command, complete with its current operational priorities. Second, a discussion of the future of Space Command was necessary to round off the findings of the previous objective. Third, an overview of the Air Force Academy was also in order. Combining all three would give the audience a coherent and accurate picture of the workings of the organisation and the necessity of its continued existence.

COL France directed the audience's attention to the centrality of space in our lives, especially in the realm of technology. He noted that every state possessing an advanced military required space as part of their defence policy. Without it, and the satellites in orbit, military hardware would simply not function. The U.S. in particular viewed space as being the core of its military doctrine; a view that was held at all strategic levels. Space Command currently commands a global presence, with numerous faculties located in every region of the earth. This is revealing as to the priority put into space defence. The maintenance of a credible military deterrent is the primary motivator of peace, thus ensuring that the deterrence in question can function. This catapults space into strategic importance.

In the civilian world, COL France revealed that the global commercial space industry possesses an estimated annual revenue of US$300 billion. This figure is expected to go up as over 170 countries now have access to space capabilities. In addition, 11 countries have indigenous launch capabilities and 1300 active payloads are being tracked. In essence, space is becoming an increasingly lucrative sector for commerce to move into. It is no longer simply the domain of scientific exploration and national defence strategies. As this trend continues, the need for ensuring security in space will increase dramatically. Both governments and militaries must be prepared for this shift when the time comes.

COL France continued by going over the technical aspects of space security and warfare. He noted that the specific mission requirements of any operation determines the orbit selection of satellites. This creates a situation whereby the location of strategic satellite assets can be determined by understanding their mission. These satellites can be utilised in a variety of settings, from global position to missile defence. Thus space, and increasingly cyberspace, is present in any military operation across the spectrum of conflict.

While space assets continue to be essential to war fighting, new threats are emerging that need to be prepared for. One particular point raised by COL France was that space assets were expensive. This is a major challenge to national budgets as space becomes more crucial. Seeking technological solutions to lower costs were thus necessary in ensuring security. Additionally, the increasing amount of space debris in orbit will threaten future launches. There are currently 23,000 tracked objects, and estimations of roughly 500,000 are considered to be accurate. Ensuring that space traffic is unharmed by these objects is a serious concern for terrestrial organisations; made all the more threatening by the lack of solutions in the present. Conventionally, technological advances in areas such as jamming and laser weaponry have allowed space-based assets to be targeted from the earth. In short, space is becoming a greater security risk than ever before.

Moving on to the role of the Air Force Academies Space Systems Research Centre, COL France described the successes they have experienced. The example given was the development of a common ground architecture for space assets, dramatically simplifying the usage and maintenance of satellites in orbit. Furthermore, research into a new generation of 'cube satellites' is progressing smoothly and should result in fundamental improvements. The most recent and tangible success, the launching of the FalconSAT-6 this August, illustrates the U.S. Air Force's commitment to mastering the new strategic landscape.

PANEL 3
QUESTION AND ANSWER SECTION

A question was raised on the role played by military personnel with humanities or social science backgrounds in the technological realm, to which RADM Chan answered that their knowledge would be useful in understanding human behaviour. Another question was asked about how the military force of the future could be sustained by increasing energy demands. RADM Chan answered that this could be done by actively seeking more alternative energy sources like lithium. He added that the main challenge faced by armed forces in this aspect is having adequate access to energy so that military tasks could be carried out. To this end, there is research being carried out on the militarisation of energy. The last question posed to RADM Chan was about operational challenges likely to surface in the future and the capabilities that should be explored to address these challenges. RADM Chan maintained that neuromorphic technology is going to be very important in the future. This is because autonomous systems with such capabilities could complement human beings on the battlefield. Lastly, RADM Chan also argued that cyber-security is of paramount significance with the increasing use of information technology and computers.

Another question, regarding potential solutions to military obsolescence, was directed at Mr Chang. He responded by saying that the key to success is to look ahead, and understanding the future is key for militaries to maintain their relevance. Prediction is certainly a hit-or-miss activity. But what is worth doing is attempting to understand the technological drivers of the future. By knowing what current developing technologies will play a key role in future society, we can predict with greater accuracy. Keeping one eye on the present day and one on the future will be a far more effective way of identifying trends that can be taken advantage of.

The next question for Mr Chang was regarding what the next RMA would be. He responded by saying that what was becoming clear now is that the lines between the military and civilian worlds are blurring. The re-emergence of hybrid warfare, as seen in Ukraine, is proof that war is becoming an increasingly broad activity. Warfare will soon incorporate many sectors of civil society that have previously been exempted. The usage of social media by the ISIS and other terrorist organisations reveals how blurred the lines have already become.

The final question, regarding how the U.S. and China could cooperate on space policy, was directed at COL France. He stated that an awareness of the situation in space is by far the biggest means of fostering cooperation. Making both sides understand that working together to solve joint problems is crucial. Currently there are numerous issues, such as space debris, that cannot be tackled by one party alone. These are issues that can be used to create a lasting partnership. To this end, sharing data and joint networking will do much in building bridges between the two sides.

PANEL 4
BATTLEFIELD APPLICATION OF TECHNOLOGY

ONLINE WARRIORS: HOW 21ST CENTURY TECHNOLOGY IS RESHAPING OUR UNDERSTANDING OF THE PROFESSION OF ARMS

Professor Christopher Coker began his presentation by sharing the following quote by German thinker Friederich Hegel: "Weapons are nothing but the essential being of the combatants themselves." In other words, he maintained that Heracles would only be good as his sword and drone pilots, their drones. However, there is an argument that drone pilots are not "warriors" in the true sense of the word. This also applies to personnel involved in cyber-warfare. Prof Coker then asked: "So what exactly is a warrior?" Indeed, suicide bombers are hailed as warriors in parts of Afghanistan and the same applied to kamikaze pilots in Japan. He also shared that an al-Qaeda manual saying that American soldiers are not warriors because they do not have the courage to torture prisoners of war.

There is a general perception that a special force soldier is more of a warrior than a drone pilot because the former is out in the field while the latter is safely ensconced in base. However, a number of drone pilots have come out to argue that their job requires immense courage to witness death and destruction frequently. Indeed, they are said to suffer from perpetration-induced traumatic stress, a condition unique to them. Prof Coker said that it is time perhaps to recognise drone pilots or cyber-warfare personnel as warriors.

He next argued that technological change would shape the character of war. For instance, the machine gun, when it was first used, was to get the enemy "to see reason" and to convince them that resistance is futile. If the enemy continued to resist, he was clearly being "unreasonable" and the machine gunner thus held the moral high ground. Prof Coker then discussed some features of the drone: it is evidence of America's omnipotence, it shows the tendency to avoid risk as it avoids putting boots on the ground, and finally it is the ultimate technological quick fix for a society that fears commitment.

Moving on to cyber-warfare, good cyber warriors are said to have analytical, multitasking, and motor skills. Prof Coker then discussed the film *Ender's Game* where a young man destroys an enemy planet while thinking he is playing a computer game. Indeed, military historian Martin Van Creveld argues that the film's protagonist would make the ideal warrior in modern military forces, as he would not be subjected to stress and anxiety in a virtual environment.

Prof Coker also discussed the various just war theories in the modern age, with emphasis on jus ante bellum or justice after war. He asked, "Are we subjecting drone pilots to unnecessary psychological stress because they are to target people whom they have to get to 'know' through constant monitoring?"

The other question that was raised was whether robots would replace people one day. Indeed, such is the prevalence of robotics that it is possible that in the future, commanders would be able to monitor their men's physical performance indicators such as heart rate and stress level. Should this be alarming? Prof Coker maintained that this should not be as we need to develop our "tools" in order to maximise our genetic potential.

Towards the end of his presentation, Prof Coker discussed three points, with the first being Meaningful Human Control (MHC). MHC is the idea that robots would upgrade humanity by making ethical decisions on our behalf, and the U.S. military is paying scientists to develop MHC algorithms. Prof Coker inquired if handing over human control to machines would diminish or upgrade humanity.

The next issue Prof Coker brought up was that of responsibility. He asked: "Should we give responsibility to machines instead of making decisions ourselves?" Prof Coker explained that there are plans to design robots with a bottom-up method, instead of the usual top-down design. This concept is called self-organisation and emergence. He pointed out that this is the most significant scientific idea around now as it resembles how human beings have evolved throughout the ages. Prof Coker added that this route must be taken with respect to robotics or it should be given up altogether.

The last point Prof Coker made was that of human dignity. Does being killed by a drone pilot in another continent or being killed by a manned airplane in your line of sight make a difference? He argued that there is much debate over such issues because people are afraid of robots. This fear, which has primal origins, is basically about being killed by a non-human adversary. However, robots are here to stay and they will be coexisting with human beings. Rounding up, Prof Coker argued that warrior geeks like drone pilots are also here to stay and are likely to be the warriors of the future.

THE SAF EXPERIENCE OF TECHNOLOGY IN MILITARY OPERATIONS: OPERATION BLUE RIDGE

Colonel Dinesh Vasu Dash began his presentation on Operation Blue Ridge by outlining the events that led to the deployment of the SAF to Afghanistan. An Islamic terrorist network had planned to bomb MRT stations around 2001-2002. Fortunately for Singapore, this information was located by coalition forces in a raid on a Taliban stronghold in Afghanistan. With this in mind, the Singapore government understood that it needed to take an active role in the War on Terror and this marked the beginning of six-year-long Operation Blue Ridge.

COL Dinesh next discussed the SAF's role in Afghanistan. As the SAF was a small conscript-based military, it was decided that Singapore would offer niche capabilities rather than a larger-scale force. With this in mind, roughly 500 troops were deployed to support The International Security Assistance Force (ISAF) forces in Afghanistan. The niche capabilities included: UAV teams, imagery specialists, medical teams, construction teams, military trainers for the Afghan Army and the weapon locating radar. Emphasis was placed on the technological sophistication of the SAF, making specific technology the crucial factor in the SAF's experience.

The SAF forces were deployed to an ISAF base that was under near constant threat of attack. The base was also located in a valley surrounded by mountains. This allowed the Taliban to fire rockets at the base from any of the surrounding mountains, making it difficult for a response to be mounted. As time went on, these rocket attacks became increasingly accurate and casualties started to become more frequent. The response was the deployment of the SAF's two artillery-detecting radar units. This system allowed the operators to detect incoming fire, trigger an alarm in the targeted area, locate the enemy, and return fire.

Several problems soon became apparent with this arrangement. The main issue was that the radar unit was designed for mobile operations and not for static defence. This meant that the radar, which was parked in extreme heat, would constantly run the risk of overheating. Each unit was also capable of limited coverage, which meant that part of the base was left unprotected. Furthermore, the radar was not designed to detect some of the smaller projectiles utilised by the Taliban. The unit was also understaffed, with a small number of SAF soldiers expected to maintain continuous coverage of the mountains. These men were also expected to endure the extreme heat in the radar unit's cabin, which was not air-conditioned.

As a result, solutions had to be found for these challenges. The primary success was the deployment of the External Generator and Cooling Unit, a device that allowed the radar to operate continuously. Technical personnel were also able to reroute air into the cabin, ensuring that the crew members inside would not dehydrate. With these solutions in place, the radar unit was capable of detecting 27 rocket attacks that took place during the operation. This was the result of technological adaptation and allied intelligence, which gave the SAF clues as to which direction the Taliban would strike from. Furthermore, the radar units were capable of detecting which particular locations the Taliban were striking from, allowing ISAF forces to launch raids against their locations. Technology, in COL Dinesh's experience, was thus a crucial component of modern warfare.

PANEL 4
QUESTION AND ANSWER SECTION

The first question, regarding what would happen when machines make morally repugnant decisions, was addressed to Prof Coker. He answered that the question was indicative of a very old-fashioned way of looking at the question of robotics. Experts, both military and civilian, cannot possibly hope to understand decisions that would be made by intelligent robots. A potentially intelligent machine would be an entirely new entity on this planet, attempting to understand how it would process decision-making is impossible at this stage. However, this scenario continues to become a reality as robotic technology advances with every year. The choice for humanity is whether we decide it is a risk worth taking and continue such research.

The second question, regarding whether Moore's law would limit technological advances, was also directed at Prof Coker, who responded by saying that technology throughout the centuries has always been portrayed as offering a brighter future for societies. The benefits technological advances bring are said to make war a "fantasy" and "illogical". Despite this not being the case with the continuing prevalence of war, the notion of technology as a peacemaker is still very relevant in the modern world. That said, robotics, and to some extent cyber weapons, are seen as making war less costly in human terms and thus more likely. A less costly war would increase the odds of conflict; this in turn makes these technologies "evil" in the eyes of the public. Yet, as all technologies bring about unintended changes, they should be welcomed and understood rather than feared. Humans will always discover new way of achieving scientific progress; circumventing Moore's law in the progress. The real question is whether we could convince the public that this is a good thing.

The third question was about the new stress brought about by advanced technology such as drones. COL Dinesh argued that the emergence of hybrid wars shows us that warfare is changing. In Singapore, the Total Defence concept envisions a battle against manifold threats rather than just a military one. Thus, Singapore is ahead of the game in trying to understand the needs of the 21st century battlefield. A continued emphasis on this will allow us to handle any new issues that technology brings us. Prof Coker directed his answer in a different direction and said that it is important to bear in mind that it is difficult to identify what makes one man brave and the other a coward. The stress of one soldier is not the stress of the other; each is an individual and must be treated as such. Drones do indeed introduce new challenges to a solider; while it may give them a fantastic overview of the situation, it does not give them any insight into the character of their targets. While soldiers in the past could see their enemy eye to eye and thus empathise with them, the drone pilot does not have this luxury. The stress is indeed real; the United States Air Force finds it hard to recruit new drone pilots because of this. But once again, technology brings about many changes that need to be grasped. Men and machines are becoming increasingly interlinked, a process which is frankly impossible to stop.

The next question was about the issue of directing training away from "legalist" warfare towards hybrid warfare. COL Dinesh argued that there is certainly a need to understand how to deal with the complexities of the modern battlefield. Soldiers today are used to very short conflicts, generally ones that are also not very bloody. Thus, if they become engaged in a long-term conflict, they will find it immensely challenging to cope with the pressure. Therefore, we must strive to endow military personnel with the ability to survive protracted wars, not the short "legalist" ones of the present era.

The final question was about whether leadership "will" is still the deciding factor in war. Prof Coker stated that what many do not factor in to the discussion of future war is that technological advances are not instantaneous. Technology takes time to mature; RMA's are not fast. Will is thus still, and always will be, the crucial factor in wartime. COL Dinesh argued that what is needed is a commander that possesses a clear set of values that he or she can present. Values are what give soldiers the ability to achieve success, no matter the technological era. Thus, technology may change war, as it has always done, but the quality and character of the soldier are still the main determiners.

PLENARY PRESENTATIONS

The first group presented the topic "How have the armed forces of the region responded to the challenges of the complex operating environment?" Firstly, they delineated some of the dynamics shaping the strategic milieu, and they include emerging technologies, Great Power politics, the changing character of warfare, non-traditional security threats, and the rise of non-state actors. The group then discussed some of the problems regional militaries would face in dealing with these issues. For instance, there are language and cultural barriers when armed forces from different countries train and operate together. Next, the group posed the question of whether states should respond to non-state or proto-state threats solely with kinetic means. That being said, states should adopt a whole-of-government approach to deal with these challenges.

Q&A SEGMENT

The sole question was about whether leadership can help conventional armed forces respond to challenges, and the group answered in the affirmative as military leaders are central in the defence policy-making process.

The second group presented the issue of handling information operations. Firstly, a number of definitions of information operations (IOs) were provided, and the consensus is that electronic and psychological warfare are crucial in such endeavours. Maximising the exploitation of information, timeliness and speed are critically important to make better decisions. Also of significance is the veracity of the information obtained, and critical thinking is crucial in this aspect. Next, the group argued that a sound and robust information architecture is essential in IOs so as to facilitate decision-making. Lastly, societal resilience is also significant in information operations.

Q&A SEGMENT

One participant raised the issue of how education and training can help practitioners to deal with IOs, and the group argued that awareness of various related technologies is crucial in this aspect.

The third group presented the challenges faced by conventional armed forces. Such challenges include increasing involvement in humanitarian-assistance and disaster-relief operations, the need to prevent an arms race from sparking off as militaries modernise, and the strategic implications of a rising China. Next, the group alluded to the challenge of the SAF operating with other militaries. In addition, the increasing prevalence of information operations is significant. Lastly, hybrid warfare will be a major challenge that all armed forces will have to grapple with. Moving ahead, conventional militaries will have to work with other government agencies and better utilise technology to deal with these various challenges. They also need to better handle the media and protect military networks.

Q&A SEGMENT

One participant argued that to deal with the challenges delineated, there must be a change in mindset. To illustrate, jointness between service arms involves doing things not usually associated with entrenched practices. He added that in the modern age, there is a need for militaries to be comfortable with being uncomfortable.

The fourth group discussed the relationship between disruptive technologies and the SAF of the future. The group first delineated likely challenges faced by the SAF and they include resource constraints in terms of manpower, budget and available training space. Evolving threats, including potential adversaries utilising disruptive technologies, is another major challenge. There are two kinds of innovation: sustaining and disruptive. Over time, there are usually more sustaining innovations, but once a disruptive innovation emerges, its effect would be profound. For instance, one such technology could significantly widen the military capability gap between two nations. That said, the group discussed how disruptive technologies could help Singapore overcome some of the aforementioned challenges. For instance, unmanned and Big Data systems can make up for the lack of manpower. Lastly, the group outlined a number of caveats with regard to adopting disruptive technologies. To illustrate, the adoption of disruptive technologies could alter the strategic balance and spark an arms race, and this is something states have to bear in mind.

Q&A SEGMENT

A participant made the point of whether conventional militaries are becoming more unconventional and whether such entities are even relevant in the contemporary era. The group answered that there is a need to consider the strategic environment where a military is operating in. Insofar as the rise of asymmetric threats seems to make conventional armies less relevant, there is still a role for them. Another participant argued that conventional warfare cannot be ruled out totally and hence traditional militaries are still needed. In the same vein, another participant argued that the case of Kuwait is illustrative of the need for a strong conventional armed force.

CLOSING REMARKS

Colonel Ng Wai Kit maintained that one main reason for putting together the seminar was for students of the Command and Staff Course to learn. He next differentiated the terms “warfare” and “war”, with the former being the way conflict is carried out and the latter being the state of fighting. He stressed that war has certain enduring features and that it exists for political reasons. As for warfare, COL Ng argued that it has changed throughout the ages due to factors such as new technologies and doctrines.

Next, he shared three general points about war. Firstly, war is about the contest of wills through the use of force. COL Ng contended that the use of force is not merely about military might, but also other factors such as economic and political pressure. He then cited the Russian annexation of Crimea without bloodshed as a good example of using the different facets of force. As for military force, it is usually not used in isolation, but in conjunction with other elements of state power. After all, COL Ng argued, war is a contest between two nations, not just their militaries. That being said, war raises many issues pertaining to ethics. For instance, are cyber-attacks initiated by civilians on military entities “legal”? COL Ng then cited the example of the use of the atomic bomb on Japan during World War II as controversial because it killed mostly civilians.

The second point he raised was that of the issue of conventional-versus-unconventional warfare. He argued that there was no reason why a conventional force could not use unconventional methods to attain its goals. Indeed, asymmetric means could use up fewer resources and yet achieve the same outcome. To illustrate, COL Ng argued that executing cyber-attacks to attack a nation’s energy infrastructure could be just as effective as air strikes.

The final point he made was the issue of ethics in war. He brought up the issue of creating superhumans with extraordinary physical and mental prowess, and asked whether this would be the way to go. He next raised the question about whether unmanned/autonomous systems should replace human beings.

In closing, COL Ng stressed that war is not a game of chess. This is because in chess, both parties can see what the other is doing; but this is not the case in war. Furthermore, only certain moves are allowed in chess, while war does not have such restrictions. Therefore, one should, within the boundary of ethics, always strive to defeat the enemy not by brute force, but by cunning.

SEMINAR PROGRAMME

Day 1
Thursday, 8 October 2015

0900–0915hrs **Opening Remarks**

RADM Giam Hock Koon
Commandant
SAFTI Military Institute

0915–1015hrs **Keynote Address**

Professor Lui Pao Chuen
Advisor, National Research Foundation
Prime Minister's Office

1015–1145hrs **Panel 1: Military Technology and the Changing Character of Armed Conflicts**

Chair:
Mr Eddie Lim
Senior Fellow and Coordinator of the Military Studies Programme,
IDSS, RSIS

Technologies Converge and Power Diffuses

Dr Thomas Hammes
Distinguished Research Fellow,
Institute for National Strategic Studies
National Defense University

Strategic Transformation and Military Modernisation in the Asia Pacific Region

Dr Michael Raska
Research Fellow,
Military Transformations Programme
IDSS, RSIS

1145–1245hrs **Lunch**

1245–1415hrs **Panel 2: Operations in the Information Age**

Chair:
Dr Michael Raska
Research Fellow,
Military Transformations Programme
IDSS, RSIS

Civil-Military Relations and International Military Cooperation in Cyberspace

Ms Caitríona Heinl
Research Fellow,
Centre of Excellence for National Security
RSIS

The Role of Social Media in the Strategic Outcome of Contemporary Conflicts

Mr Eddie Lim
Senior Fellow and Coordinator of the Military Studies Programme
IDSS, RSIS

Technological Diffusion in Hybrid Warfare

Assistant Professor Ong Weichong
Military Studies Programme,
IDSS, RSIS

1415–1445hrs **Coffee Break**

1445–1615hrs **Syndicated Group Discussion 1**

Day 2
Friday, 9 October 2015

0900–1045hrs **Panel 3: Developing the Future Force**

Chair:
Dr Graham Gerard Ong-Webb
Research Fellow, Military Studies Programme
IDSS, RSIS

Seeking Out Disruptive and Game Changing Technologies

RADM Harris Chan Weng Yip
Future Systems and Technology Architect
Ministry of Defence, Singapore

Opportunities and Challenges of using Commercial Technology for Future Capability Development

Mr Henry Chang Weng Foo
Director (Land Systems)
Defence Science & Technology Agency

U.S. Air Force Space Command: Current Mission, Technology Perspectives, Small Satellites, and Personnel Development

COL Martin France
Permanent Professor and
Head of the Department of Astronautics
United States Air Force Academy

1045–1115hrs **Coffee Break**

1115–1245hrs **Panel 4: Battlefield Application of Technology**

Chair:
Assistant Professor Ong Weichong
Military Studies Programme
IDSS, RSIS

On-Line Warriors: How 21st Century Technology is Reshaping our Understanding of the Profession of Arms

Professor Christopher Coker
Professor of International Relations
The London School of Economics and Political Science

The SAF Experience of Technology in Military Operations: Operation Blue Ridge

COL Dinesh Vasu Dash
Director (Information), MINDEF
Communications Organisation
Ministry of Defence, Singapore

1245–1345hrs **Lunch**

1345–1515hrs **Syndicated Group Discussion 2**

1515–1545hrs **Coffee Break**

1545–1715hrs **Plenary Presentations**

Chair:
Mr Eddie Lim
Senior Fellow and Coordinator of the Military Studies Programme
IDSS, RSIS

1715–1730hrs **Closing Remarks**

COL Ng Wai Kit
Commandant, Goh Keng Swee Command and Staff College
Singapore Armed Forces

LIST OF SPEAKERS AND CHAIRS
(In alphabetical order according to given names)

Ms Caitríona Heinl
Research Fellow
Centre of Excellence for National Security (CENS),
S. Rajaratnam School of International Studies (RSIS),
Nanyang Technological University (NTU),
Singapore

Professor Christopher Coker
Professor of International Relations
The London School of Economics and Political Science
United Kingdom

Colonel Dinesh Vasu Dash
Director (Information)
MINDEF Communications Organisation,
Ministry of Defence,
Singapore

Mr Eddie Lim
Senior Fellow and Coordinator of the Military Studies Programme,
Institute of Defence and Strategic Studies (IDSS),
S. Rajaratnam School of International Studies (RSIS),
Nanyang Technological University (NTU),
Singapore

Dr Graham Gerard Ong-Webb
Research Fellow
Military Studies Programme,
Institute of Defence and Strategic Studies (IDSS),
S. Rajaratnam School of International Studies (RSIS),
Nanyang Technological University (NTU),
Singapore

Rear Admiral Harris Chan Weng Yip
Future Systems and Technology Architect (FSTA)
Future Systems and Technology Directorate,
Ministry of Defence,
Singapore

Mr Henry Chang Weng Foo
Director (Land Systems)
Defence Science & Technology Agency,
Singapore

Rear Admiral Giam Hock Koon
Commandant
SAFTI Military Institute,
Singapore Armed Forces,
Singapore

Colonel Martin France
Permanent Professor and Head of the Department of Astronautics
United States Air Force Academy,
United States of America

Dr Michael Raska
Research Fellow
Military Transformations Programme,
Institute of Defence and Strategic Studies (IDSS),
S. Rajaratnam School of International Studies (RSIS),
Nanyang Technological University (NTU),
Singapore

Professor Lui Pao Chuen
Advisor
National Research Foundation,
Prime Minister's Office,
Singapore

Dr Thomas Hammes
Distinguished Research Fellow
Center for Strategic Research,
Institute for National Strategic Studies,
National Defense University,
United States of America

Colonel Ng Wai Kit
Deputy Commandant, SAFTI Military Institute;
Commandant, Goh Keng Swee Command and Staff College;
Singapore Armed Forces,
Singapore

Dr Ong Weichong
Assistant Professor
Military Studies Programme,
Institute of Defence and Strategic Studies (IDSS),
S. Rajaratnam School of International Studies (RSIS),
Nanyang Technological University (NTU),
Singapore

ABOUT THE GOH KENG SWEE COMMAND AND STAFF COLLEGE

The Goh Keng Swee Command and Staff College (GKS CSC) is the Singapore Armed Forces' premier educational institution. All SAF's leaders pass through the portals of GKS CSC.

Each year, specially selected officers attend the various courses offered at GKS CSC. Through the GKS CSC's course curriculum and extra curricula activities, these officers acquire the requisite exposure to the complexities and challenges of leading the SAF into the future.

GKS CSC is proud to be one of three schools within SAFTI Military Institute, the other two being the Officer Cadet School (OCS) and the SAF Advanced Schools (SAS). Together, these schools provide holistic officer education and training for regular and National Service Full-Time officers of the Singapore Armed Forces.

ABOUT THE SAF-NTU ACADEMY

The SAF-NTU Academy (SNA)'s mission is to create and sustain the academic capacity and knowledge needed to equip military leaders with professional military knowledge using multidisciplinary approaches. The programmes managed by SNA will contribute to the SAF's overall nurturing and engagement efforts to develop competent and committed military professionals. SNA is also charged with growing a pool of deep specialists skilled in both military and academic disciplines.

SNA oversees the SAF-NTU Continuing Education Master's (CE Master's) and the SAF-NTU Undergraduate Professional Military Education and Training (UGPMET) programmes. SNA works closely with the SAF Education Office and Goh Keng Swee Command and Staff College at the SAFTI Military Institute and SAF Personnel Management Centres in the execution of its programmes.

Other than delivering education, SNA manages research, scholarship and collaboration programmes to ensure the renewal, creation and management of knowledge for educational purposes, and to raise the professional and academic standing of both the SAF and NTU.

ABOUT THE S. RAJARATNAM SCHOOL OF INTERNATIONAL STUDIES

The **S. Rajaratnam School of International Studies (RSIS)** is a professional graduate school of international affairs at the Nanyang Technological University, Singapore. RSIS' mission is to develop a community of scholars and policy analysts at the forefront of security studies and international affairs. Its core functions are research, graduate education and networking. It produces cutting-edge research on Asia Pacific Security, Multilateralism and Regionalism, Conflict Studies, Non-Traditional Security, International Political Economy, and Country and Region Studies. RSIS' activities are aimed at assisting policymakers to develop comprehensive approaches to strategic thinking on issues related to security and stability in the Asia Pacific.

For more information about RSIS, please visit www.rsis.edu.sg.

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